MAÍSA REDD+ PROJECT

MONITORING REPORT OF GHG EMISSIONS REDUCTIONS FROM AVOIDING UNPLANNED DEFORESTATION FROM 2013 TO 2019

Document Prepared by Biofílica Investimentos Ambientais S.A.

Project Title	Maísa REDD+ Project
Version	2.4
Report ID	
Date of Issue	29 October 2020
Project ID	1329
Monitoring Period	22-May-2013 to 21-May-2020
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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The REDD + Maísa Project is a partnership between Biofílica, Fazenda Maísa and Sipasa-Moju, started in 2012 with the first feasibility studies and the signing of the contract. The validation of the project and the first verification, referring to the reduction of emissions that occurred in 2012, occurred in 2014. For this second monitoring period, the main activities of the Project that have been implemented are listed below. Further details on each of the activities can be found in Section 3.1.

1) Selection and contracting of the Validation/Verification Body (VVB): March to June 2020.
2) Monitoring and collaboration with the audit process conducted by VVB: to be carried out throughout the verification period (August to October 2020).
3) Project update on the Platform for registration and generation of verified credits (VCUs): periodically throughout the life of the project;
4) Technical activities: work plan to strengthen the social component (July 2016 to January 2017);
5) Valuation of the Forest: timber forest management and exploration of non-wood products, such as açaí and Brazil nut.
6) Patrimonial Surveillance and Vegetation Cover Monitoring: surveillance carried out periodically within the limits of the Farm and satellite monitoring of forest cover carried out annually.
7) Leak management: diversification of economic activities and income generation to maintain the property and guarantee support for forest conservation; and responding to requests from the surrounding communities, especially the inputs donation;
8) Adaptive management and continuous improvement: workshops to strengthen the social component (July 2016 to January 2017) and intensified asset surveillance according to demand (periodic activity).

Historically, the region has been marked by land conflicts that began in the 1970s, with disputes between farmers, land grabbers, squatters and illegal loggers. Although deforestation in the Project Area has been contained, an analysis of the progress of deforestation in the region shows that deforestation agents operate close to rivers, roads and in areas of deforestation that have occurred in previous years.

In order to reduce greenhouse gas (GHG) emissions from unplanned deforestation and promote benefits to the climate, activities and strategies associated mainly with patrimonial surveillance within the limits of the project area and monitoring of forest cover via satellite were implemented. In this monitoring period (22 May 2013 to 21 May 2020) the total reduction in GHG emissions was 702,217 tCO_2eq.

1.2 Sectoral Scope and Project Type

- **Sectoral Scope:** 14 – Agriculture, Forestry and Other Land Uses (AFOLU)
- **Project Category:** Reducing Emissions from Deforestation and Degradation (REDD)
- **Type of Activity:** Avoided Unplanned Deforestation (AUD)
- **Grouped Project:** No

1.3 Project Proponent

The Project proponents and their respective contacts are described below:

Organization name	Biofílica Investimentos Ambientais S.A.
Contact person	Plínio Ribeiro
Title	Executive Director
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Organization name	Maísa-Moju Agroindustrial Ltda
Contact person	Márcio Roberto Pinto Lisboa Pinheiro
Title	Land owner
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Email	maisa.marciopinheiro@hotmail.com

Nome da Organização	Sipasa-Seringa Industrial do Pará S/A
Contato	Márcio Roberto Pinto Lisboa Pinheiro
Cargo	Owner
Endereço	Rodovia PA-150, Km-240, s/n, Estrada do Projeto Seringueira, Km-52 - Município de Moju, Pará - Brasil
Telefone	+55 91 99116-2126 / +55 91 99146-8542
Email	maisa.marciopinheiro@hotmail.com

1.4 Other Entities Involved in the Project

The other entity involved in the REDD+ Maísa Project and its respective information are described below.

Organization name	PDS Consultoria Socioambiental
Role in the Project	Development of workshops to strengthen the social component
Contact person	Ana Carolina Casemiro Vieira
Title	PDS Coordinator
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1.5 Project Start Date

The REDD + Maísa Project start date is May 21, 2012.

1.6 Project Crediting Period

The crediting period for the project is 30 years, starting on May 21, 2012 and ending on May 21, 2042.

1.7 Project Location

The Project is located in the Baixo Tocantins region (between the Tocantins and the Moju River), in the municipality of Moju, State of Pará, between the parallels 3º6'30"S and 3º22'3"S and meridians 49º16'10"O and 49º29'30"O. The Project area, of 28,752 hectares, is inserted within Fazenda Maísa, belonging to Maísa-Moju Agroindustrial Ltda.

The municipality of Majú, and consequently the project area, is surrounded by five other municipalities, which directly influence the project: Baião, Mocajuba, Thailand, Goianésia and Breu Branco. Figure 1 shows the Project map and the surrounding region. The geodetic coordinates that define the project boundaries are shown in Table 1.

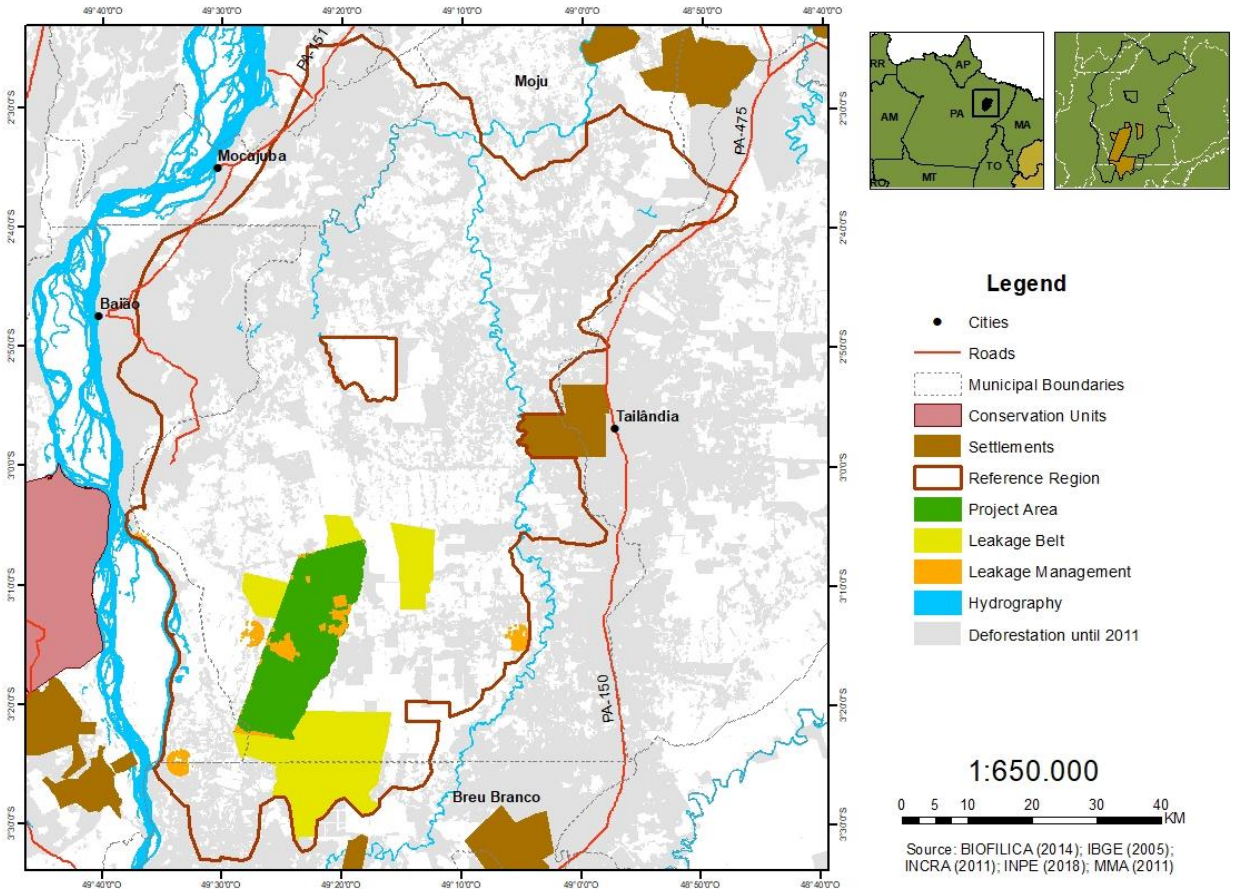


Figure 1 - Localization of the Maísa REDD+ Project.

Table 1 - Geodetic coordinates of the limits of the Project Area.

Vertex	X	Y
01	688530.63	9656879.45
02	678399.14	9654369.60
03	668474.29	9627169.49
04	677741.05	9625965.27

1.8 Title and Reference of Methodology

- VCS Methodology VM0015 for Avoided Unplanned Deforestation, version 1.1;
- Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities, VT001, version 3.0; and
- AFOLU Non-Permanence Risk Tool, version 3.2.

1.9 Participation under other GHG Programs

The REDD + Maísa Project was not registered and does not seek registration in any other GHG program besides the VCS Program (in English, Verified Carbon Standard).

1.10 Other Forms of Credit

The REDD + Maísa Project does not hold or wish to generate any type of environmental credit related to the reduction of GHG emissions or removals claimed in addition to the VCS Program.

1.11 Sustainable Development

The REDD + Maísa Project, despite being situated in a region with great deforestation pressures and a considerable history of degradation, managed to contain deforestation in the Project Area - mainly due to the good governance applied in the area and through patrimonial surveillance and monitoring activities by satellite images - and, consequently, was able to maintain the benefits associated with biodiversity. In a global context, the project is mainly aligned with two UN Sustainable Development Goals, described in Table 2 below:

Table 2 - Contribution to the UN Sustainable Development Goals.

	Action Against Global Climate Change: The activities carried out by the project seek to act to combat climate change and its impacts by reducing deforestation in the Project Area and, consequently, reducing the emission of greenhouse gases. The project has the potential to reduce 2,023,743.8 tCO2eq of GHG emissions in 30 years. During the monitoring period of this report, the project achieved a reduction of 702,217 tCO2eq.
	The project area is considered a high priority for conservation, as it contains endangered species (According to IUCN) and is located in the middle of the Belém Endemism Center, one of the most historically deforested endemism centers in the Amazon. Thus, by containing deforestation and maintaining the forest standing, it acts in maintaining the conservation of biodiversity and ecosystem services, such as pest and disease control, pollination, water quality and climate regulation. Furthermore, the area serves as an ecological corridor along the other preserved areas in the region. This connectivity between the fragments constitutes a large and resilient conservation system, which will act to alleviate future changes in the climate and living standards of local populations, in addition to functioning as a buffer zone to the risks and threats in Belém Endemism Center.

2 SAFEGUARDS

2.1 No Net Harm

Potential negative environmental and socioeconomic impacts

Despite the financial crisis that Fazenda Maísa has faced since 2015, reinforced by the rejection of the exploration of the Annual Productive Unit number 12 ("Unidade Produtiva Anual" – UPA12, in Portuguese) in late 2014, which culminated in the reduction of the intensity or paralysis of some economic and social activities carried out by the Farm, activities to contain deforestation were maintained.

The stoppage of forest management activities reduced the entry of financial resources, employability and, consequently, the actions developed with the surrounding communities. Even so, from July to December 2016, in an attempt to maintain the activities associated with the REDD + Project and the communities, workshops were developed to strengthen the social component both internally (employees of Fazenda Maísa) and externally (four surrounding communities). Further details on these workshops are described in Section 3.1.

It is important to note that although Fazenda Maísa did not develop many actions with the communities since 2015, as they did when the Farm was more productive (such as helping with road maintenance, donating food and wood for building warehouses, schools and others structures, as well as other aid,

detailed in Section 3.1), no negative impact on communities, or even on biodiversity, occurred due to the implementation of the REDD+ Project.

In order to maintain the property, the patrimonial surveillance, jobs and maintaining forests, the owner signed a partnership contract additive for eucalyptus sale to the neighboring farm (owned by Dow Corning Silício do Brasil Indústria e Comércio Ltda) and has been managing species to obtain non-wood forest products, such as Brazil nuts (*Bertholletia excelsa*), açaí fruit (*Euterpe oleracea*) and eventually Copaiba oil (*Copaifera langsdorffii*). It is noted that the eucalyptus area is not part of the Project Area, but allows its functionality due to the financial resources it generates.

During this monitoring period was identified, through satellite imagery analysis and confirmed by reports of the property owner, an increase in pressure for deforestation, invasions and other illegal practices in the region. Through satellite monitoring it was possible to identify a high occurrence of fire outbreaks in the vicinity of the farm, some causing the degradation of forest fragments in the limits of the Project Area. In 2015 a big fire occurred in the limits of the southwest portion of the farm, which fortunately was contained and did not cause significant impacts. These events demonstrate that the conservation role played by the area is essential for maintaining carbon stocks, as opposed to the common practice activities observed in the surroundings.

2.2 Local Stakeholder Consultation

Communication channels

As already mentioned, the Farm's financial crisis led to a distance with local communities. The farm still employs people from the communities and municipalities in the region, but in reduced numbers.

Thus, the communication occurs mainly through the employees, especially by the manager José Eli. In the rainy seasons, when roads are inaccessible or hardly crossed, communities' inhabitants are allowed to use Baixa Verde Port (which is localized 35 km away from the property) for voyages, cargo receipt and transportation. Edilson, the employee in charge for the port, is also a resident of the Vila Itaquara community, and thus ends up being the main communication channel between the Farm and the communities which use the port, delivering messages to the farm manager.

Therefore, the manager acts as the communication channel between the Fazenda Maísa, the communities, and other interested parts, delivering demands to the project proponents (Farm owners and Biofílica).

Previously, the former farm manager was the only communication channel with communities and other interested parts, but after his demise, this channel was divided between the employee in charge for the port and the current manager.

During the project implementation period, the proponents maintained a constant communication with clients, partners and potential investors, whether within the scope of carbon credits commercialization and project activities dissemination carried out by the Project, as well as in partnerships acquisition for

the implementation of other economic activities in the farm. Meanwhile, Biofílica maintained communication materials, documents and other relevant information about the project available on its website.

Potential communication fragilities with local communities, regarding farm economic and operational capacity reduction, did not cause negative impacts on the communities and other local interested parts, because there was no overlapping between rights and interests within the project area. Furthermore, conservation activities promoted by the project, aiming deforestation reduction in project's area, did not foment conflicts with local actors or rights and interests overlapping.

Socio-environmental workshops

During the monitoring period, the entrepreneur passed through financial crisis which forced him to reduce the intensity of several activities that were not essential to the business. In addition, the low carbon credit generation at the first verification, summed to the voluntary market decline, resulted in huge resources scarcity for the implementation of the activities initially planned by the project.

Due to this financial limitation, the proponents opted to postpone or reduce varied socio-environmental activities first conceived in the CCB certification scope. Thus, it was defined that the project would give priority or continuity only to actions directly associated with deforestation containment and carbon stock conservation, aiming the maintenance of the credit generation capacity for a better market timing and better entrepreneurial economic conditions. Therefore, primarily conceived non-essential and/or non-obligatory actions for the VCS certification, were strategically postponed.

Between 2016 July and 2017 January, a Social Component Strengthening Working Plan for the REDD+ Maísa Project was developed by PDS Socio-Environmental Consultancy. The Plan acted on two social fronts: internal, involving Maísa-Mojú employees; and external, involving four surrounding communities (Ituquara, Alto Apeí, Nossa Senhora do Perpétuo Socorro and Branquelândia).

On the internal front, four workshops were developed: i) Farm Maísa REDD+ Project: Labor Security and Health; ii) Labor Health and Security: Normative Instruction 31; iii) Forest Fire; and iv) Forest Fire Prevention and Containment.

Regarding the external front, three workshops were developed in each community: i) Fazenda Maísa's REDD+ Project Comprehension and Environment Conservation; ii) Communication channels identification and proposals; and iii) Opportunities and weaknesses identification and priority actions definition for socioeconomic development.

This Working Plan, beyond strengthening the social and communication components with interested parts, involved environment conservation workshops addressing themes like climate changes and REDD+ Projects (e.g. Fazenda Maísa's REDD+ Project), forest fire and Agroforestry Systems.

In general, those involved in the workshops gave a positive feedback to these workshops, being a participatory moment of learning and dialogue. The reports were made available to VVB team and are listed on Section 3.1.

2.3 AFOLU-Specific Safeguards

There were no negative environment and socioeconomic impacts under local interested parts during the project implementation. Conservation activities promoted by the project, aiming deforestation reduction in the project area in view of the common practice scenario, do not promote conflicts with local social actors or rights and interests overlapping.

The Project doesn't interfere on property rights or lands usage by local rural communities, as well as any other traditional communities or indigenous populations. As established in PDD's Section 3.2 (Usage Right Evidence), possession and use of the Project area occurs through the 29.906 ha registry office definitive title, within Moju's municipality, Pará state. Property's localization, as well as Farm's surrounding communities, is depicted in Figure 2.

