AGROPALMA REDD+ PROJECT

Document prepared by Biofílica Ambipar Environmental Investments

Project Title	*Agropalma REDD+ Project*
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Project Location	*Pará, Brazil*
Project Proponent(s)	*Biofílica Ambipar Environmental Investments - Plinio Ribeiro (Chief Executive Officer), +55 11 3073-043/ e-mail: plinio@biofilica.com.br* *Agropalma – Túlio Dias (Sustainability Director), +55 11 2505-6401/ e-mail: tuliodias@agropalma.com.br*
Prepared By	*Biofílica Ambipar Environmental Investments*

Validation Body	*EPIC Sustainability Services Private Limited – R.B. Venkataramanaiah (Director), +91 95909 29936/e-mail: operations@epicsustainability.com*
Project Lifetime	*August 04, 2021 through August 03, 2051 – 30 years.*
GHG Accounting Period	*August 04, 2021 through August 03, 2051 – 30 years.*
History of CCB Status	*First validation attempt*
Gold Level Criteria	*GL3 Gold Level – Exceptional Benefits to Biodiversity.*
Expected Verification Schedule	*First Verification in CCBS every three years after validation/verification;* *VCS checks are expected every three years.*

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1 SUMMARY OF PROJECT BENEFITS

1.1 Unique Project Benefits

The results or summary impacts of expected benefits in the Agropalma REDD+ Project are reported in Summary of Project Benefits described in the Table 1, below.

Table 1 - Summary of the expected benefits in the Agropalma REDD+ Project.

Outcome or Impact Estimated by the End of Project Lifetime	Section Reference
1) Expected benefits for the Climate: with the Agropalma REDD+ Project, it is expected that after its life cycle, based on the first baseline defined for the Project, it will help mitigate climate change with a total avoided emission of 6,717,438 tCO2eq. The avoided deforestation in the scenario with the Project is 13,951 hectares during the Project life cycle and an average of 671,744 tCO2eq of reduced emissions.	3
2) The benefits for the communities located around the Project Area and other stakeholder's actors will be focused on aspects of promoting regional socioeconomic development through alternative practices to deforestation and the development and strengthening of value chains, with sustainable practices and the articulation of ways to educate people, environmentally speaking, about issues related to hunting and fishing. Therefore, we intend to influence the social issues and the living conditions of the communities surrounding the Project area, reducing social vulnerability and rural exodus, generating value in the adaptation to climate change, increasing the level of socioeconomic conditions and the quality of life of families, and helping to obtain partnerships to help aggregate the generation of goods and services that promote economic and social well-being.	4
3) Expected benefits for Biodiversity: the REDD+ Agropalma Project provides for the maintenance of fauna and flora in the Project Area, ensuring the protection and conservation of habitats and local biodiversity, including endemic species and those with some degree of threat according to the IUCN RedList. In addition, the Project Area is located in the Belém Endemism Center (CEB), a region with a high concentration of rare and endemic species.	5

1.2 Standardized Benefit Metrics

Shown below are various metrics for estimating the net benefit that the Agropalma REDD+ Project aims to achieve during the Project lifetime (Table 2).

Table 2 - Estimated net benefit for different metrics over the lifetime of the Agropalma REDD+ Project.

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
GHG emission reductions or removals	Net estimated emission removals in the project area, measured against the without-project scenario	Not applicable	-
	Net estimated emission reductions in the project area, measured against the without-project scenario	6,717,438 tCO2eq	3
Forest[1] cover	For REDD[2] projects: Estimated number of hectares of reduced forest loss in the project area measured against the without-project scenario	13,951 hectares	3
	For ARR[3] projects: Estimated number of hectares of forest cover increased in the project area measured against the without-project scenario	Not applicable	-
Improved land management	Number of hectares of existing production forest land in which IFM[4] practices are expected to occurred as a result of project activities, measured against the without-project scenario	Not applicable	-
	Number of hectares of non-forest land in which improved land management practices are expected	Not applicable	-

[1] Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (*VCS Program Definitions*)

[2] Reduced emissions from deforestation and forest degradation (REDD) - Activities that reduce GHG emissions by slowing or stopping conversion of forests to non-forest land and/or reduce the degradation of forest land where forest biomass is lost (*VCS Program Definitions*)

[3] Afforestation, reforestation and revegetation (ARR) - Activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (*VCS Program Definitions*)

[4] Improved forest management (IFM) - Activities that change forest management practices and increase carbon stock on forest lands managed for wood products such as saw timber, pulpwood and fuelwood (*VCS Program Definitions*)

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
	to occurred as a result of project activities, measured against the without-project scenario		
Training	Total number of community members who are expected to have improved skills and/or knowledge resulting from training provided as part of project activities	Potential 27,632 residents and 23 communities	4
	Number of female community members who are expected to have improved skills and/or knowledge resulting from training as part of project activities	To be mapped	4
Employment	Total number of people expected to be employed in project activities,[5] expressed as number of full-time employees[6]	To be defined	4
	Number of women expected to be employed as a result of project activities, expressed as number of full-time employees	To be defined	4
Livelihoods	Total number of people expected to have improved livelihoods[7] or income generated as a result of project activities	Potential 27,632 residents and 23 communities	4
	Number of women expected to have improved livelihoods or income generated as a result of project activities	To be mapped	4
Health	Total number of people for whom health services are expected to improve as a result of project activities, measured against the without-project scenario	Potential 27,632 residents and 23 communities	4

[5] Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers and community members that are paid to carry out project-related work.