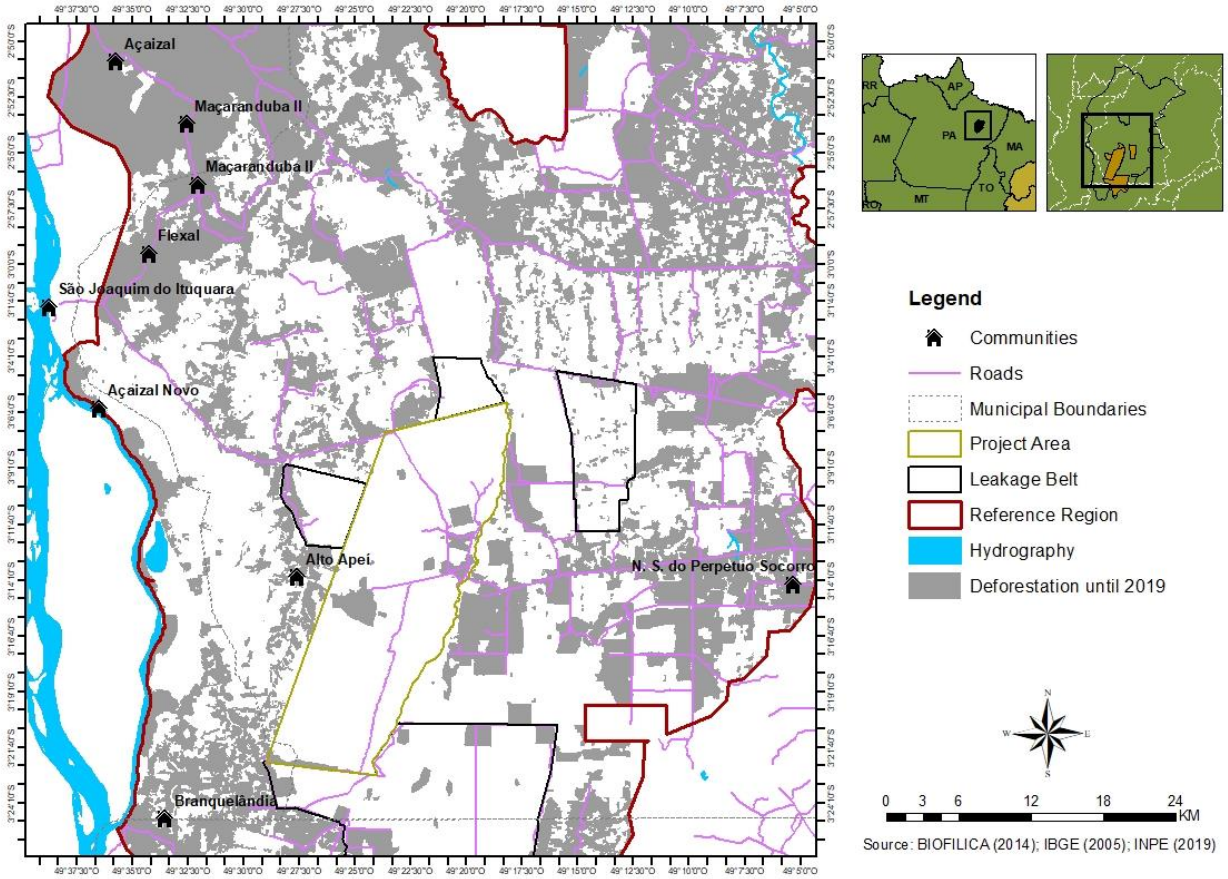


Figure 2 – Maísa REDD+ Project Area and surrounding communities

The communities surrounding the project area are not obliged to change their lifestyles because of Fazenda Maísa activities or of REDD+ Project, as well as there are no records of conflicts with thirds regarding the property possession or the access to natural resources and property usage.

Complementary, National System of Rural Register (Sistema Nacional de Cadastro Rural – Sicar, in Portuguese) data were consulted and no nobility overlapping was found for the property.

Surroundings networking

Local communities

Until 2014, last year before the stoppage of Sustainable Forest Management, constant actions were taken with the surrounding communities. The communities sent their requests through the Farm manager, which transferred them to the owner. The request occurred through official letters or verbally. The answers were always verbal, being communicated by the manager.

The requests reduced and ceased while communities realized the impossibility of resolutions as in the past. Inhabitants' awareness about the Farm crisis, as well as the range of actions adopted by the Farm while there were still financial resources, is described on PDS Socio-Environmental Consultancy reports and in Section 3.1.

The relationship between surrounding communities and Fazenda Maísa, though, persists calm and respectful, without the occurrence of any conflicts during monitoring period.

Surrounding Private Properties

The relationship with surrounding farm owners was also civilized and without conflicts. For instance, there is an eucalyptus selling contract in Fazenda Maísa (details with VVB team).

Patrimonial surveillance employees from both farms also present cordial connections. There are times when teams cross paths during surveillance and situations in which the team from one farm supports the team from the other (e.g. invaders withdraw).

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

REDD+ activities implemented on the second monitoring period (2013 22nd May – 2020 21st May) are demonstrated in Table 3.

Table 3 - Maísa REDD+ Project Main Activities Summary During the Monitoring Period

Activities	Description	Status, applicable procedures and additional informations related to registry formats
Validation/Verification VCS		
Selection and contracting of the Validation and Verification Body (VVB)	Prospection and contact with accredited Validation and Verification Body (VVB), according to the VCS standard. Negotiation and selection of the most suitable VVB (according to VCS's rules) for verification.	Occurred from March to June 2020
Audit process tracking	Collaboration with the audit process, conducted by VVB.	Developed during the second verification.
Poject Registering/ Updating	Project registering or updating on Register Platform, as well as verified credits generation (VCUs)	Periodically
Technical Activities		
Work plan to enhance the social component	The work plan to enhance the social component, developed with PDS Socio-Environmental Consultancy, worked on two frontlines: i) internal (Farm's employees); and ii) external (four surrounding communities: Ituquara, Alto Apeí, Nossa Senhora do Perpétuo Socorro and Branquelândia). The actions developed are described below: • Internal Social – 4 participatory workshops: i) Farm Maísa REDD+ Project: Security and Work Health; ii) Health and Work Security: Normative Instruction 31; iii) Forest fires, and iv) Forest fires' prevention and fight. • External Social – 3 workshops in each community: i) Environment Conservation and Maísa REDD+ Project Comprehension; Connections with the Farm; ii) Identification of communication channels and comprehension about the communication process actualization; and iii) Identification of opportunities and weaknesses and definition of priority actions.	Conducted between 2016 July and 2017 January. Referenced documents: "Produto 1 – Componente Social"; "Produto 2 – Componente Social"; "Produto 3 – Componente Social"; "Produto 4 – Componente Social"; "Produto 5 – Relatório Final_Componente Social"; "Produto 5 - Apêndices"; "Produto3 – Anexo 01_Frequencia Funcionários"; "Produto 3 – Anexo 02_Frequencia Ituquara";

	The methodological approach of the entire process, conduced with both publics, is described on the four field reports ("Produtos" 1 to 4), which detail the development process and the identified partial results. The "Produto 5" mentions all the workshops, summarizing the work development.	"Produto3 – Anexo 03_Frequencia Perpetuo Socorro"
Management and Monitoring		
Valuation of the Forest	The valuation of the standing forest, through a sustainable forest management associated with the forest maintenance, occurred with the exploration of the Annual Production Unit number 11 (UPA 11) between 2013 and 2014, along with non-wood products management. Since 2015, the native "açaí groves" (*Euterpe oleracea)* at the farm's floodplain areas have been managed, with allows, associated with the picking of Brazil nuts "ouriços" (*Bertholletia excelsa)*, started in 2012, the generation of revenue and temporary jobs for the local population. Eventually, there is also extraction and commercialization of Copaíba (*Copaifera langsdorffii)* oil.	Wood forest management occurred in UPA11 between 2013 and 2014. The management of Brazil nuts has been occurring since 2012, and açaí's, since 2015. Referenced documents: "POA_UPA11"; "POA_UPA11 – estradas e pátios" "Relatório técnico_SEMA_UPA11" "Relatório técnico_SEMA_UPA12" "Produção de açaí"; and "Produção de castanha".
Vegetation Cover Monitoring	The forest cover monitoring within the Project Area and within the Leakage Belt occured through satellite images analyses by Biofílica. Areas categorized as "deforestation" by PRODES data were identified by geographic coordinates and forwarded to the manager of Fazenda Maísa, through the Monitoring Bulletin. The surveillance team checked in field the points identified as deforestation.	The monitoring occurs once a year, with results presented in the Monitoring Bulletin. Referenced documents: "Boletim de Monitoramento – Maisa 2013"; "Boletim de Monitoramento – Maisa 2014"; "Boletim de Monitoramento – Maisa 2015"; "Boletim de Monitoramento – Maisa 2016-2017";

		"Boletim de Monitoramento – Maisa 2018-2019"; "Boletim de Monitoramento – Maísa 2019"; and "Revisão do Monitoramento – Maisa 2012-2015".
Leakage Management	Livestock activity within Fazenda Maísa, localized inside the Leakage Management Area, began to be reduced in 2014 and was stopped completely in 2016. The property maintenance and the forest conservation were guaranteed by the diversification of the economic activities (eucalyptus, *açaí*, Brazil nut and Copaíba oil, eventually). While timber Forest Management was active on the farm (and consequently there was an inflow of financial resources), several requests from the communities were fulfilled, but no actions were carried out or promoted in the Leakage Management Areas (both inside and outside Fazenda Maísa area) that could lead to emissions above the baseline scenario forecast during this monitoring period.	The diversification of the productive activities is continuous. Support to the communities was reduced since 2014, as well as Sustainable Forest Management. The contributions done by Fazenda Maísa can be found on PDS documents, mainly on the Final Report and on the document released by the landowner: "Produto 5 – Relatório Final_Componente Social"; "Contribuições_comunidades"
Patrimonial Surveillance	The property security sector of Fazenda Maísa performs the surveillance rounds weekly, in pairs. There are 5 home bases, one central camp (also considered a home base) and two sentry-houses (Figure 5). The common procedure is to direct (by the guards themselves) the invaders out of the property. It's recurrent the presence of strange trying to steal copaiba oil, fruits or to hunt. Sometimes, hardwood is also the target of the thieves. Whenever necessary, police were called and provided backup to the invaders withdraw. In grievous cases, which involved threatening and fire occurence, Police Reports were registered. In 2017, a particular case occurred. A Report of Threatening and Invasion to Rural Properties and a Police Report were submitted to four Public Bodies: Secretaria de Segurança Pública, PMPA-AJ GERAL,	Continuous and periodic activity. Referenced documents: "Relatórios de Vigilância – 2013"; "Relatórios de Vigilância – 2014"; "Relatórios de Vigilância – 2015"; "Relatórios de Vigilância – 2016"; "Relatórios de Vigilância – 2017"; "Relatórios de Vigilância – 2018";

	Secretaria de Estado de Meio Ambiente (SEMA-PA) and SUPES/PA (Portuguese names and acronyms).	"Relatórios de Vigilância – 2019"; "Mapa de Vigilância Patrimonial (imagem e *shapefile*)"
Adaptive Management		
Adaptive management and continuous improvement	The need to strengthen the social component was identified in the Project and, as an adaptive measure and for continuous improvement, the Work Plan developed by PDS (already mentioned in this same Section, in "Technical activities") was carried out, with workshops held in the 4 communities the surroundings and with Fazenda Maísa employees. Patrimonial surveillance operations work in a flexible and adaptive manner. The routes traveled, as well as the frequency and intensity in the same or other paths are monitored depend on previous surveillance. When something abnormal is detected, such as the presence (or trace) of invaders, surveillance on the site is reinforced. Monitoring Bulletins, sent annually, are also tools for adaptive management and provide support patrimonial surveillance activities.	Characterized as a continuous activity. PDS Work Plan associated documents, Patrimonial Surveillance and Monitoring Reports are respectively described in this table.

3.1.1 Contributions with surrounding communities

Several actions were carried out with the communities involved in the Project until 2015. In Braquelândia, support was given for roads cleaning and *cestas básicas* (Portuguese expression for "basic food package") were donated to 250 families, as well as oil for machines, cows for local community festivals and legal wood for the construction of a shed, planned to be the community associates headquarter.

The community Nossa Senhora do Perpétuo Socorro received maintenance of its main road, along with donation of *cestas básicas* and toys on Christmas. Hardwood was donated for the building of schools, churches and the communitarian flour house.

In Ituquara, on the other hand, there was help in the process of emancipation from the community (becoming a district) and donation of hardwood for the construction of a dock, sheds for local meetings and churches. *Cestas básicas* were also distributed to prevent hunting and a heavy machine was made available in the summer to recover and maintain roads and internal streets. In addition, the farm contributed to the construction of the community's first paved street. As required by the community, the

access to the Baixa Verde Port was provided in rainy seasons for goods loading and unloading, since access to their dock is impaired during this period.

The farm also opened a winery-related road connecting Fazenda Maísa to the Tocantins River (Baixa Verde Port), which benefited no only Ituquara, but Matacurá, Acapú and Açaizal communities. These three received supports at the construction of its communitarian centers, either. Furthermore, the farm interconnected these communities to the main road, associated with the access to Tocantins River, through secondary roads. Figure 3 presents some of the aforementioned buildings.

Figure 3 - Dock in Vila Ituquara (left) and Community Center in Vila Matacurá (right).

3.1.2 Analysis of soil use and coverage during the monitoring period

The analysis followed the procedures described in item 4.5 of the Project Description, using PRODES data. Data was furnished as *shapefile* and *raster* formats, accounting for spatial resolution of 30 meters. According with PRODES methods (Câmara et al., 2006), these images are geometrically corrected with a translation of less than 1 pixel (30 x 30 m). The images were acquired in the period from 2013 to 2019 and are localized through the orbit/point at Landsat 224/62 scene. The main activities executed by PRODES system to monitor the Brazilian Amazon forest coverage will be detailed below.

Pre-processing

Image pre-processing procedures by PRODES Project are determined by the following steps (Câmara et al., 2006):

1) Selection of images with the lowest cloud coverage and with acquisition dates closer to the dry season in Amazon, as well as with suitable radiometric quality.
2) Georeferencing of images with spatial resolution of 30 meters on topographic maps at the scale 1:100.00, and images with MrSID orthoretified NASA format.

Interpretation and Classification

Satellite-images classification method used by PRODES follows four main steps. First, a mixed spectral model is generated, identifying vegetation, soil and shadow components. This technique is known as spectral mixture linear model (SMLM), and aim to estimate vegetation, soil and shadow components percentage of every single satellite image cell (pixel). The second step is the application of segmentation technique, which identifies spatially adjacent regions (i.e. segments) with similar spectral characteristics in the satellite images. Following segmentation, the segments are individually classified by the categories forest, non-forest vegetation, hydrography and deforestation (i.e. anthropic vegetation). Categorized segments are submitted to edition process or to audit classification, executed by specialists. Then, state mosaics are created.

Map accuracy evaluation

PRODES data accuracy was accessed through the comparison of Sentinel-2 image of 2019 August, with spatial resolution of 10 meters at strips composition 4-3-2, and LandSat8 image of 2019 October, with spatial resolution of 30 meters on highly cloudy coverage areas. The map of soil coverage area was generated by INPE, in 2019.

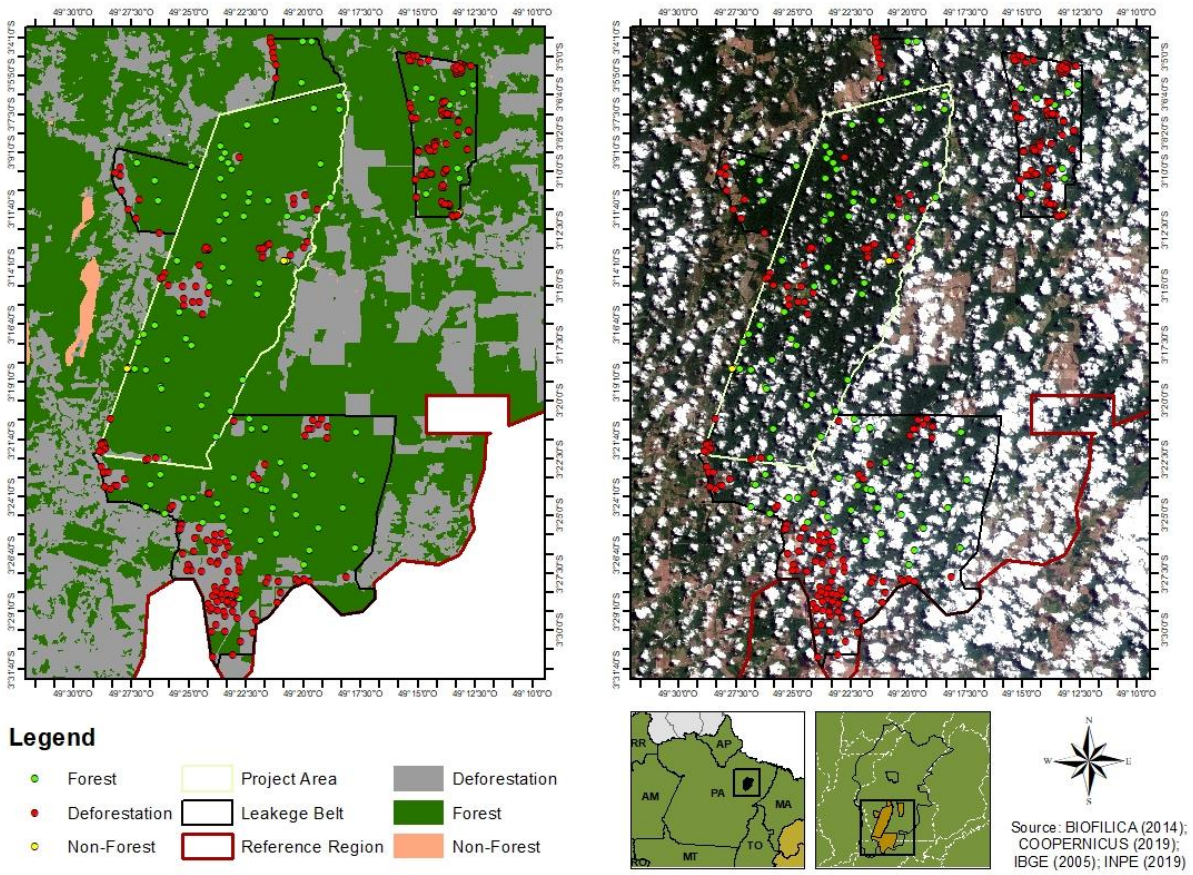


Figure 4 - Mapping accuracy evaluation

405 points were randomly distributed in monitored areas (Project Area and Leakage Belt). For each point, a visual interpretation of the predominant class (classes: forest, deforestation and non-forest vegetation) was done. Figure 4 demonstrates the method chosen for the accuracy evaluation on PRODES mapping.

Reference points data associated with the map of soil coverage and usage during the monitoring period allowed the evaluation of the monitoring performance through confusion matrices analysis (Table 4) (Congalton & Green, 2008). The accuracy of the monitoring process for soil coverage and usage categories in the monitored area was 83%, greater than VM0015 previous values of 80%.

The confusion matrix was made from random allocation of points at the different determined layers, which are exactly soil coverage and usage categories. 405 points were used in accuracy evaluation, value greater than the 82 points suggested in Project's Description. 97 points were categorized as Forest, 264 as Deforestation and the remaining 44 points, as Non-Forest Vegetation.

Table 4 – Confusion matrix generated by PRODES data evaluation on monitored period (2013-2019)

		References			Total	User's Precision	Omission Error
		Forest	Deforestation	Non-Forest Vegetation			
Classified	Forest	88	2	7	97	91%	9%
	Deforestation	34	218	12	264	83%	17%
	Non-Forest Vegetation	11	2	31	44	5%	95%
Total		133	222	50	405		
Producer's Precision		66%	98%	62%			
Omission Error		34%	2%	38%			
Map's Accuracy							83%

Field validation

In addition to the monitoring carried out through PRODES and the accuracy of these data, the points were checked in the field. Two polygons detected by PRODES were overlooked because of misidentification of deforestation. These polygons are inside a Campinarana phytophysiognomy spot, distinct from the Dense Ombrophilic Forest which characterizes the Project Area.

Furthermore, project proponents evaluated the exclusion of these polygons as deforestation because of lacking evidence of invasion registers, which would suggest anthropic actions. Thus, field checking didn't reveal perturbation of the area, as well as indicated the association of the identified variations with ecological issues.

Complementation with images of higher resolution and greater details of the area are presented in "Relatório de Vigilância – 2019".

Patrimonial Surveillance

Throughout the monitoring period, alongside with data surveying and PRODES Project images acquisition, and the annual submission of Monitoring Bulletin by Biofílica, Fazenda Maísa patrimonial surveillance team conducted their patrolling activities within the farm perimeter. The rounds occurred in pairs, following the home bases route (Figure 5). Specific actions were taken relying on identified eventualities through the patrols.

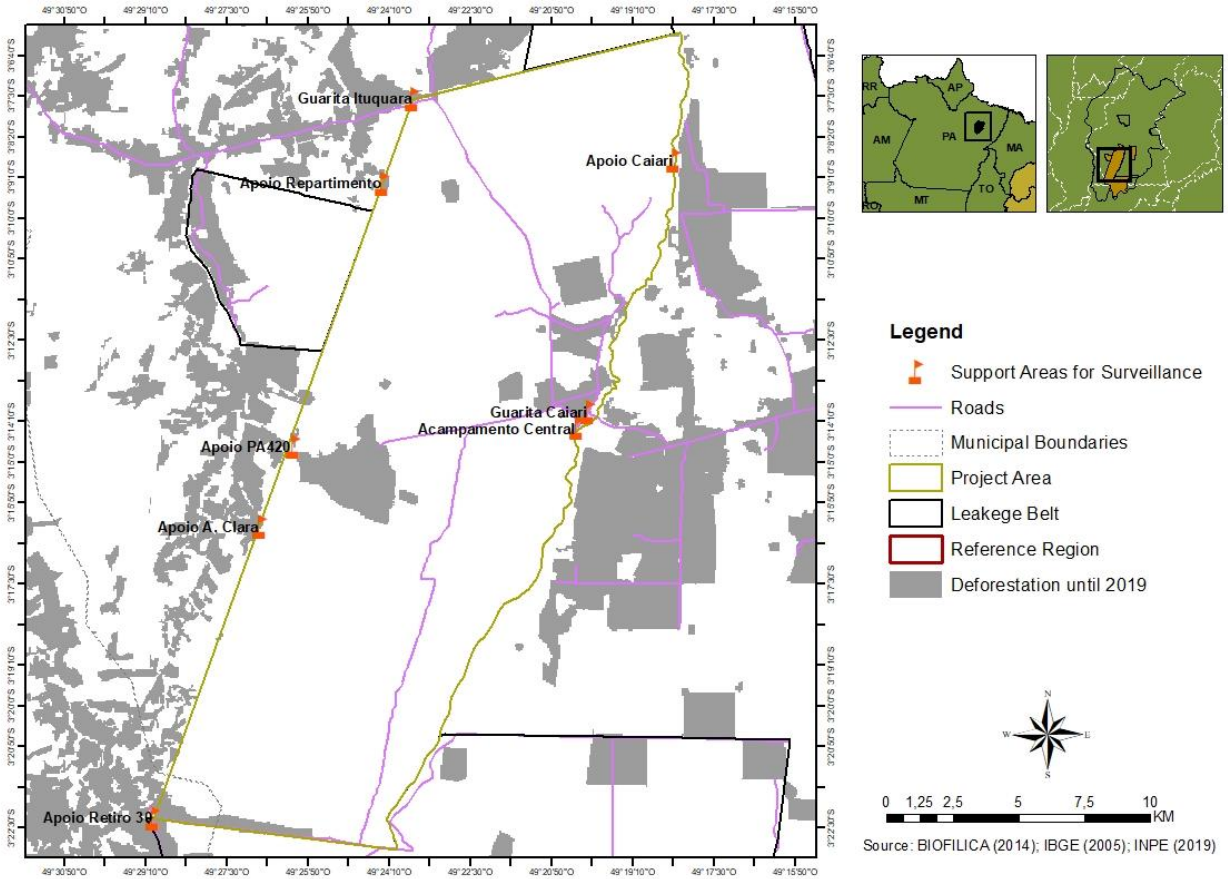


Figure 5 - Localization of home bases for the guard team in Farm Maísa

When invasions occurred, the surveillance team itself did verbal warnings and led the invaders away from the property. Some situations required the support of the patrol team from the Água Azul Farm. Police backup was also required once.

When invasion involved threatening, as well as when a fire started in neighbor farms occurred, a Police Report was registered alongside the municipality public security agency (Tailândia or Moju Police Stations). Moreover, an invasion threatening report was submitted at Secretaria de Segurança Pública,

Secretaria de Estado de Meio Ambiente (SEMA-PA), Polícia Militar (PMPA) e à Superintendência do Ibama (SUPES/PA) (Brasilian Public Agencies).

Forest fire

As previously mentioned, fire outbreaks were detected on the property by the patrimonial surveillance team in November 2015, with a Police Report registered on January 4, 2016.

According to the information contained in this report, on 19 November 2015 the Maísa Farm was hit by three fire outbreaks in different areas, which originated in areas surrounding the property. The responsible people were identified and it was registered that an area of approximately 950 hectares of forest was affected inside the farm. To analyze the possible fire damage, a temporal analysis of the affected area was performed through the visual evaluation of satellite images and by calculating the NDVI of the area.

First, the satellite images of the property were evaluated to locate and define the actual size of the affected area. For this, images from the Landsat-8 satellite were used in the composition of simulated natural colors, which were already available in the Biofílica database and were used in the preparation of the 2015 monitoring bulletin.

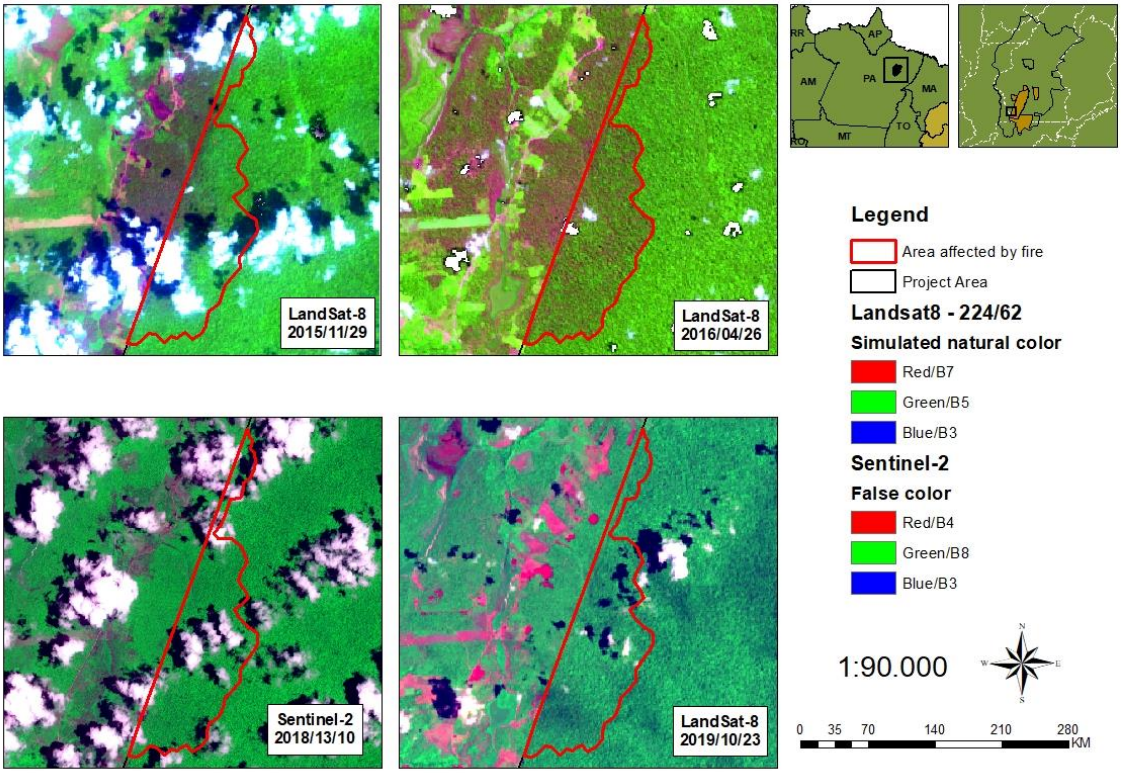


Figure 6 - Image comparison of LandSat-8 and Sentinel-2 satellites for analysis of the impact of fire on vegetation.

With the analysis of the images it was possible to identify the area affected was 875,437 ha (a value close to that mentioned in the Police Report), but despite the clear differentiation in the image, there was no significant impact on the forest. The clear and effective visualization of the affected area was only possible in the images from July 2016, while in the image of November 29, 2015 (10 days after the event) it is not possible to identify much difference in vegetation.

The visualization of this area through more recent images (using 2018 and 2019 images from the Sentinel-2 satellite, with false color composition and in a better resolution for the visualization) reveals a texture close to the other forest areas of the Farm that were not hit by fire (Figure 6). The fact that the forest was not significantly degraded, and the rapid recovery of vegetation, may explain why Project PRODES data, used to identify areas of deforestation, did not detect these changes in vegetation during the monitored period.

Even so, it was decided to carry out the calculation of the NDVI (Normalized Difference Vegetation Index) for a more detailed verification of possible damage. This calculation is made from the difference between the reflectances of the near-infrared and red (visible) bands, divided by the sum of the reflectances of these two bands. The result is a raster image that presents values that varies from -1 to 1, so the areas that are closer to 1 indicate greater sanity of vegetation, while values closer to -1 indicate the presence of soil discovered in degraded areas (MEDEIROS, s.a), or, in this case, confirmation of the occurrence of degradation by fire.

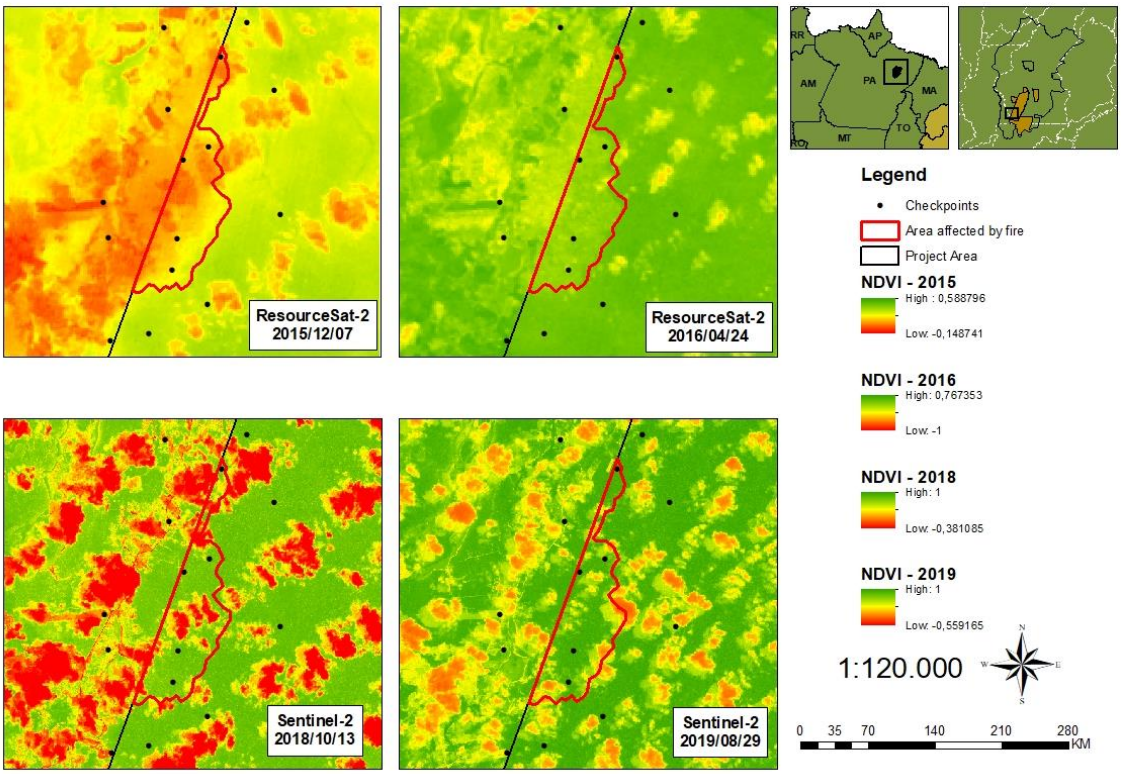


Figure 7 - NDVI calculation for the area affected by fire in 2015, 2016, 2018 and 2019.

The NDVI of December 2015 and April 2016 was calculated using images from the ResourceSat-2 satellite with AWiFS sensor, which has a spatial resolution of 56m, available in INPE's free image catalog. For October 2018 and August 2019 images of the Sentinel-2 were used, previously presented to the verification of the accuracy of the PRODES data.

Even if the resolution of the AWiFS sensor is lower than the Sentinel-2 used, within the free images made available for the period, the use of images with low cloud view was prioritized. However, the images used had a slight cloud coverage, which inevitably influenced the calculated NDVI values. As can be seen in Figure 7, the clouds can be identified by the more rounded shape and its random presence in each image, standing out mainly by the low NDVI values they present.

The value of the NVDI, presented in Figure 7, of the areas reached in 2015 (using images from 07 December 2015, 18 days after the fire started) was approximately -0.15, indicating the impact of the fire. However, the values for 2016, 2018 and 2019 indicate the recovery of the forest, which quickly began to present NDVI close to 1, evidencing a possible recovery of vegetation in the area, although the presence of clouds has hindered the complete visualization of the data.

To confirm if there was indeed a recovery in the forest areas, 15 checkpoints were distributed within a radius of 2 kilometers from the area potentially affected by the fire, covering both the forest area within Fazenda Maísa and the surrounding degraded areas, as illustrated in Figure 7. The NDVI value of each point for all the years analyzed was then assessed, and the data of the potentially affected area were considered as "control" of the analysis. From this, were calculated the averages of the points found, arriving then in the data presented in graph below (Figure 8).

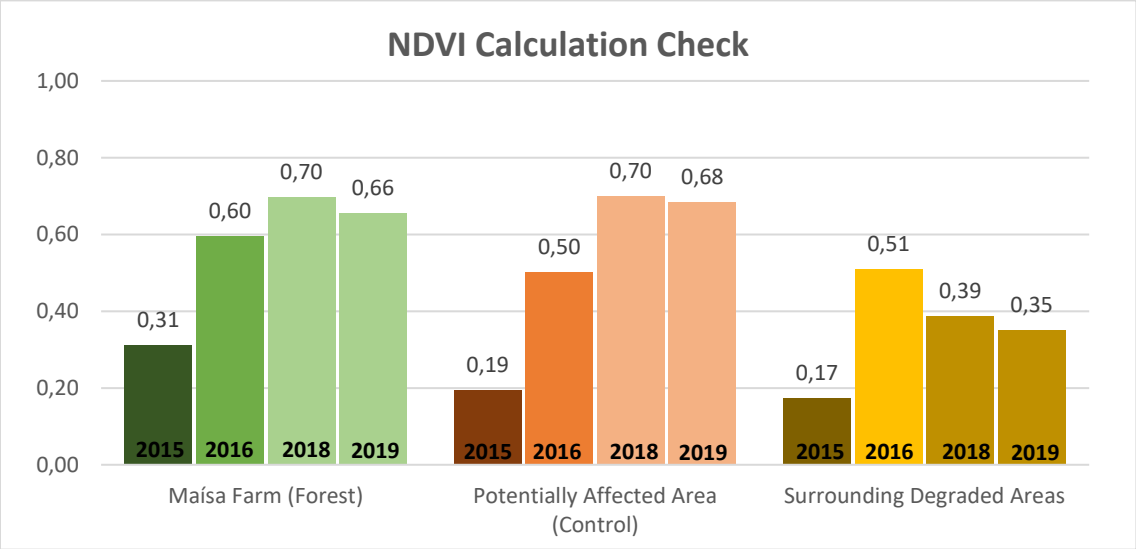


Figure 8 - Result of checking of NDVI calculated for forest area, control area and surrounding degraded areas.

Evaluating the results, the control area presented a behavior very similar to the forest area of Fazenda Maísa, and in the years following the event of the denunciation of the hotspots, the values arrived very close to 1. The correlation between the averages raised for the forest area and the control area calculated was 0.98, which indicates a strong correlation between the data. The deforestation data, in turn, even if they presented NDVI values above zero, were lower than that found in the control area.

In this way, despite the large area affected, the fire did not cause significant and permanent damage to the forest, with evidence of canopy closure and vegetation occupation of the lower stratum 6 months after the event. Therefore, as the analysis showed a complete recovery of biomass, the losses of forest cover from forest fires were not accounted for in the emissions calculations.

Non-CO2 emissions

In addition to the analysis of the fire impact on the forest, explained above, the calculation of gas emissions (non-CO_2) from this forest fire was carried out, as well as the calculation of the significance of these emissions.

Through the specific equations for estimating non-CO_2 emissions from forest fires contained in VM0015 (presented in this document in Section 4.3.2), it was found that the non-CO_2 emissions resulting from this 2015 fire were not significant and, therefore, were not considered in the GHG emissions calculations for this monitoring period. The spreadsheet with the calculations was made available to the VVB.

3.1.3 Leakage monitoring and non-permanence risk factors management

Two strategies were used regarding the reduction of non-planned deforestation-caused emissions, leakage control, and mitigation of non-permanence risks: value aggregation to the forest and to the range of forest products in the project area; and a rise in patrimonial guard efficiency at the borders of the project area.

Leakage monitoring occurred through satellite images, leading to the mapping of forest covered areas and to the follow-up of forest coverage changes in the Leakage Belt, as mentioned in Section 4.3.

Surrounding areas deforestation

Differently from the observed until 2014, since 2015 deforestation areas was detected in the Leakage Belt, from 7.6 ha to 151.2 ha in 2018, the year with the highest deforested area. Farm Maísa's northwest properties presented the highest deforestation rates in the last three years, being responsible for the raise in deforestation in the Leakage Belt. These three farms, managed by Luiz Fagundes, are: Canaã Farm, Seringueira Farm and Plot 08. Reports revealed the invasion of these properties after the temporary relocation of the owner to other state as a result of health complications. The property was reintegrated after a few years, though.

Although the enhance in deforestation at the Leakage Belt, it's important to mention that there was no gas emissions leak during the Project, as indicated in Table 27.

This non-permanence risk, categorized as External Risk, has been managed mainly through the patrimonial guard. As mentioned above, the guard teams from Maísa's and Água Azul Farms collaborate, benefiting both in invasions control and illegal deforestation reduction.

As much as the rounds are made inside Fazenda Maísa, the guard also pay attention to the surroundings. There was a case, for example, in which a fire in a neighboring property was reported by Maísa's team. It is also recorded (in the Surveillance Report), for example, when a neighbor prepares an area for cultivation (commonly called "broca"), in order to pay attention to burning, preparing firebreaks and fire control equipment.

Legal authorization for deforestation

Internal Risks are the most relevant issues to be considered regarding the Project continuity.

Brazilian legislation, through the Forest Code, requires that 80% of the forest area of properties located in the Amazon Biome be conserved (Legal Reserve). Fazenda Maísa maintains 92.7% of its preserved area and, therefore, has the right to deforest the surplus Legal Reserve by law. Thus, the possibility of deforestation presents itself as one of the greatest risks of non-permanence of the project.

This risk is highly relevant, considering that local economic activities are not enough to maintain a positive cash flow for the business. Economic activities under development related to the valorization of preserved forests aim to manage deforestation-associated potential risks.

The proponents believe that this new verification of credits will allow the mitigation of this risk category, since market prices are growing, making the Project more economically attractive for the coming years.

Forest fires

Another existing risk is fire. As presented in the Monitoring Reports, the Project Area, as well as the whole property, suffers from deforestation pressures and heat focuses, started on surrounding deforested areas.

This risk is attenuated by the patrimonial surveillance team, which also work on forest fire management, characterized by fire propagation prevention practices (e.g. firebreaks), firefighting equipment acquisition and employee capacitation, trough PDS workshop, for instance.

3.2 Deviations

3.2.1 Methodology Deviations

There were no methodology deviations during the monitoring period.

3.2.2 Project Description Deviations

Over the monitoring period, there were deviations regarding the Project description. These deviations were associated mainly with expected actions for the attendance of CCB certification. As mentioned above, the entrepreneur passed through financial crisis which induced him to reduce the intensity of a range of non-essential business activities, including the temporary stoppage of the Forest Management operation. Furthermore, the low carbon credits generation at the first verification, summed to the volunteering market drop, resulted in a huge scarcity of resources for the implementation of initially planned project activities.

In this context of economic crisis and reduction in actions directed at the CCB, the activities foreseen in the Project associated with the Leakage Management Areas were also not carried out. These activities were based, in particular: i) in the diversification of land use (and income) within Fazenda Maísa, through crop-livestock-forest integration; and ii) in the increase of agroextractive productivity and in the implementation of more sustainable techniques and technologies in the Leakage Management Areas located outside the Project Area, mainly through the articulation with rural and forestry extension institutions to facilitate the access of the surrounding communities to public policies and rural development programs. Therefore, due to this reduction in the intensity of actions foreseen in the socio-environmental scope of the CCB certification, these activities were not implemented, configuring a deviation from the Project Description.

Certain socio-environmental actions and the forest management operation itself, included initialy in the project, were also not fully developed. However, this fact does not alter or reduce the project additionality, once the expected revenue from the forest management also was not attended, maintaining a negative cash flow within the forest operation, described in financial reports available to VVB.

The Forest Management activity is essential to ensure long-term conservation of the forest. This is due to the fact that management promotes effective forest management, with ongoing economic and operational activities, in addition to ensuring permanent physical presence, which is essential to prevent invasions by deforestation agents.

However, the economic crisis that the entrepreneur has gone through in recent years has led him to make the decision to temporarily halt the operation of forest management, but without neglecting the actions necessary to contain deforestation and the property management. Regardless of this context, in this period there was no change in the project scenario since the forest management activity still occurred at the beginning of this period (2013) and the paralysis occurred temporarily, that is, it was not excluded from the long-term management plan of the property. In addition, the performance of additional business alternative activities, synergistic with the maintenance of forest cover, was foreseen in the project scenario.

The temporary stoppage of forest management and other actions not carried out do not affect the additionality of the project because the expenses necessary for the conservation of the forest were maintained since the context of pressure for deforestation and forest degradation motivated by the deforestation agents did not change in the monitored period.

The property continues to depend on additional activities to contain/monitor unplanned deforestation and forest degradation, which were carried out in this period in line with other activities synergistic to the maintenance of forest cover. Forest management activity should be resumed in the coming years, helping to ensure the effective permanence of carbon stocks in the long-term.

Parameters without monitoring

As activities in sustainable forest management were halted in 2014, monitoring parameters associated with these activities have not been assessed, such as "Regeneration Rates of Permanent Plots" and "Harvest Damages Assessment" were not analyzed.

According to VM0015, the carbon stock means per hectare (Ctot) must be reanalyzed within every forest class at least once in 10 years. The Permanent Parts calculus plan for each Annual Production Unit (UPA), this parameter was not compulsory and does not interfere in carbon emission calculus.

The DAP parameter, which is the field measurement of biomass and carbon stocks (Ctot), was also not monitored.

Parameters change

Differently from the previously established in the Project Description (Section 8.3, p. 182), Deforestation within the Project and Leakage Belt Areas parameter, which would merge deforestation data, was divided for better data organization. Furthermore, the name of the parameter also included its mathematical code, established in VM0015. Thus, these data are described in this Monitoring Report as Project Area Deforestation ($ABSLPA_{[c],t}$) and Leakage Belt Deforestation ($ABSLLK_{[c],t}$).

3.3 Grouped Projects

Not applicable, as this is not a grouped project.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	Deforestation
Data unit	Hectare (ha)
Description	Maps of forest cover areas converted into non-forest areas.

Source of data	PRODES/INPE project[1]
Value applied	Average of 2,12 ha/year (2000-2011)
Justification of choice of data or description of measurement methods and procedures applied	The data from PRODES Digital (Official Satellite responsible for mapping deforestation in the Brazilian Amazon forest) was used for mapping deforestation and producing the Forest Cover Benchmark Map. A total of 48 Landsat images were used during the analyzed period. The ISOSEG non-supervised classification method was used in the classification of the images to map forest classes, non-forest vegetation, hydrography and deforestation.
Purpose of Data	• Determination of baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	See the following documents: • CÂMARA et al., 2006. Methodology for the annual calculation of deforestation within the Legally-defined Amazon. • www.obt.inpe.br/prodes

Data / Parameter	Ctot
Data unit	$tCO_2e\ ha^{-1}$
Description	Average carbon stock per hectare in all carbon pools in the initial Forest class used in the baseline scenario.
Source of data	Calculated by allometric equations, expansion factors from literature and field measured data.
Value applied	478,1 tCO_2e ha-1
Justification of choice of data or description of measurement methods and procedures applied	Above and below ground biomass estimates were carried out using forest inventory data and allometric equations developed in areas similar to the project area (SILVA, 2007). The dead wood reservoir was estimated based on Feldpausch, 2005.
Purpose of Data	• Determination of baseline scenario

	• Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	See the following documents: • Section 5.3 of "Project Description" • Stock calculation log spreadsheet • Carbon Stock Inventory Report

Data / Parameter	DBH
Data unit	Centimeter (cm)
Description	Diameter at Breast Height (tree diameter at 130cm from the ground). Measured in each tree with DBH equal or higher than 15cm in each plot of forest inventory.
Source of data	Field measurement by Amazônia Gestão Ambiental
Value applied	See spreadsheet with field data
Justification of choice of data or description of measurement methods and procedures applied	Application of the VCS VM0015 methodology. Forest inventory data collected less than 10 years ago through multiple plots in a suitable spatial distribution.
Purpose of Data	• Determination of baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	Main variable for the REDD+ Maísa Project carbono estimates.

Data / Parameter	$PF = 2.7179 * (DBH)^{1.8774}$
Data unit	Kilogram (kg) (of fresh weight of biomass)
Description	Equation to convert the DBH of each tree in fresh biomass.

Source of data	SILVA, 2017.
Value applied	$PF = 2.7179 * (DBH)^{1.8774}$
Justification of choice of data or description of measurement methods and procedures applied	Equation developed on dryland forest with characteristics that are similar to those of the reference region.
Purpose of Data	• Determination of baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	-

Data / Parameter	CF
Data unit	Tonne (t)
Description	Carbon contained within the dry biomass.
Source of data	NOGUEIRA, E. et al., 2008. Estimates of forest biomass in the Brazilian Amazon: New allometric equation and adjustments to biomass from wood volume inventories. Forest Ecology and Management, 256 (11), pp.1853-1867.
Value applied	0.485
Justification of choice of data or description of measurement methods and procedures applied	Value found in scientific literature.
Purpose of Data	• Determination of baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	-

Data / Parameter	44/12
Data unit	tCO_2e
Description	Carbon mass to CO2e mass conversion factor.
Source of data	Scientific literature: 2006 IPCC *Guidelines for National Greenhouse Gas Inventories* Volume 4 AFOLU.
Value applied	44/12 (3,66666667)
Justification of choice of data or description of measurement methods and procedures applied	IPCC standard value
Purpose of Data	• Determination of baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	-

Data / Parameter	Exploited Wood Volume
Data unit	m^3/ha
Description	Volume of wood harvested by each Annual Production Unit.
Source of data	Post-harvest Report
Value applied	Maximum of $20m^3/ha$
Justification of choice of data or description of measurement methods and procedures applied	Volume set out on the Sustainable Forest Management Plan. These data are collected in the field during the packing list and wood extradition.
Purpose of Data	• Calculation of project emissions • Correlation with the financial performance of the sustainable forest management • Analysis of sustainable forest management impacts

Comments	The annual volume of wood exploited also should preferably be compared with the historical average.

Data / Parameter	**Opening of area for management infrastructure**
Data unit	Percentage (%)
Description	Area cleared for building the infrastructure required for Sustainable Forest Management activities, such as patios, primary and secondary roads.
Source of data	Post-harvest Report
Value applied	Maximum 5% of the Annual Production Area Maximum volume permitted by law
Justification of choice of data or description of measurement methods and procedures applied	The data is collected in the field after the harvesting activity.
Purpose of Data	• Calculation of project emissions • Analysis of sustainable forest management impacts
Comments	The annual clearing of areas for management infrastructure should also be compared with the historical average.

Data / Parameter	**Acquisition/maintenance of legality verification (LHV or similar)**
Data unit	Not applicable
Description	Acquisition and maintenance of the legality verification seal.
Source of data	Verification Report of the certifying institution
Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable

Purpose of Data	Specific certification by an independent third party on the compliance with all laws and regulations related to sustainable forest management activities.
Comments	-

Data / Parameter	**Number of monitoring stations**
Data unit	Number
Description	Number of active monitoring stations within the limits of the farm
Source of data	Interviews with monitoring employees and field visits
Value applied	3
Justification of choice of data or description of measurement methods and procedures applied	Current number of monitoring stations
Purpose of Data	Supervision of property integrity
Comments	Based on subsequent verifications, this Information should also be contained in property security reports.

Data / Parameter	**Number of patrols**
Data unit	Number
Description	Number of patrols responsible for surveillance rounds.
Source of data	Interviews with monitoring employees and field visits
Value applied	3
Justification of choice of data or description of measurement methods and procedures applied	Current number of monitoring stations
Purpose of Data	Supervision of asset property

Comments	Based on subsequent verifications, this Information should also be contained in property security reports.

Data / Parameter	Surveillance Frequency
Data unit	Time interval
Description	Time interval in which the same area is patrolled
Source of data	Interviews with monitoring employees and field visits
Value applied	2 times/day
Justification of choice of data or description of measurement methods and procedures applied	Current frequency of watches
Purpose of Data	
Comments	Based on subsequent verifications, this Information should also be contained in property security reports.

Data / Parameter	Number of new businesses prospected
Data unit	Number
Description	Number of new businesses prospected to gain scope in the Project Area.
Source of data	Project Monitoring Report
Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable
Purpose of Data	Monitor: • Diversification of the enterprise's income sources • Project's decreased financial risk

	• Generation of employment and income
Comments	-

Data / Parameter	Number of prospected alternative uses for the soil
Data unit	Número
Description	Number of prospected alternative uses for the soil for the Leakage Management Areas within the limits of Fazenda Maísa.
Source of data	Project Monitoring Report
Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable
Purpose of Data	Monitor: • Diversification of the enterprise's income sources • Project's decreased financial risk • Generation of employment and income
Comments	-

Data / Parameter	Number of New Businesses Implemented
Data unit	Number
Description	New businesses that were effectively implemented, based on the new businesses that were prospected.
Source of data	Project Monitoring Report
Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable

Purpose of Data	Monitor: • Diversification of the enterprise's income sources • Project's decreased financial risk • Generation of employment and income
Comments	-

Data / Parameter	**Number of different land uses within the limits of Fazenda Maísa**
Data unit	Number
Description	Number of different land uses developed within the limits of Fazenda Maísa
Source of data	Project Monitoring Report
Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable
Purpose of Data	Monitor: • Diversification of the enterprise's income sources • Project's decreased financial risk • Generation of employment and income
Comments	-

Data / Parameter	**Number of employees for each land use within the limits of Fazenda Maísa**
Data unit	Number
Description	Employability of different land uses within the limits of Fazenda Maísa
Source of data	Project Monitoring Report

Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable
Purpose of Data	Monitor: • Diversification of the enterprise's income sources • Project's decreased financial risk • Generation of employment and income
Comments	-

Data / Parameter	**Cash flow of the project**
Data unit	Not applicable
Description	Analysis of disbursements made with the project's internal resources.
Source of data	Project Activity Report
Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable
Purpose of Data	Monitor the implementation of activities through a financial disbursement flow
Comments	-

Data / Parameter	**Frequency of publication of Activity Reports**
Data unit	Months
Description	Time interval between the publication of activity reports
Source of data	Project Activity Report

Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable
Purpose of Data	Monitor project communication and provide verification resources
Comments	-

Data / Parameter	**Number of institutions involved in the implementation and monitoring of activities for the climate**
Data unit	Number
Description	Number of institutions involved in the implementation and monitoring of activities for the climate
Source of data	Project Activity Report
Value applied	Not applicable
Justification of choice of data or description of measurement methods and procedures applied	Not applicable
Purpose of Data	Monitor the scope of project relationships in climate interventions
Comments	-

4.2 Data and Parameters Monitored

Data / Parameter	**Deforestation in the Project Area ($ABSLPA_{icl,t}$)**
Data unit	Hectare (ha)
Description	Forest cover areas converted into non-forest areas inside the Maísa REDD+ Project Area.
Source of data	Calculated through LANDSAT8 satellite images used by the PRODES Project, corresponding to the orbit/point:

	• 2013-2019: 224/62 (08/20/2019)
Description of measurement methods and procedures to be applied	The monitoring of forest cover in the monitored area was carried out by overlapping the PRODES vector data with the limits of the Maísa REDD+ Project Area. The polygons mapped as deforestation in the years 2013 to 2019 were selected to quantify the deforested area (and subsequent field verification activities).
Frequency of monitoring/recording	Annual
Value monitored	• 2013: 0 ha • 2014: 0 ha • 2015: 1,4 ha • 2016: 0,3 ha • 2017: 0 ha • 2018: 0 ha • 2019: 0 ha
Monitoring equipment	Remote sensing images from digital processing software, geographic information systems and navigation GPS.
QA/QC procedures to be applied	Images with spatial resolution of 30 m or more will be used in the mapping. The minimum mapping unit is 1ha. The assessment of the classifications was carried out through data collected in the field using GPS navigation. The minimum accuracy of the land use and land cover classification map is 80%.
Purpose of the data	• Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Calculation method	Where unplanned deforestation was detected, the Forest Cover Benchmark Map was updated by the map algebra.
Comments	• PRODES Project: http://www.dpi.inpe.br/prodesdigital/prodes.php • More information on control and quality assurance available at: Câmara et al. 2006. Metodologia para o cálculo da taxa anual de desmatamento na Amazônia Legal.

Data / Parameter	Deforestation in the Leakage Belt ($ABSLLK_{icl,t}$)
Data unit	Hectare (ha)
Description	Forest cover areas converted into non-forest areas inside the Maísa REDD+ Leakage Belt.
Source of data	Calculated through LANDSAT8 satellite images used by the PRODES Project, corresponding to the orbit/point: • 2013-2019: 224/62 (08/20/2019)
Description of measurement methods and procedures to be applied	The monitoring of forest cover in the monitored area was carried out by overlapping the PRODES vector data with the limits of the Leakage Belt areas of Maísa REDD+ Project. The polygons mapped as deforestation in the years 2013 to 2019 were selected to quantify the deforested area.
Frequency of monitoring/recording	Annual
Value monitored	• 2013: 0,1 ha • 2014: 0,0 ha • 2015: 7,6 ha • 2016: 12,1 ha • 2017: 82,6 ha • 2018: 138,9 ha • 2019: 68,9 ha
Monitoring equipment	Remote sensing images from digital processing software, geographic information systems and navigation GPS.
QA/QC procedures to be applied	Images with spatial resolution of 30 m or more will be used in the mapping. The minimum mapping unit is 1ha. The assessment of the classifications was carried out through data collected in the field using GPS navigation. The minimum accuracy of the land use and land cover classification map is 80%.
Purpose of the data	• Calculation of leakage
Calculation method	Where unplanned deforestation was detected, the Forest Cover Benchmark Map was updated by the map algebra.

Comments	• PRODES Project: http://www.dpi.inpe.br/prodesdigital/prodes.php • More information on control and quality assurance available at: Câmara et al. 2006. Metodologia para o cálculo da taxa anual de desmatamento na Amazônia Legal.

Data / Parameter	Ctot
Data unit	$tCO_2e\ ha^{-1}$
Description	Average carbon stock per hectare in all reservoirs in the forest class used in the baseline scenario.
Source of data	Calculated by allometric equations, expansion factors contained in the scientific literature and data obtained in the field by the inventory team.
Description of measurement methods and procedures to be applied	Above and below ground biomass estimates are developed using forest inventory data and allometric equations developed in areas similar to the project (SILVA, 2007).
Frequency of monitoring/recording	One year before harvest. At one, three and five-year intervals after the harvesting of the Annual Production Unit.
Value monitored	Not applicable
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Control and quality assurance information available in the Sustainable Forest Management Plan.
Purpose of the data	• Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Calculation method	Comparison between the average stock value contained in the forestry class used in the baseline scenario and measurements analyzed after the UPA harvest.
Comments	Mandatory requirement of the VM0015 methodology for areas with forest harvest, which must be carried out at least every 10 years.

Data / Parameter	DHB
Data unit	cm
Description	Diameter at Breast Height (tree diameter 130cm from the ground). Measured in all trees with DBH above 15cm, in all parcels of forest inventory.
Source of data	Calculated from the circumference at Breast Height (CBH) measured in the field by the inventory team.
Description of measurement methods and procedures to be applied	From each tree measured in the field, the circumference at chest height is taken. The DBH is obtained by transforming the circumference into a diameter, through mathematical calculation.
Frequency of monitoring/recording	One year before harvest. At one, three and five-year intervals after the harvesting of the Annual Production Unit.
Value monitored	Not applicable
Monitoring equipment	Calculated from the circumference at breast height (CBH) measured in the field using a measuring tape.
QA/QC procedures to be applied	Requirement required by the VCS VM0015 Methodology. Forest inventory data collected less than 10 years ago through multiple plots and in an appropriate spatial distribution.
Purpose of the data	• Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Calculation method	DBH is calculated from the circumference at breast height (CBH) data for each tree measured in the field. The calculation consists of dividing the value obtained from the CBH by the constant “Pi (π)”.
Comments	Main variable used n the carbon stock change estimates for REDD + Maísa project.

Data / Parameter	Planned deforestation for Forest Management infrastructure ($APDPA_{icl,t}$)

Data unit	Hectare (ha)
Description	Survey and mapping of forest cover areas converted to non-forest cover areas due to the construction of roads, trails and patios necessary for sustainable forest management.
Source of data	Annual Operational Plan ("Plano Operacional Anual - POA, in Portuguese)
Description of measurement methods and procedures to be applied	The monitoring of forest cover areas in the area of sustainable forest management was carried by verifying information contained in the POA referring to the construction of roads, trails and patios. The Forest Cover Benchmark Map was updated by the map algebra, once the planned deforestation occurred. The verification processes reported a reduction in the carbon stock in the Project Area.
Frequency of monitoring/recording	During the year of management of each UPA.
Value monitored	• 2013: 7,2 ha (0,64%) • 2014: 0 ha • 2015: 0 ha • 2016: 0 ha • 2017: 0 ha • 2018: 0 ha • 2019: 0 ha
Monitoring equipment	Geographic information systems
QA/QC procedures to be applied	The mapping of deforestation areas planned for the implementation of sustainable forest management infrastructures were carried out through high resolution images
Purpose of the data	• Calculation of project emissions
Calculation method	Where unplanned deforestation was detected, the Forest Cover Benchmark Map was updated by the map algebra.
Comments	These values were established based on data from the shapefiles and planning information on UPA 11 forest management.

Data / Parameter	$\Delta CabBSLLK_t$
Data unit	tCO_2-e
Description	Total carbon stock changes in the leakage belt area
Source of data	Calculated
Description of measurement methods and procedures to be applied	• Leak prevention activities are listed; • Prepared the map showing areas of intervention and the type of intervention; • Identified the areas in which leakage prevention activities impact the carbon stock; • Identified the classes of non-forest cover existing in these areas in the baseline case; • Measured the carbon stock in the identified classes; • Reported in Table 30.c of VM0015 Methodology the changes in the carbon stock of the leakage management areas under the project scenario; • Calculated the net changes in the carbon stock caused by leakage prevention measures during the fixed baseline period and, alternatively, during the project crediting period; • Reported the results of the calculations in Table 30.c of the VM0015 methodology.
Frequency of monitoring/recording	Annual
Value monitored	• 2013: 0 tCO_2-e • 2014: 0 tCO_2-e • 2015: 0 tCO_2-e • 2016: 0 tCO_2-e • 2017: 0 tCO_2-e • 2018: 0 tCO_2-e • 2019: 0 tCO_2-e
Monitoring equipment	Remote sensing images from digital processing software and calculation table.

QA/QC procedures to be applied	Images with spatial resolution of 30 m or more will be used in the mapping. The minimum mapping unit is 1ha. The assessment of the classifications was carried out through data collected in the field using GPS navigation. The minimum accuracy of the land use and land cover classification map is 80%.
Purpose of the data	• Calculation of leakage
Calculation method	Evaluation of ex-post estimates in the Leakage Belt in relation to the ex-ante estimate of the project (Table 35 of VM0015).
Comments	-

Data / Parameter	**Emissions of methane (CH_4) and nitrous oxide (N_2O) arising from herds**
Data unit	tCO_2-e yr^{-1}
Description	Emissions derived from grazing animals in the leakage management areas in year *t*.
Source of data	The values of pasture areas existing in the leakage management areas, located inside and outside the limits of Fazenda Maísa, were obtained through MapBiomas, Collection 5. The spreadsheet with annual values was made available to the VVB.
Description of measurement methods and procedures to be applied	• Specified areas that have annual livestock activities (in the leakage management area); The following steps are carried out when there is an increase in the pasture area within the leakage management areas: • Briefly described on the type of forage and manure management. Use of Table 31 of the VM0015 methodology to report the key parameters required for the calculation of GHG emissions; • The number of animals in the case of baseline and under the project scenario is determined based on the area and forage available. The difference is considered when calculating the increase in GHG emissions; • Use of methods described in Appendix 4 of VM0015 to estimate emissions from enteric fermentation and manure management. Performed the final calculations using

	equation 18 and results reported in table 32, both contained in the VM0015 methodology.
Frequency of monitoring/recording	Annual
Value monitored	As there was a reduction in pasture areas both in the Project's Leakage Management Areas existing within Fazenda Maísa and in surrounding communities, it was not necessary to calculate methane and nitrous oxide emissions, as well as the conversion to carbon dioxide (tCO2eq).
Monitoring equipment	Remote sensing images of the project "Annual Mapping of Brazil's Land Cover and Land Use" (MapBiomas), geographic information systems and calculation spreadsheet.
QA/QC procedures to be applied	Not applicable
Purpose of the data	• Calculation of project emissions • Calculation of leakage
Calculation method	Equation 18 of the VM0015 methodology
Comments	The reduction in pasture areas in the leakage management areas was mainly due to the interruption of livestock activity within Fazenda Maísa.

Data / Parameter	Regeneration rate of permanent plots
Data unit	m^3/ha/ano
Description	Inventory carried out in the permanent plots of each UPA one year before the harvest, one year later, three years later and then every 5 years.
Source of data	Post-Exploratory Report
Description of measurement methods and procedures to be applied	See Sustainable Forest Management Plan
Frequency of monitoring/recording	One year before harvest and at intervals of one, three and five years after harvest

Value monitored	Not applicable
Monitoring equipment	See Sustainable Forest Management Plan
QA/QC procedures to be applied	See section 8, item 8.1. PD for information on quality assurance and control procedures.
Purpose of the data	• Impact Assessment of Sustainable Forest Management
Calculation method	See Sustainable Forest Management Plan
Comments	-

Data / Parameter	**Harvest damage assessment**
Data unit	m^3/ha
Description	See Sustainable Forest Management Plan
Source of data	Post-Exploratory Report
Description of measurement methods and procedures to be applied	See Sustainable Forest Management Plan
Frequency of monitoring/recording	Annual, after completion of the harvesting operations of each annual production unit.
Value monitored	Not applicable
Monitoring equipment	See Sustainable Forest Management Plan
QA/QC procedures to be applied	See section 8, item 8.1. PD for information on quality assurance and control procedures.
Purpose of the data	• Impact Assessment of Sustainable Forest Management
Calculation method	See Sustainable Forest Management Plan
Comments	-

Data / Parameter	**Maintenance of the Legal Harvesting Verification (LHV)**

Data unit	Not applicable
Description	Maintenance of the forest management legality verification certificate - LHV
Source of data	Verification Report of the certifying institution
Description of measurement methods and procedures to be applied	Measurement procedures defined by the certifying institution
Frequency of monitoring/recording	Annual
Value monitored	SCS - Legal Harvesting Verification acquired on April 23, 2013, valid until April 11, 2016.
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Verification procedures carried out by the certifying institution
Purpose of the data	• Certify compliance with all laws and regulations related to sustainable forest management activities
Calculation method	Not applicable
Comments	-

Data / Parameter	**Acquisition/maintenance of robust forest management certifications.**
Data unit	Not applicable
Description	Acquisition and maintenance of robust certification standards for sustainable forest management.
Source of data	Auditing Report of the certifying institution
Description of measurement methods and procedures to be applied	Not applicable

Frequency of monitoring/recording	Annual
Value monitored	0
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Not applicable
Purpose of the data	• Certify compliance with all laws and regulations related to sustainable forest management activities, the implementation of good sustainable forest management practices and the social and environmental responsible management.
Calculation method	Not applicable
Comments	-

Data / Parameter	Number of surveillance posts
Data unit	Number
Description	Number of active surveillance posts within the limits of the Farm
Source of data	Information sent by the landowner and proponent of the Project
Description of measurement methods and procedures to be applied	Information, images and coordinates sent by the landowner and proponent of the Project
Frequency of monitoring/recording	With each change in the number of posts
Value monitored	8 (5 home bases, 1 central camp and 2 sentry-houses)
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Not applicable
Purpose of the data	• Patrimonial surveillance to supervise and maintain the integrity of the forest and property.

Calculation method	Not applicable
Comments	-

Data / Parameter	**Number of guards**
Data unit	Hectare (ha)
Description	Number of employees responsible for security rounds
Source of data	Information sent by the landowner and proponent of the Project
Description of measurement methods and procedures to be applied	Current number of employees responsible for surveillance
Frequency of monitoring/recording	With each change in the surveillance team
Value monitored	10
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Not applicable
Purpose of the data	• Patrimonial surveillance to supervise and maintain the integrity of the forest and property.
Calculation method	Not applicable
Comments	-

Data / Parameter	**Frequency of surveillance rounds**
Data unit	Time interval
Description	Time interval required to make the security round “the entire” perimeter of the farm.
Source of data	Information sent by the landowner and proponent of the Project

Description of measurement methods and procedures to be applied	Current frequency of surveillance rounds
Frequency of monitoring/recording	*Weekly*
Value monitored	One week
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Not applicable
Purpose of the data	• Patrimonial surveillance to supervise and maintain the integrity of the forest and property.
Calculation method	Not applicable
Comments	Modifications to the surveillance routine may change if events are identified.

Data / Parameter	**Number of Occurrences**
Data unit	Number
Description	Number of times that there was occurrence during surveillance
Source of data	Patrimonial Surveillance Report
Description of measurement methods and procedures to be applied	Internal occurrences detected by the surveillance teams during the rounds. These occurrences are reported in the monthly Surveillance Reports.
Frequency of monitoring/recording	Monthly
Value monitored	• 2013: 3 • 2014: 3 • 2015: 5 • 2016: 4

	• 2017: 4 • 2018: 3 • 2019: 0
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Record of the occurrence is passed on to the farm manager and/or landowner, who are responsible for documenting it in the Surveillance Reports.
Purpose of the data	• Evaluation of occurrence records
Calculation method	Not applicable
Comments	-

Data / Parameter	Status of occurrences
Data unit	Not applicable
Description	Forwarding to the detected occurrence
Source of data	Patrimonial Surveillance Reports
Description of measurement methods and procedures to be applied	The common procedure is to send the invaders off the property, carried out by the vigilantes themselves. When necessary, the police are called. In a more serious case, such as threats or a fire, a police report is made.
Frequency of monitoring/recording	Monthly
Value monitored	Information can be found in the Surveillance Reports, made available to the VVB.
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Not applicable
Purpose of the data	• Supervise and maintain the integrity of the forest and property.
Calculation method	Not applicable

Comments	-

Data / Parameter	**Net income of each land use within the limits of Fazenda Maísa**
Data unit	R$
Description	Net income (gross revenue - costs) from each type of land use within the limits of Fazenda Maísa
Source of data	Documents sent by the landowner
Description of measurement methods and procedures to be applied	Consultations with the owner and proponent of the Project and the accounting documents
Frequency of monitoring/recording	Annual
Value monitored	Documents made available to the VVB team
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Validation of the information systematized by the proponents before the official publication of the Monitoring Report and the sending of documents to the VVB team.
Purpose of the data	Financial analysis of a property that keeps its forests conserved and develops activities related to forest valuation
Calculation method	Not applicable
Comments	-

Data / Parameter	**Publication Frequency of Monitoring Reports**
Data unit	Number
Description	Time interval between the publication of the Project's monitoring reports, the main ones being the Deforestation Reports, Social Activities, Fauna Monitoring Reports, Project Activities Report and Post-exploratory Management Reports.
Source of data	Monitoring Bulletins

Description of measurement methods and procedures to be applied	Monitoring Bulletins Deforestation Report (Monitoring Bulletin): The monitoring of forest cover in the monitored area was carried out by overlapping the PRODES vector data with the limits of the Leakage Belt and Project Area. The polygons mapped as deforestation in the years 2013 to 2019 were selected for quantification of the deforested area, preparation of the Bulletin and subsequent field verification activities. Eventually, fires outbreaks, cloud cover and accuracy of the data are evaluated.
Frequency of monitoring/recording	Annual
Value monitored	1 per year
Monitoring equipment	Remote sensing images from digital processing software, geographic information system and GPS navigation.
QA/QC procedures to be applied	Images with spatial resolution of 30 m or more will be used in the mapping. The minimum mapping unit is 1ha. The assessment of the classifications was carried out through data collected in the field using GPS navigation. The minimum accuracy of the land use and land cover classification map is 80%.
Purpose of the data	• Control of deforestation in the project area and monitor deforestation in the Leakage Belt
Calculation method	Not applicable
Comments	• PRODES Project: http://www.dpi.inpe.br/prodesdigital/prodes.php • More information on control and quality assurance available at: Câmara et al. 2006. Metodologia para o cálculo da taxa anual de desmatamento na Amazônia Legal.

4.3 Monitoring Plan

4.3.1 Organizational structure, responsibilities and competencies

The monitoring plan for the climate component of the Maísa REDD+ Project for this second verification period involves monitoring deforestation in the Project Area and the Leakage Belt. Biofílica is responsible for coordinating the monitoring processes during the project's life cycle. In addition, it was also

responsible for the monitoring of climatic aspects with the support of the Maísa–Moju Agroindustrial and Sipasa team.

Project Competencies and Responsibilities

Biofílica: is a Brazilian company focused on the management and conservation of forest areas in the Amazon biome. Created in 2008 with the objective of creating pioneering alternatives and making environmental conservation an economically interesting activity for forest owners, communities and investors Biofílica's mission is to reduce deforestation and carbon emissions into the atmosphere, conserve biodiversity and water resources, and promotes the social inclusion and development of communities living in the Amazon biome through commercialization of credits for environmental services, promotion and financing of scientific research activities and development of sustainable business chain.

Responsibilities: general coordination of socioeconomic and environmental diagnostics (DSEA) and baseline and carbon stock studies; development and financing of the PDD (Project Design Document); remote monitoring of forest cover and implementation/coordination of additional actions aimed at reducing/mitigating greenhouse gas emissions (GHG); validation/verification and commercialization of credits; co-management of the Project throughout its duration.

Maísa–Moju Agroindustrial Ltda: Fazenda Maísa was acquired from the State of Pará in the beginning of the 1970s with the objective of developing sustainable forest management activities for the production of tropical timber for sawmills. Currently, the main activity is the management of eucalyptus and non-timber forest products, such as açaí and Brazil nuts. It is a family company that owns the land.

Responsibilities: holder of the ownership title, is responsible for co-management of the project, maintenance of infrastructure, land security and property surveillance, low-impact forest management (occurring until 2014) and providing infrastructure and logistics support to Biofílica and other professionals involved in the project, as well as all activities related to environmental and social management of the Project to reduce negative impacts and generate positive ones.

Sipasa-Seringa Industrial do Pará S/A: part of the same family economic group, Sipasa is responsible for the operation of sustainable forest management and other investments associated with this operation.

Responsibilities: operation of sustainable forest management and implementation of improvement techniques to maintain and increase the forest's carbon stock.

4.3.2 Monitoring Plan for Climate Impacts

The Monitoring Plan for Climate Impacts contains the essential aspects for demonstrating the reduction of emissions from deforestation and degradation due to avoided unplanned deforestation (according to the applied methodology VM0015). Thus, it brings information from the monitoring of greenhouse gas (GHG)

emissions reductions and in the carbon stock changes over the lifetime of the project due to changes in land use within the Project Area and the Leakage Belt.

Application of the Methodology VM0015

TASK 1: MONITORING CARBON STOCK CHANGES AND GHG EMISSIONS FOR PERIODICAL CHECKS

1. **Monitoring current changes in carbon stock and GHG emissions in the Project area**

a) **Technical description of monitoring tasks**

Monitoring of carbon stock changes and GHG emissions within the Project Area is done by monitoring avoided unplanned deforestation. Thus, in order to avoid unplanned deforestation, Biofílica Investimentos Ambientais carries out the stage of verification of forest cover areas by satellite images, while Sipasa-Moju carries out the stage of field checks in the Project Area.

b) **Data collected**

Table 5 - Data collected to monitor changes in carbon stock and GHG emissions for periodic verification.

Parameter	Description	Unit	Source	Frequency
$AUDPA_{icl,t}$	Unplanned deforestation areas in the *icl* forest class in year *t* in the Project Area	Hectares (ha)	Calculated using remote sensing images, technical maps and data, field and post-exploration management information	Annual
$\Delta CUDdPA_t$	Total decrease in carbon stock due to unplanned and unavoidable deforestation within the Project Area in year *t*	ton of carbon dioxide equivalent (tCO_2-e)	Calculated	Annual
$APDPA_{icl,t}$	Areas of planned deforestation in forest class *icl* in year *t* in the Project Area	Hectares (ha)	Calculated	Annual
$\Delta CPLdPA_t$	Total decrease in carbon stocks due to planned harvesting activities in year *t* in the Project Area	ton of carbon dioxide equivalent (tCO_2-e)	Calculated	Annual

$ACPA_{icl,t}$	Annual area within the Project Area affected by catastrophic events in the *icl* class in year *t*	Hectares (ha)	Not applicable	Each time a catastrophic event occurs
$\Delta CUCdPA_t$	Total decrease in carbon stocks due to catastrophic events in year *t* in the Project Area	ton of carbon dioxide equivalent (tCO_2-e)	Not applicable	Each time a catastrophic event occurs
$AUFPA_{icl,t}$	Annual area within the Project Area affected by forest fires in class *icl* in year *t*	Hectares (ha)	Calculated	Each time a forest fire event occurs
$\Delta CUFdPA_t$	Total decrease in carbon stocks due to forest fires in year *t* in the Project Area	ton of carbon dioxide equivalent (tCO_2-e)	Calculated	Each time a forest fire event occurs
$\Delta CPSPA_t$	Total project carbon stock change within the Project Area at year *t*	ton of carbon dioxide equivalent (tCO_2-e)	Calculated	Annual

c) Brief description of data collection procedures

Monitoring changes in land-use and land-cover:

The monitoring of unplanned deforestation in the Project Area was based on the data processed by the PRODES project, identifying land use conversion areas. The procedures performed for data collection and processing were described in Section 3.1 of this document.

The monitoring of planned deforestation caused by forest management activities used information contained in maps and shapefiles from the planning of roads, tracks and stockyards, as well as information contained in the Annual Operation Plan.

d) Quality control and quality assurance procedures

Monitoring changes in land-use and land-cover:

In order to validate the information obtained from satellite images, the mapped information on the occurrence of deforestation was checked through data collected in the field with a navigation GPS. Thus, field checks and surveillance reports were considered tools for validating the deforestation areas identified by PRODES.

Another methodology used in the validation is the realization of the accuracy. The minimum accuracy in land use and land cover classification is 80%. The analysis was performed using the Sentinel-2 satellite image, with 10 meters spatial resolution, and for areas with cloud coverage, the LandSat-8 image with 30m spatial resolution and a minimum unit of 1ha, with good visualization and low cloud coverage, was used as support.

The original (raster) and processed (vector) digital data from satellite images, coordinates, technical maps, photos and field sheets are stored by Biofílica Investimentos Ambientais throughout the project. Maps with installed infrastructure, satellite images and deforestation reports are made available to the verification body at each verification event.

e) Data archiving

All data and reports produced by Maísa REDD+ Project are stored by Biofílica Investimentos Ambientais through digital files during the life cycle of the project. All documents related to the monitoring of Maísa REDD+ Project are gathered in physical and/or virtual files and made available to the verification body at each verification event.

1.1. Monitoring of Project Implementation

The implementation of REDD+ activities are monitored through financial spreadsheets, social management reports, vegetation cover maps, follow-up meetings, meeting reports, surveillance reports, and occurrence of property invasions and other relevant documents.

1.2. Monitoring of changes in land use and land cover within the Project area

Unplanned deforestation monitoring was carried out by mapping the forest cover of the Project area using data provided annually by PRODES. Subsequently, the mapping was validated from the accuracy assessment with images with good visualization and low cloud coverage, from the Sentinel-2 satellite, supported by LandSat-8 images.

The monitoring of deforestation for the implementation of infrastructure of forest management activities was carried out through information contained in the Annual Operation Plan of the Annual Production Unit exploited and shapefiles containing information of the forest cover areas converted into non-forest class.

Data regarding deforestation events were compared to baseline scenarios. Reduced emissions values in the deforestation period were derived from the comparison between predicted and actual deforestation.

1.3. Monitoring of changes in carbon stocks

<u>Within the Project area</u>

Although the ex-ante estimate of carbon stock by forest class is not expected to change during the baseline period, the VCS VM0015 Methodology requests monitoring of the carbon stock in the Project Area subject to significant carbon stock reduction in the project scenario - with ex ante evaluation as a reference. This reduction may occur in areas subject to planned deforestation, arising from planned forest management activities, or in areas subjected to unplanned carbon stock reduction, such as in cases of catastrophic events or forest fires.

The total change in carbon stock due to unplanned and unavoidable deforestation within the Project Area was calculated by the following equation:

$$\Delta\,\mathrm{CUDdPA}_t = \sum_{y=1}^{t}\left(\sum_{icl=1}^{icl} AUDPA_{icl,y} * \Delta Ctot_{icl,t-y} - \sum_{fcl=1}^{fcl} AUDPA_{fcl,y} * \Delta Ctot_{fcl,t-y}\right) \quad (1)$$

Where:

$\Delta CUDdPA_t$: Total carbon stock changes due to unavoidable unplanned deforestation in the Project Area in year *t*

$AUDPA_{icl,y}$: Unplanned deforestation area in the initial forest class *icl* in year *t* in the Project Area in the Project scenario

$\Delta Ctot_{icl,Ac}$: Loss of carbon stock in the initial forest class *icl* at the age of change *Ac* (number of years after the change of use and soil cover)

$AUDPA_{fcl,y}$: Post deforestation non-forest class area *fcl* in year *t* in the Project Area after unplanned deforestation in the Project scenario

$\Delta Ctot_{fcl,Ac}$: Gain in carbon stock in the final post deforestation non-forest class *fcl* at the age of change *Ac* (number of years after change of use and soil cover).

All reductions in the carbon stock from forest management activities were reported in the verification processes in Table 29 of the Methodology VM0015.

<u>Within the areas of leakage management:</u>

In the Project scenario, no area is subjected to the planned decrease of carbon stock within the Leakage Management Areas, whether located within or outside the limits of Fazenda Maísa.

Monitoring non-CO_2 emissions due to forest fires

Emissions from biomass burning are not computed in this Project. According to the VM0015 Methodology, non-CO_2 emissions can be conservatively omitted since, as demonstrated by scientific research, the occurrence of natural fires is rare in the Amazon region, with a predominance of anthropogenic fires related to human occupation (SCHROEDER et al, 2009). Furthermore, besides the project not stimulating activities associated with fire, it promotes actions to mitigate deforestation caused by these agents,

represented mainly by the strengthening of patrimonial vigilance, with frequent monitoring of the farm forest areas and their limits.

In this monitoring period, however, as in 2015 there was a forest fire from neighboring areas that reached the Project Area (Section 3.1.2), calculation of non-CO_2 emissions from this fire was carried out, as well as the significance of these emissions .

The result of these calculations indicated that the emissions were not significant and, therefore, these were not considered in the GHG emissions calculations of this monitoring period. The spreadsheet with the calculations was made available to the VVB.

The following formulas presented in VM0015, version 1.1 (Section 6.2) were used to calculate non-CO_2 emissions from forest fires:

$$EBBtot_{icl,t} = EBBN2O_{icl,t} + EBBCH4_{icl,t} \qquad (2)$$

Where:

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

$EBBN2O_{icl,t}$: N_2O emission from biomass burning in forest class *icl* at year *t* (tCO_2-e.ha^{-1});

$EBBCH4_{icl,t}$: CH_4 emission from biomass burning in forest class *icl* at year *t* (tCO_2-e.ha^{-1});

$$EBBN2O_{icl,t} = EBBCO2_{icl,t} * 12/44 * NCR * ER_{N2O} * 44/28 * GWP_{N2O} \qquad (3)$$

$$EBBCH4_{icl,t} = EBBCO2_{icl,t} * 12/44 * ER_{CH4} * 16/12 * GWP_{CH4} \qquad (4)$$

Where:

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

$EBBN2O_{icl,t}$: Per hectare N_2O emission from biomass burning in slash and burn in forest class *icl* at year *t* (tCO_2-e.ha^{-1});

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

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

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

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

GWP_{N2O}: Global Warming Potential for N_2O (IPCC default value = 310 for the first commitment period);

GWP_{CH4}: Global Warming Potential for CH_4 (IPCC default value = 21 for the first commitment period);

$$EBBCO2_{icl,t} = Fburnt_{icl} * \sum_{p=1}^{p}(C_{p,icl,t} * Pburnt_{p,icl} * CE_{p,icl}) \quad (5)$$

Where:

$EBBCO2_{icl,t}$: Per hectare CO2 emission from biomass burning in slash and burn in forest class *icl* at year *t* (tCO_2-e.ha^{-1});

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

$C_{p,icl,t}$: Average *carbon stock* per hectare in the carbon pool *p* burnt in the forest class *icl* at year *t* (tCO_2-e.ha^{-1});

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

$CE_{p,icl}$: Average combustion efficiency of the carbon pool *p* in the forest class *icl*; dimensionless;

p: Carbon pool that could burn (above-ground biomass, dead wood, litter);

icl: 1, 2, 3, ...*icl* (pre-deforestation) forest classes;

t: 1, 2, 3 ... *t,* a year of the proposed project crediting period (dimensionless).

1.4. Monitoring of impacts of natural disturbances and other catastrophic events

Decreases in carbon stock and increasing GHG emissions caused by natural disturbances or catastrophic events was controlled by monitoring the forest cover by satellite using the same methods applied for monitoring the forest cover in the Project area.

The main activities developed by the Project for data collection and processing are:

- Selection of optical satellite images with less cloud cover and date of collection of images near the dry season in the Amazon and appropriate radiometric quality;
- Georeferencing of satellite imagery with scale 1: 100,000 topographic maps or NASA images in ortho-rectified MrSID format;
- Mapping of areas of forest cover reached.

Emissions due to natural disturbance or catastrophic events were estimated by multiplying the area of forest loss mapped by the average of forest carbon stock. During this monitoring period no significant reduction in carbon stock due to natural disturbance or catastrophic events were identified during the forest cover monitoring (Table 20).

2. Monitoring of Leakage

a) Technical description of monitoring tasks

The Maísa REDD+ Project involves two monitoring activities for leakage sources:

i. Monitoring the decrease in carbon stocks and/or increase in GHG emissions correlated with leakage prevention measures if project proponents implement activities such as tree planting, agricultural intensification, fertilization, forage production and/or other measures of improvement in agricultural areas and pastures.

When these activities cause a reduction in carbon stocks and/or an increase in GHG emissions in the Leakage Management Areas, these changes in carbon stocks and/or GHG emissions are estimated by Biofílica Investimentos Ambientais.

During the monitoring period project proponents did not carry out any of the interventions mentioned. Therefore, changes in carbon stock and GHG emissions associated with prevention activities and leakage were not accounted.

ii. Monitoring of forest cover in the Leakage Belt through satellite images, conducted by Biofílica Investimentos Ambientais.

Biofílica Investimentos Ambientais monitored the forest cover in the Leakage Belt through satellite images to account for the reduction in carbon stock and the increase in GHG emissions due to leakage displacement.

b) Data collected

Table 6 - Data collected for leakage monitoring in the Maísa REDD+ Project.

Parameter	Description	Unit	Source	Frequency
$ABSLLK_{fcl,t}$	Area of final (post-deforestation) forest class *fcl* deforested at time *t* within the leakage belt in the baseline case	Hectare (ha)	Calculated	Annual
$\Delta CLPMLK_t$	Decrease in carbon stock due to leakage prevention measures	ton of carbon dioxide equivalent (tCO_2-e)	Not applicable	Annual
$EgLK_t$	Emissions from grazing animals in the management area in year *t*	ton of carbon dioxide equivalent (tCO_2-e)	Not applicable	Annual
$ELPMLK_t$	Total annual increase in GHG emissions due to leakage prevention measures in year *t*	ton of carbon dioxide equivalent (tCO_2-e)	Not applicable	Annual

$\Delta CabBSLLK_t$	Total carbon stock change in the leakage belt area	ton of carbon dioxide equivalent (tCO_2-e)	Calculated	Annual

c) Brief description of data collection procedures

Monitoring of carbon stock changes and GHG emissions associated to leakage prevention activities:

No activities were carried out or stimulated by the Project to improve agricultural techniques or manage pasture areas (which could alter carbon stocks and increase GHG emissions, compared to the baseline scenario).

Even so, the land occupation by pasture was monitored in the Leakage Management Areas located inside and outside the Fazenda Maísa, in order to calculate the emissions from the herd (when there is an increase in the pasture area and a consequent increase in the number of animals).

To obtain the annual data on pasture areas, the "Coleção 5" of the MapBiomas platform was used (online platform for mapping land use in Brazil), which revealed that there was a reduction in pasture areas in this monitoring period (calculation spreadsheet and geographic database were made available to the VVB). Thus, the calculation of methane (CH_4) and nitrous oxide (N_2O) emissions from the herd was not performed.

In this sense, Tables 30b, 30c, 31, 32 and 33 of VM0015 were not applied.

It is noteworthy that when there is an increase in pasture areas within the Leakage Management Areas, some procedures for monitoring the carbon stock and GHG emissions are performed. Details of these procedures are presented in the PPD, in Section 8.1. - Description of the Monitoring Plan.

Monitoring of carbon stock decrease and increases in GHG emissions due to leakage displacement:

Activity data for the Leakage Belt were determined using the same methods applied for monitoring deforestation in the Project Area (item 1). If during the monitoring process a larger than expected event in the baseline is identified in the Leakage Belt (which did not happen during this monitoring period), and this deforestation is attributed to deforestation agents in the Project Area, the carbon stock losses are accounted for and reported using tables 22c and 21d of the approved methodology VM0015,version 1.1.

d) Quality control and quality assurance procedures

Monitoring of carbon stock changes and GHG emissions associated to leakage prevention activities:

During the monitored period, no leakage prevention activities were implemented. If any activity occurs, the specific procedures for the activity will be determined.

Monitoring of carbon stock decrease and increases in GHG emissions due to leakage displacement:

Procedures used for quality control and quality assurance were the same as those applied to monitoring deforestation in the Project Area (item 1).

e) Data archiving

Original reports and field worksheets are stored by Biofílica Investimentos Ambientais, which also maintains a copy of these documents in digital format throughout the life of the project. The original digital data (raster) and processed (vector) of the satellite images, coordinates, technical maps, field photos and files are also stored by Biofílica Investimentos Ambientais during the life of the project. Annual map of deforestation areas, satellite images and reports are made available to the verification body at each verification event.

2.1. Monitoring of carbon stock changes and GHG emissions associated to leakage prevention activities

There was no decrease in the carbon stock associated with activities developed at Leakage Management Areas, since no activity to improve agricultural techniques, or the management of pasture areas, which could alter carbon stocks and increase GHG emissions in compared to the baseline scenario, were implemented during this monitoring period.

However, if it is decided that these activities are necessary, the ex-ante carbon stock changes and the GHG emissions associated with these activities will be estimated through Step 8 of the VM0015 methodology. If significant, activities and associated emissions will be monitored and data will be made available to verifiers through tables 30b, 30c, 31, 32 and 33 of the VM0015 methodology, version 1.1.

The following activities can cause a reduction in the carbon stock or an increase in GHG emissions in Leakage Management Areas:

- Carbon stock changes due to activities implemented in the Leakage Management Areas;
- Methane (CH_4) and nitrous oxide (N_2O) emissions derived from the intensification of the livestock (involving changes in the animal's diet and/or number of animals).

Nitrous oxide (N_2O) emissions from nitrogen fertilization are always considered insignificant, according to the most recent version of the VCS - VM0015 standard. The consumption of fossil fuels is always considered insignificant in the AUD of the project activities and should not be considered.

In addition, as noted earlier, no activities were carried out that would cause a significant increase in CH_4 and N_2O emissions. Thus, Tables 31 and 32 of VM0015 were not applied.

2.2. Monitoring of carbon stock decrease and increases in GHG emissions due to leakage displacement

Monitoring of carbon stock changes

Activity data for the Leakage Belt area was determined by the same methods applied to monitor deforestation in the Project Area (item 1).

No deforestation events greater than expected for the baseline scenario were identified within the Leakage Belt.

If during the monitoring process a deforestation event greater than expected in the baseline scenario is identified in the Leakage Belt, and such deforestation is attributed to deforestation agents in the Project Area, carbon stock losses are accounted for and reported using Tables 22c and 21c of the Approved Methodology VM0015. Such situation was not identified in the Leakage Belt during the monitored period.

The total carbon stock change due to unplanned and unavoidable deforestation within the Leakage Belt area was calculated as follows:

$$\Delta \mathrm{CBSLLK}_t = \sum_{y=1}^{t} \left(\sum_{icl=1}^{icl} AUDLK_{icl,y} * \Delta Ctot_{icl,t-y} - \sum_{fcl=1}^{fcl} AUDLK_{fcl,y} * \Delta Ctot_{fcl,t-y} \right) \quad (6)$$

Where:

$\Delta CBSLLK_t$: Total carbon stock change due to unavoided unplanned deforestation within the area of the Leakage Belt at year *t*:

$AUDLK_{icl,y}$: Area of unplanned deforestation in the initial forest class *icl* at year *t* within the area of the Leakage Belt in the project scenario.

$\Delta Ctot_{icl,Ac}$: Carbon stock loss in the initial forest class *icl* at age of change *Ac* (# of years after LU/LC change).

$AUDLK_{fcl,y}$: Non-forest area *fcl* at time *t* within the area of the Leakage Management Belt after unplanned deforestation in the Project Area.

$\Delta Ctot_{fcl,Ac}$: Carbon stock gain in the final non-forest class *icl* at age of change *Ac* (number of years after LU/LC change).

2.3. Estimated total ex-post leakage

The results were presented to the verification body through Table 35 of the VM0015 Methodology.

3. Net ex-post GHG reductions

a) Technical description of monitoring tasks

In the verification processes the results was presented using the Table 36 of the Approved Methodology VM0015 version 1.1, together with spatial data (deforestation maps).

b) Data collected

Table 7 - Data collected for monitoring ex-post net GHG reductions for the Maísa REDD+ Project.

Parameter	Description	Unit	Source	Frequency
$\Delta REDD_{,t}$	Net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year *t*	ton of carbon dioxide equivalent (tCO_2-e)	Calculated	Annual
$VCU_{,t}$	Number of Verified Carbon Units (VCUs) to be made available for trade in year *t*	ton of carbon dioxide equivalent (tCO_2-e)	Calculated	Annual

c) Brief description of data collection procedures

The calculation of the number of Verified Carbon Units (VCUs) to be produced by the Maísa REDD+ Project activities at the years 2013, 2014, 2015, 2016, 2017, 2018 and 2019 were calculated using equation 19 and 20 of Methodology VM0015 version 1.1.

d) Quality control and quality assurance procedures

All tasks and tools listed in part 2 of the Approved Methodology VM0015 were used to ensure that the data are suitable for the verification process and the number of Verified Carbon Units is reliable.

e) Data archiving

All data and reports of the Maísa REDD+ Project are stored by Biofílica Investimentos Ambientais in digital files throughout the project. All documents related to the monitoring of the Project are compiled and made available to the verification body at each verification event.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

The estimate of unplanned deforestation in the Project Area under the scenario without the project was implemented by applying the following four steps:

- Analysis of the historical change in land cover between 2000 and 2011 in the Reference Region (RR) of the Maísa REDD+ Project;
- Estimation of the annual areas of unplanned baseline deforestation in the Reference Region (RR);
- Estimation of annual areas of unplanned baseline deforestation in the Project Area (PA);
- Analysis of the ex-post scenario that occurred during the monitored period.

The detailed process is described in the Maísa REDD+ Project Design Document, while the results of the monitoring period 2013-2019 are presented in tables on the following pages.

To determine the reduced emissions, the value of the carbon stock estimated in the forest inventory (previously carried out and described in the PDD) was multiplied by 3.6667 (44/12), since 1 kg of C is equivalent to 3.6667 kg of CO_2. The average values of the ton of carbon or carbon dioxide per hectare for each initial class of land use and land cover considered for the baseline scenario present in the Project Area and Leakage Belt can be seen in Table 8 below.

Table 8 - Carbon stocks per hectare of initial forest classes *icl* existing in the Project Area and Leakage Belt.

Initial forest class *icl* Name: Forest ID_{icl} 1 Average carbon stock per hectare + 90% CI							
Cab_{icl}		Cbb_{icl}		Cdw_{icl}		$Ctot_{icl}$	
C stock $tCO_2e\ ha^{-1}$	± 95% CI $tCO_2e\ ha^{-1}$	C stock $tCO_2e\ ha^{-1}$	± 95% CI $tCO_2e\ ha^{-1}$	C stock $tCO_2e\ ha^{-1}$	± 95% CI $tCO_2e\ ha^{-1}$	C stock $tCO_2e\ ha^{-1}$	± 95% CI $tCO_2e\ ha^{-1}$
330.8	-	122.3	-			453.1	27.8
$tC\ ha^{-1}$	$tC\ ha^{-1}$	$tC\ ha^{-1}$	$tC\ ha^{-1}$	$tC\ ha^{-1}$	$tC\ ha^{-1}$	$tC\ ha^{-1}$	$tC\ ha^{-1}$
90.2	-	33.4	-			123.6	27.8

Cab_{icl} = Average equivalent carbon stock per hectare for the above-ground biomass reservoir for the initial forest class (tCO_2-e/ha);

Cbb_{icl} = Average equivalent carbon stock per hectare for the below-ground biomass reservoir for the initial forest class (tCO_2-e/ha);

Cdw_{icl} = equivalent carbon stock per hectare for the dead biomass reservoir for the initial forest class (tCO_2-e/ha);

$Ctot_{icl}$ = Average carbon stock per hectare for the total biomass reservoir for the initial forest class (tCO_2-e/ha).

For the baseline calculations (estimation of annual unplanned deforestation areas for the Project Area and the Leakage Belt), the maps produced of annual baseline deforestation for each future year were combined with the land use and land cover map produced for the initial situation (elaborated in step 2 of the PDD), in order to produce a set of maps showing, for each forest class, the polygons that would be deforested each year in the absence of the project activity. The number of hectares that could be deforested for each forest class was extracted from these maps and the results of the baseline projections showed a deforestation of 1,962 hectares in the Project Area between 2013 and 2019 (Table 9) and of 5,924 hectares in the Leakage Belt (Table 10).

Table 9 - Annual areas of unplanned baseline deforestation in the Project Area for the 2013-2019 monitoring period.

Area established after deforeatation per zone within the Project Area		Total baseline deforestation in the Project Area	
IDz>	1		
Name>	Zone 1	Annual	Acumulado
Project year *t*	ha	ha	ha
2013	257	257	257
2014	242	242	499
2015	286	286	785
2016	329	329	1.114
2017	370	370	1.484
2018	252	252	1.736
2019	226	226	1.962

Table 10 - Annual areas of unplanned baseline deforestation in the Leakage Belt for the 2013-2019 monitoring period.

Area established after deforeatation per zone within the Leakage Belt		Total baseline deforestation in the Leakage Belt	
IDz>	1		
Name>	Zone 1	Annual	Acumulado
Project year *t*	ha	ha	ha
2013	1.012	1.012	1.012
2014	855	855	1.867
2015	845	845	2.712
2016	965	965	3.677
2017	923	923	4.600
2018	673	673	5.273

2019	651	651	5.924

For the calculation of baseline carbon stock changes in the Project Area (Table 11) and Leakage Belt (Table 12) for year t method 1 VM0015 version 1.1, according to Equation 10 on page 72, was used. The Equation is presented below:

$$\Delta CBSLPA_t = \sum_{p=1}^{P}\left(\sum_{icl=1}^{Icl} ABSLPA_{icl,t} * \Delta Cp_{icl,t=t*} - \sum_{z=1}^{Z} ABSLPA_{z,t} * \Delta Cp_{z,t=t*} + \sum_{icl=1}^{Icl} ABSLPA_{icl,t-1} * \Delta Cp_{icl,t=t*+1} - \sum_{z=1}^{Z} ABSLPA_{z,t-1} * \Delta Cp_{z,t=t*+1} + \sum_{icl=1}^{Icl} ABSLPA_{icl,t-2} * \Delta Cp_{icl,t=t*+2} - \sum_{z=1}^{Z} ABSLPA_{z,t-2} * \Delta Cp_{z,t=t*+2} + \cdots + \sum_{icl=1}^{Icl} ABSLPA_{icl,t-19} * \Delta Cp_{icl,t=t*+19} - \sum_{z=1}^{Z} ABSLPA_{z,t-19} * \Delta Cp_{z,t=t*+19}\right) \quad (7)$$

Where:

$\Delta CBSLPA_t$: Total baseline carbon stock change within the project area at year *t* (tCO_2-e);

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

$ABSLPA_{icl,t-1}$: Area of initial forest class *icl* deforested at time *t*-1 within the project area in the baseline case (ha);

$ABSLPA_{icl,t=t-19}$: Area of initial forest class *icl* deforested at time *t*-19 within the project area in the baseline case (ha);

$\Delta Cp_{icl,t=t*}$: Average carbon stock change factor for carbon pool pin the initial forest class *icl* applicable at time *t* (as per Table 20.a) (tCO_2-e.ha^{-1});

$\Delta Cp_{icl,t=t*+19}$: Average carbon stock change factor for carbon pool pin the initial forest class *icl* applicable at time *t*=*t**+19 (20th year after deforestation, (as per Table 20.a) (tCO_2-e.ha^{-1});

$ABSLPA_{z,t}$: Area of the zone *z* "deforested" at time *t* within the project area in the baseline case (ha);

$ABSLPA_{z,t-1}$: Area of the zone *z* "deforested" at time *t*-1 within the project area in the baseline case (ha);

$ABSLPA_{z,t-19}$: Area of the zone *z* "deforested" at time *t*-19 within the project area in the baseline case (ha);

$\Delta Cp_{z,t=t*}$: Average carbon stock change factor for carbon pool pin zone *z* applicable at time *t* = *t** (as per Table 20.b) (tCO_2-e.ha^{-1});

$\Delta Cp_{z,t=t+1}$: Average carbon stock change factor for carbon pool pin zone *z* applicable at time *t* = *t**+1 ((=2nd year after deforestation, as per Table 20.b) (tCO_2-e.ha^{-1});

$\Delta Cp_{z,t=t^*+19}$: Average carbon stock change factor for carbon pool pin zone *z* applicable at time *t* = *t**+19 ((=20th year after deforestation, as per Table 20.b) (tCO_2-e.ha^{-1}).

The total emissions estimated in the baseline scenario of the Project Area for the period of 2013 and 2019 are shown in Table 11, as well as the total emissions estimated for each year. In Table 12, the same information can be found for the Leakage Belt areas.

Table 11 - Total net baseline carbon stock change in baseline scenario in the Project Area (table 21.b. VM0015).

Carbon stock changes per initial forest class *icl*		Total carbon stock change of initial forest class in the Project Area		Carbon stock changes per post-deforestation zone z		Total carbon stock change of post-deforestation zones in the Project Area		Total net carbon stock change of the Project Area	
ID_{icl}>	1	$\Delta CBSLPA_{icl,t}$	$\Delta CBSLPA_{icl}$	ID_{iz}>	1	$\Delta CBSLPA_{z,t}$	$\Delta CBSLPA_z$	$\Delta CBSLPA_t$	$\Delta CBSLPA$
Name>	Forest	annual	cumulative	Name>	Zone 1	annual	cumulative	annual	cumulative
Project Year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project Year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
2013	90,764	90,764	90,764	2013	2,875	2,875	2,875	87,889	87,889
2014	88,761	88,761	179,525	2014	4,355	4,355	7,230	84,406	172,295
2015	106,814	106,814	286,339	2015	6,105	6,105	13,335	100,710	273,005
2016	125,062	125,062	411,402	2016	8,117	8,117	21,452	116,945	389,950
2017	143,150	143,150	554,552	2017	10,380	10,380	31,832	132,770	522,720
2018	107,198	107,198	661,750	2018	11,922	11,922	43,754	95,276	617,996
2019	101,361	101,361	763,111	2019	13,304	13,304	57,059	88,057	706,052

Table 12 - Total net baseline carbon stock change in baseline scenario in the Leakage Belt area (table 21.c. VM0015).

Carbon stock changes per initial forest class *icl*		Total carbon stock change of initial forest class in the leakage belt area		Carbon stock changes per post-deforestation zone z		Total carbon stock change of post-deforestation zones in leakage belt area		Total net carbon stock change of the leakage belt area	
ID_{icl}>	1	$\Delta CBSLLK_{icl,t}$	$\Delta CBSLLK_{icl}$	ID_{iz}>	1	$\Delta CBSLLK_{z,t}$	$\Delta CBSLLK_z$	$\Delta CBSLLK_t$	$\Delta CBSLLK$
Name>	Forest	annual	cumulative	Name>	Zone 1	annual	cumulative	annual	cumulative
Project Year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project Year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
2013	360,856	360,856	360,856	2013	13,047	13,047	13,047	347,809	347,809
2014	319,377	319,377	680,233	2014	18,277	18,277	31,325	301,100	648,909
2015	326,404	326,404	1,006,637	2015	23,446	23,446	54,771	302,957	951,866

2016	377,902	377,902	1,384,539	2016	29,349	29,349	84,120	348,553	1,300,419
2017	375,296	375,296	1,759,835	2017	34,995	34,995	119,115	340,301	1,640,720
2018	300,827	300,827	2,060,662	2018	39,112	39,112	158,226	261,715	1,902,435
2019	301,511	301,511	2,362,173	2019	43,094	43,094	201,320	258,417	2,160,853

5.2 Project Emissions

5.2.1 Emissions due to planned deforestation

Emissions from planned deforestation occurred in the Project Area in 2013. Deforestation occurred as a result of the opening of areas for infrastructure for Forest Management at UPA11 (Annual Production Unit number 11), such as roads, trails and storage patios. The value of the area (hectares) opened for such infrastructure was obtained from the POA (Annual Operational Plan).

Table 13 contains the value of the carbon stock decrease due to this deforestation planned at UPA11. This value was obtained by multiplying the area of open infrastructure by the average carbon stock, as shown in the equation below:

$$\Delta CPDdPA_t = (APDPA_{icl,t} \times Ctot_{icl,t}) \quad (8)$$

Where:

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

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

$Ctot_{icl,t}$: Average carbon stock of all accounted carbon pools in forest class *icl* at time *t*.

Table 13 - Carbon stock decrease due to planned deforestation in the Project Area (Table 25.a. VM0015).

Project Year *t*	Areas of planned deforestation x Carbon stock change (decrease) in the Project Area		Total carbon stock decrease due to planned deforestation	
	ID_{cl} =	1	annual	cummulative
	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CPDdPA_t$	$\Delta CPDdPA$
	ha	$tCO_2e\ ha^{-1}$	tCO_2e	tCO_2e
2013	7.2	453.1	3,242	3,242
2014	0	0.0	0.0	3,242
2015	0	0.0	0.0	3,242

2016	0	0.0	0.0	3,242
2017	0	0.0	0.0	3,242
2018	0	0.0	0.0	3,242
2019	0	0.0	0.0	3,242

5.2.2 Emissions due to planned logging activities

There were no emissions associated with logging activities planned in the Project Area from 2013 to 2019. The logging of Sustainable Forest Management was directed to obtain long-lived logging products and, based on the fact that VM0015 considers conservative disregard these products from the calculations, all logging activities were excluded.

Table 14 - Carbon stock decrease due to planned logging activities in the Project Area (Table 25.b. VM0015).

Project Year *t*	Areas of planned logging activities x Carbon stock change (decrease) in the Project Area		Total carbon stock decreases due to planned logging activities	
	ID_{cl} =	1	annual	cummulative
	$APLPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CPLdPA_t$	$\Delta CPLdPA$
	ha	$tCO_2e\ ha^{-1}$	tCO_2e	tCO_2e
2013	0	0.0	0.0	0.0
2014	0	0.0	0.0	0.0
2015	0	0.0	0.0	0.0
2016	0	0.0	0.0	0.0
2017	0	0.0	0.0	0.0
2018	0	0.0	0.0	0.0
2019	0	0.0	0.0	0.0

5.2.3 Emissions due to planned fuel-wood and charcoal activities

There were no emissions associated with planned fuel-wood and charcoal production activities in the Project Area.

Table 15 - Carbon stock decrease due to planned fuel-wood collection and charcoal production in the Project Area (Table 25.c. VM0015).

Project Year *t*	Areas of planned fuel-wood & charcoal activities x Carbon stock change (decrease) in the project area		Total carbon stock decreases due to planned fuel-wood and charcoal activities	
	ID_{cl} =	1	annual	cummulative
	$APFPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CPFdPA_t$	$\Delta CPFdPA$
	ha	$tCO_2e\ ha^{-1}$	tCO_2e	tCO_2e
2013	0	0.0	0.0	0.0
2014	0	0.0	0.0	0.0
2015	0	0.0	0.0	0.0
2016	0	0.0	0.0	0.0
2017	0	0.0	0.0	0.0
2018	0	0.0	0.0	0.0
2019	0	0.0	0.0	0.0

5.2.4 Removals due to carbon stock increase of planned activities

Carbon stock increase due to planned activities in areas that would be deforested in the baseline case was omitted.

Table 16 - Total ex post carbon stock decrease due to planned activities in the Project Area (Table 25.d. VM0015).

Project Year t	Total carbon stock decrease due to planned deforestation		Total carbon stock decrease due to planned logging activities		Total carbon stock decrease due to planned fuel-wood and charcoal activities		Total carbon stock decrease due to planned activities	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPDdPA_t$	$\Delta CPDdPA$	$\Delta CPLdPA_t$	$\Delta CPLdPA$	$\Delta CPFdPA_t$	$\Delta CPFdPA$	$\Delta CPAdPA_t$	$\Delta CPAdPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2013	3,242	3,242	0.0	0.0	0.0	0.0	3,242	3,242
2014	0.0	3,242	0.0	0.0	0.0	0.0	0.0	3,242
2015	0.0	3,242	0.0	0.0	0.0	0.0	0.0	3,242
2016	0.0	3,242	0.0	0.0	0.0	0.0	0.0	3,242
2017	0.0	3,242	0.0	0.0	0.0	0.0	0.0	3,242

2018	0.0	3,242	0.0	0.0	0.0	0.0	0.0	3,242
2019	0.0	3,242	0.0	0.0	0.0	0.0	0.0	3,242

5.2.5 Emissions due to unavoidable unplanned deforestation

The total area of unplanned and unavoided deforestation in the Project Area was 1.65 ha, according to PRODES data. Deforestation of approximately 1.4 ha was detected in 2015, and 0.3 ha was detected in 2016, as shown in Table 17.

Table 17 - Observed annual areas deforested in each zone within the project area monitored (Table 13.b. VM0015).

Area established after deforestation per zone within the project area		Total monitored deforestation in the project area		Total baseline deforestation in the project area
IDz>	1			
Name>	Zone 1	Annual	Cumulative	$ABSLPA_t$
Project year *t*	ha	ha	ha	ha
2013	0.0	0.0	0.0	257
2014	0.0	0.0	0.0	242
2015	1.37	1.37	1.37	286
2016	0.28	0.28	1.65	329
2017	0.0	0.0	1.65	370
2018	0.0	0.0	1.65	252
2019	0.0	0.0	1.65	226

5.2.6 Total ex-post carbon stock decrease (ex-post) in the Project Area

Table 18 below presents the total carbon stock change in the project, which involves the sum of emissions associated with planned deforestation (in the case of the project, which occurred for the construction of infrastructure for Sustainable Forest Management) with that of unavoidable unplanned deforestation.

Table 18 - Total carbon stock decrease (ex-post) due to planned and unplanned activities in the Project Area.

Project Year t	Total carbon stock decrease due to planned activities	Total carbon stock increase due to planned activities	Total carbon stock decrease due to unavoidable unplanned deforestation	Total carbon stock change in the project case

	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CPAiPA_t$	$\Delta CPAiPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2013	3,242	3,242	0.0	0.0	0.01	0.01	3,242	3,242
2014	0.0	3,242	0.0	0.0	0,0	0,0	0.0	3,242
2015	0.0	3,242	0.0	0.0	460	460	460	3,702
2016	0.0	3,242	0.0	0.0	102.7	563	102.7	3,805
2017	0.0	3,242	0.0	0.0	10.1	573	10.1	3,815
2018	0.0	3,242	0.0	0.0	10.1	583	10.1	3,825
2019	0.0	3,242	0.0	0.0	10.1	593	10.1	3,835

5.2.7 Emissions due to forest fires and catastrophic events

There were no significant emissions from forest fires and/or catastrophic events in the Project Area in the monitored period.

Table 19 - Carbon Stock decrease due to forest fires in the Project Area (Table 25.e. VM0015).

Project Year *t*	Areas affected by forest fires x Carbon stock change (decrease)		Total carbon stock decrease due to forest fires	
	ID_{cl} =	1	annual	cummulative
	$AUFPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CUFdPA_t$	$\Delta CUFdPA$
	ha	$tCO_2e\ ha^{-1}$	tCO_2e	tCO_2e
2013	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0
2018	0.0	0.0	0.0	0.0
2019	0.0	0.0	0.0	0.0

Table 20 - Carbon Stock decrease due to catastrophic events in the Project Area (Table 25.f. VM0015).

Project Year *t*	Areas affected by catastrophic events x Carbon stock change (decrease)		Total carbon stock decrease due to catastrophic events	
	ID_{cl} =	1	annual	cummulative
	$ACPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CUCdPA_t$	$\Delta CUCdPA$
	ha	$tCO_2e\ ha^{-1}$	tCO_2e	tCO_2e
2013	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0
2018	0.0	0.0	0.0	0.0
2019	0.0	0.0	0.0	0.0

Table 21 - Carbon Stock decrease due to forest fires and catastrophic events (Table 25.g. VM0015).

Project Year *t*	Total carbon stock decrease due to forest fires		Total carbon stock decrease due to catastrophic events		Total carbon stock decreases due to forest fires and catastrophic events	
	annual	cummulative	annual	cummulative	annual	cummulative
	$\Delta CUFdPA_t$	$\Delta CUFdPA$	$\Delta CUCdPA_t$	$\Delta CUCdPA$	$\Delta CFCdPA_t$	$\Delta CFCdPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2013	0.0	0.0	0.0	0.0	0.0	0.0
2014	0.0	0.0	0.0	0.0	0.0	0.0
2015	0.0	0.0	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	0.0	0.0
2018	0.0	0.0	0.0	0.0	0.0	0.0
2019	0.0	0.0	0.0	0.0	0.0	0.0

5.2.8 Total net carbon stock change (ex-post) in the Project Area

The annual changes in the carbon stock (both by initial forest class and post-deforestation), as well as the resulting net change, are shown in Table 22.

Table 22 - Ex-post carbon stock change in the Project Area (Table 21.b.2. VM0015).

Carbon stock changes per initial forest class *icl*		Total carbon stock change of initial forest class in the Project Area		Carbon stock changes per post-deforestation zone z		Total carbon stock change of post-deforestation zones in the Project Area		Total net carbon stock change in the Project Area	
ID_{icl}>	1	$\Delta CBSLPA_{icl,t}$	$\Delta CBSLPA_{icl}$	ID_{iz}>	1	$\Delta CBSLPA_{z,t}$	$\Delta CBSLPA_{z}$	$\Delta CBSLPA_{t}$	$\Delta CBSLPA$
Name>	Forest	annual	cumulative	Name>	Zone 1	annual	cumulative	annual	cumulative
Project Year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project Year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
2013	0.02	0.02	0.02	2013	0.01	0.01	0.01	0.01	0.01
2014	0.0	0.0	0.0	2014	0.0	0.0	0.0	0.0	0.0
2015	469	469	469	2015	8.4	8.4	8.4	460	460
2016	112.7	112.7	581	2016	10.1	10.1	18.5	102.7	563
2017	20.1	20.1	601	2017	10.1	10.1	28.5	10.1	573
2018	20.1	20.1	622	2018	10.1	10.1	38.6	10.1	583
2019	20.1	20.1	642	2019	10.1	10.1	48.7	10.1	593

The total carbon stock change considering emissions associated with deforestation due to planned activities and emissions from forest fires and/or catastrophic events is shown in Table 23.

Table 23 - Carbon stock change in the Project Area under the Project scenario (Table 27 VM0015).

Project Year t	Total carbon stock decrease due to planned activities		Total carbon stock increase due to planned activities		Total carbon stock decrease due to fires and catastrophic events		Total carbon stock increase due to fires and catastrophic events		Total carbon stock change in the project case	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CPAiPA_t$	$\Delta CPAiPA$	$\Delta CFCdPA_t$	$\Delta CFCdPA$	$\Delta CFCiPA_t$	$\Delta CFCiPA$	$\Delta CPSPA_t$	$\Delta CPSPA$
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2013	3,242	3,242	0.0	0.0	0.0	0.0	0.0	0.0	3,242	3,242
2014	0.0	3,242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,242
2015	0.0	3,242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,242
2016	0.0	3,242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,242

2017	0.0	3,242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,242
2018	0.0	3,242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,242
2019	0.0	3,242	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,242

5.2.9 Non-CO_2 emissions from forest fires

Following the guidelines in item 6.2 of VM0015 (page 81), the non-CO_2 emissions from forest fires (use of fire to deforest forests) were omitted in the baseline scenario, being monitored in the ex-post scenario only when significant.

During the monitoring period, the monitored area did not suffer any significant and unplanned reduction in the carbon stock due to uncontrolled forest fires and/or other catastrophic events, as pointed out in Section 4.3.2 and Section 3.1.2.

Table 24 - Total ex ante estimated actual net carbon stock changes and emissions of non-CO_2 gasses in the project area (Table 29 VM0015).

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 net carbon stock change		Total ex post estimated actual non-CO2 emissions from forest fires in the project area	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CPAdPA_t$	$\Delta CPAdPA$	$\Delta CPAiPA_t$	$\Delta CPAiPA$	$\Delta CUDdPA_t$	$\Delta CUDdPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBBSLPA_t$	EBBPSPA
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2-e	tCO_2-e
2013	3,242	3,242	0.0	0.0	0.01	0.01	3,242	3,242	0.0	0.0
2014	0.0	3,242	0.0	0.0	0.0	0.0	0.0	3,242	0.0	0.0
2015	0.0	3,242	0.0	0.0	460	460	460	3,702	0.0	0.0
2016	0.0	3,242	0.0	0.0	102.7	563	102.7	3,805	0.0	0.0
2017	0.0	3,242	0.0	0.0	10.1	573	10.1	3,815	0.0	0.0
2018	0.0	3,242	0.0	0.0	10.1	583	10.1	3,825	0.0	0.0
2019	0.0	3,242	0.0	0.0	10.1	593	10.1	3,835	0.0	0.0

5.3 Leakage

As defined in the VCS VM0015 methodology, deforestation detected above the baseline in the Leakage Belt area is considered to be leakage by displacement. Thus, the possible leakage associated with the displacement activity was monitored during this period of the project. This monitoring was carried out by mapping forest cover change in the Leakage Belt and the methodology involved was the same applied in the mapping of deforestation in the Project Area.

5.3.1 Total ex-post carbon stock decrease in the Leakage Belt

During the monitored period, total deforestation in the Leakage Belt was 310,3 ha, according to PRODES 2019 data. The areas identified as deforestation in each of the monitored years (2013 to 2019), as well as the values forecast in the baseline, are shown in Table 25.

Table 25 - Annual areas deforested in each zone within the leakage belt monitored (Table 13.c. VM0015).

Area establiseh after deforestation per zone within the leakage belt		Total monitored deforestation in the leakage belt		Total baseline deforestation in the leakage belt
IDz>	1			
Name>	Zone 1	Annual	Cumulative	$ABSLLK_t$
Project year *t*	ha	ha	ha	ha
2013	0.1	0.1	0.1	1,012
2014	0.0	0.0	0.1	855
2015	7.6	7.6	7.8	845
2016	12.1	12.1	19.9	965
2017	82.6	82.6	102.4	923
2018	138.9	138.9	241.3	673
2019	68.9	68.9	310.3	651

The annual carbon stock change in the Leakage Belt was calculated using equation 6, presented in Section 4.3 - Monitoring Plan.

The results for these annual changes in the carbon stock in the Leakage Belt, both by initial forest class and after deforestation, as well as the resulting net change, are shown in Table 26.

Table 26 - Ex-post Baseline carbon stock change in the leakage belt area (Table 21.c.2. of VCS VM0015).

Carbon stock changes per initial forest class *icl*		Total carbon stock change of initial forest class in the leakage belt area		Carbon stock changes per post-deforestation zone z		Total carbon stock change of post-deforestation zones in leakage belt area		Total net carbon stock change of the leakage belt area	
ID_{icl}>	1	$\Delta CBSLLK_{icl,t}$	$\Delta CBSLLK_{icl}$	ID_{iz}>	1	$\Delta CBSLLK_{z,t}$	$\Delta CBSLLK_z$	$\Delta CBSLLK_t$	$\Delta CBSLLK$
Name>	Forest	annual	cumulative	Name>	Zone 1	annual	cumulative	annual	cumulative
	tCO_2-e	tCO_2-e	tCO_2-e		tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e

Project Year *t*				Project Year *t*					
2013	66	66	66	2013	13	13	13	53	53
2014	26	26	92	2014	13	13	26	13	66
2015	2,645	2,645	2.738	2015	60	60	86	2,586	3,652
2016	4,270	4,270	7,007	2016	134	134	220	4,136	6,788
2017	28,588	28,588	35,596	2017	639	639	858	27,950	34,737
2018	48,924	48,924	84,520	2018	1,488	1,488	2,347	47,436	82,173
2019	26,627	26,627	111,146	2019	1,910	1,910	4,257	24,717	106,889

5.3.2 Total ex-post estimated leakage

The ex-post total carbon stock change in the Leakage Belt due to displacement activities in this monitored period are shown in Table 27. The leakage was calculated by the difference between the ex-post and ex-ante analyzes.

The value of changes in the carbon stock in the monitoring period from 2013 to 2019 were less than zero (<0). Thus, the ex-post leak was defined as zero in those years, as recommended by item 1.2 - Leak Monitoring, of VCS VM0015.

Table 27 - Total net ex ante and ex post baseline carbon stock change in the Leakage Belt.

Project Year *t*	Total net carbon stock change of the leakage belt area (baseline)		Total net carbon stock change of the leakage belt area		Total ex-post Leakage	
	$\Delta CBSLLK_t$	$\Delta CBSLLK$	$\Delta CBSLLK_t$	$\Delta CBSLLK$	$\Delta CBSLLKt$	$\Delta CBSLLK$
	annual	cumulative	annual	cumulative	annual	cumulative
	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
2013	347,809	347,809	53	53	0.0	0.0
2014	301,100	648,909	13	66	0.0	0.0
2015	302,957	951,866	2,586	3,652	0.0	0.0
2016	348,553	1,300,419	4,136	6,788	0.0	0.0
2017	340,301	1,640,720	27,950	34,737	0.0	0.0
2018	261,715	1,902,435	47,436	82,173	0.0	0.0
2019	258,417	2,160,853	24,717	106,889	0.0	0.0

5.4 Net GHG Emission Reductions and Removals

The reduction in anthropogenic GHG emissions was calculated according to equations 19, 20 and 21 of VCS VM0015 version 1.1, presented below. The risk factor used to calculate the VCS buffer credits (VBC)

was 17%, as calculated in the Non-Permanence Risk Report. The calculated ex-post GHG emissions reductions are presented in Table 28.

$$\Delta REDD_t = (\Delta CBSLPA_t + EBBBSLPA_t) - (\Delta CPSPA_t + EBBPSPA_t) - (\Delta CLK_t + ELK_t) \quad (9)$$

Where:

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

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

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

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

$EBBPSPA_t$: Sum of ex post actual emissions from biomass burning in the project area at year *t* (tCO_2e);

ΔCLK_t: Sum of ex post leakage net carbon stock changes at year *t* (tCO_2e);

ELK_t: Sum of ex post leakage emissions at year t (tCO_2e);

t: 1, 2, 3 … T, a year of the proposed project crediting period (dimensionless).

$$VCU_t = \Delta REDD_t - VCB_t \quad (10)$$

$$VBC_t = (\Delta CBSLPA_t - \Delta CPSPA_t) \times RF_t \quad (11)$$

Where:

VCU_t: Number of Verified Carbon Units that can be traded at time *t* (tCO_2e);

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

VBC_t: Number of Buffer Credits deposited in the VCS Buffer at time *t* (t CO_2-e);

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

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

RF_t: Risk factor used to calculate VCS buffer credits (%);

t: 1, 2, 3 … T, a year of the proposed project crediting period (dimensionless).

Table 28 - Ex post estimated net anthropogenic GHG emission reductions ($\Delta REDD_t$) and Verified Carbon Units (VCU_t) (Table 36 VM0015).

Project Year t	Baseline carbon stock changes		Ex post project carbon stock changes		Ex post leakage carbon stock changes		Ex post net anthropogenic GHG emission reductions		Ex post buffer credits		Ex post VCUs tradable	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CBSLPA_t$	$\Delta CBSLPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	ΔCLK_t	ΔCLK	$\Delta REDD_t$	$\Delta REDD$	VCB_t	VCB	VCU_t	VCU
	tCO_2-e	tCO_2-e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2013	87,889	87,889	3,242	3,242	0.0	0.0	84,647	84,647	14,390	14,390	70,257	70,257
2014	84,406	172,295	0	3,242	0.0	0.0	84,406	169,053	14,349	28,739	70,057	140,314
2015	100,710	273,005	460	3,702	0.0	0.0	100,249	269,302	17,042	45,781	83,207	223,521
2016	116,945	389,950	103	3,805	0.0	0.0	116,843	386,145	19,863	65,645	96,979	320,500
2017	132,770	522,720	10	3,815	0.0	0.0	132,760	518,905	22,569	88,214	110,191	430,691
2018	95,276	617,996	10	3,825	0.0	0.0	95,266	614,171	16,195	104,409	79,071	509,762
2019	88,057	706,052	10	3,835	0.0	0.0	88,047	702,217	14,968	119,377	73,079	582,840

REFERENCES

CÂMARA, G.; VALERIANO, D. M.; SOARES, J. V. Metodologia para o cálculo da taxa anual de desmatamento na Amazônia Legal. **INPE**, São José dos Campos, 2006. 24p.

CONGALTON, R. G.; GREEN, K. **Assessing the accuracy of remotely sensed data: Principles and practices.** 2. ed. CRC Press, 2008. 183 p. ISBN 78-1-4200-5512-2.

INPE – INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS. **PRODES – Amazônia: Monitoramento do Desmatamento da Floresta Amazônica Brasileira por Satélite.** Available in: <www.obt.inpe.br/prodes>. Access in: 3 ago. 2020.

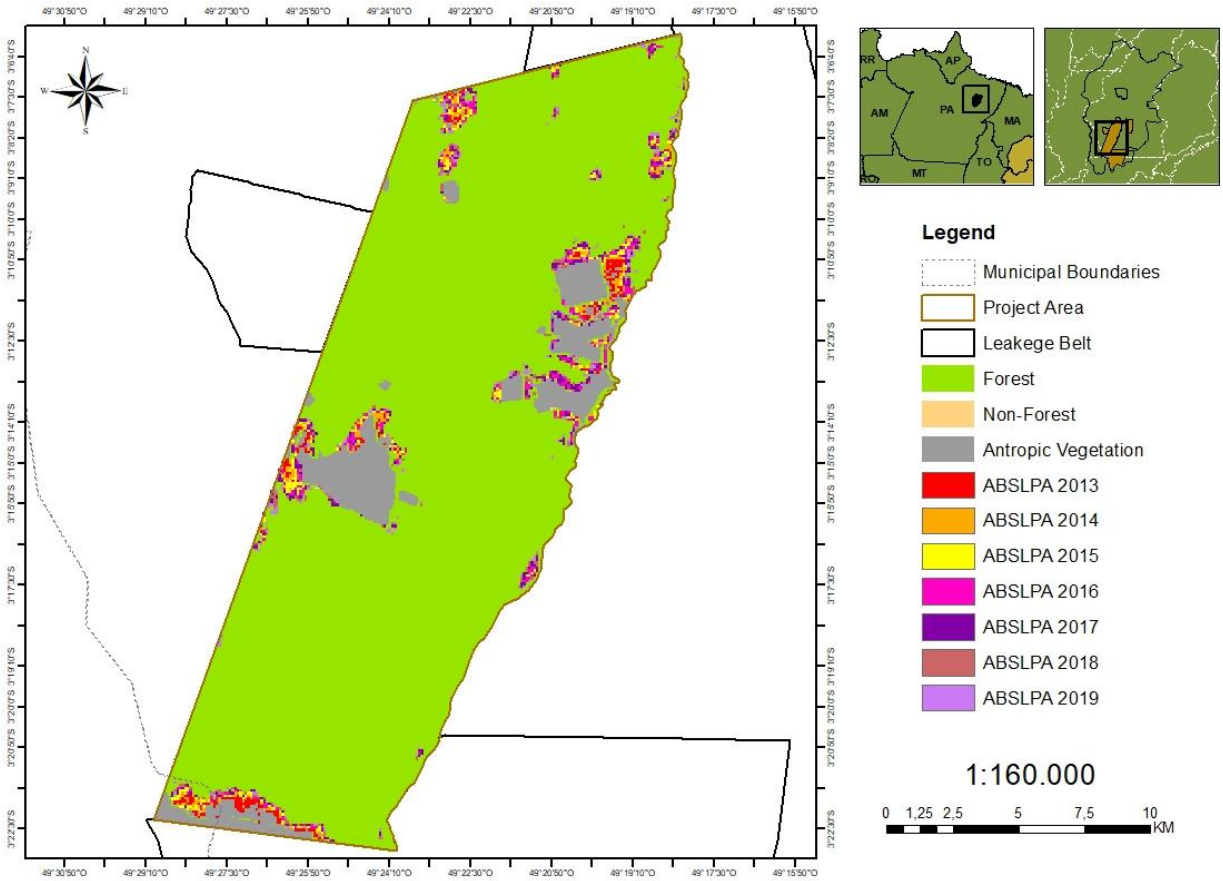
MEDEIROS, A. **Como Calcular NDVI no QGIS**. In: MEDEIROS, Anderson. Como Calcular NDVI no QGIS. ClickGeo, s.a. Available in: http://www.clickgeo.com.br/qgis-fazer-ndvi/. Access in: 14 ago. 2020.

NOGUEIRA, E. et al., 2008. Estimates of forest biomass in the Brazilian Amazon: New allometric equation and adjustments to biomass from wood volume inventories. **Forest Ecology and Management**, 256 (11), pp.1853-1867.

SILVA, R. (2007). **Alometria, estoque e dinâmica da biomassa de florestas primárias e secundárias na região de Manaus (AM)**. Manaus - AM: Tese de Doutorado. Instituto Nacional de Pesquisas da Amazônia – INPA.

SCHROEDER, W. et al. **The Spatial Distribution and Interannual Variability of Fire in Amazonia**. Amazonia and Global Change, v. 186, p. 43-60, 2009.

APPENDIX: CUMULATIVE AREAS CREDITED WITHIN THE PROJECT AREA



Digital files used for the mapping (satellite images, shapefiles and GPS points) were presented to verification team as evidence of monitoring land-use and land-cover within the Project Area and Leakage Belt area.