[6] Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region or economic territory (adapted from the UN System of National Accounts (1993) paragraphs 17.14[15.102];[17.28])

[7] Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
	Number of women for whom health services are expected to improve as a result of project activities, measured against the without-project scenario	To be mapped	4
Education	Total number of people for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario	Potential 27,632 residents and 23 communities	4
	Number of women and girls for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario	To be mapped	4
Water	Total number of people who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	Not applicable	-
	Number of women who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	Not applicable	-
Well-being	Total number of community members whose well-being[8] is expected to improve as a result of project activities	Potential 27,632 residents and 23 communities	4
	Number of women whose well-being is expected to improve as a result of project activities	To be mapped	4
Biodiversity conservation	Expected change in the number of hectares managed significantly better by the project for biodiversity conservation,[9] measured against the without-project scenario	50,519 hectares	5

[8] Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g. Training, Employment, Livelihoods, Health, Education and Water), and may also include other benefits such as strengthened legal rights to resources, increased food security, conservation of access to areas of cultural significance, etc.

[9] Managed for biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation, e.g. enhancing the status of endangered species

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
	Expected number of globally Critically Endangered or Endangered species[10] benefiting from reduced threats as a result of project activities,[11] measured against the without-project scenario	6 species	5

[10] Per IUCN's Red List of Threatened Species
[11] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit

2 GENERAL

2.1 Project Goals, Design and Long-Term Viability

2.1.1 Summary Description of the Project (G1.2)

The Agropalma REDD+ Project is a partnership between Biofílica Ambipar Environmental and Agropalma Group and its purpose is to promote forest conservation, maintenance of carbon stocks and mitigation of climate change through the reduction of Greenhouse Gas (GHG) emissions from land use change. In addition to the climate benefits, the Project also intends to generate social benefits based on sustainable economic development practices and improved well-being of the surrounding communities, as well as environmental benefits through actions aimed at the conservation of local flora and fauna.

The Project area covers 50,519 hectares of Amazon forest and is located almost entirely in the northeastern mesoregion of Pará State, including the municipalities of Tailândia, Moju, Tomé Açu and Acará. It is located near the PA-150, an important highway for the distribution of the state's agricultural production, and on the banks of the Acará River. We identified communities that are directly or indirectly influenced by the Project, either because they supply labor to Fazenda Agropalma or because they are geographically close to the Project Area and depend on its ecosystem services.

The region has great relevance in relation to its biodiversity, since it is located in the Belém Center of Endemism (CEB), a place with a large concentration of rare and endemic species. The predominant vegetation is Dense Ombrophylous Forest with a high density of medium and large trees, besides woody lianas and epiphytes. It is home to at least 28 species of fauna and flora with some degree of threat according to the IUCN Red List, some of which are endemic to the region.

It was identified that the main agents of deforestation and forest degradation in the region are small, medium-sized family farmers or even large landowners. They are mostly rural producers who own areas in agrarian reform settlements, squatters, and land grabbers who are in areas not yet recognized by the agrarian reform or officially registered in the responsible public agencies and practice deforestation to expand areas of agricultural and livestock production with low productivity or to search for raw material to sustain the illegal trade in wood.

Based on this context, the Project's activities were designed to guarantee the conservation and protection of biodiversity and natural resources, through mitigating and preventive measures such as the strengthening of patrimonial vigilance, social inclusion and regional socioeconomic development through alternative practices to deforestation, and the development and strengthening of value chains, the establishment of a biodiversity conservation program, promoting in situ monitoring of the fauna and flora in the Project Area, in addition to environmental education as a strategy to discourage predatory hunting and

fishing, and the strengthening of local governance, mainly through the engagement and involvement of stakeholders.

Thus, the Agropalma REDD+ Project expects to improve the welfare of communities and generate exceptional benefits for local biodiversity, in addition to the climate impact by reducing 6,717,438 tCO2 of GHG emissions in 10 years, equivalent to an average annual reduction of 671,743.8 tCO2.

2.1.2 Project Scale

Project Scale	
Project	
Large project	X

2.1.3 Project Proponent (G1.1)

Organization name	Biofílica Ambipar Environmental Investments S.A.
Contact person	Plínio Ribeiro
Title	Chief Executive Officer (CEO)
Address	Rua Vieira de Morais, 420 – Suite 43/44 – Campo Belo ZIP 04617-000, São Paulo/SP, Brazil
Telephone	+55 11 3073-0430
Email	plinio@biofilica.com.br

Organization name	Agropalma S.A.
Contact person	Túlio Dias
Title	Sustainability Director
Address	Rodovia PA 150, KM 74, Direito -Tailândia/PA, Brazil
Telephone	+55 11 2505-6401
Email	tuliodias@agropalma.com.br

2.1.4 Other Entities Involved in the Project

Organization name	Biodendro Consultoria Florestal LTDA
Contact person	Eduardo Gusson
Title	Project Coordinator
Address	Av. Antônia Pazinato Sturion, nº 357, Jd. Petrópolis, Piracicaba/SP, Brazil
Telephone	+55 (19) 9 9629-1020
Email	eduardo.gusson@biodendro.com.br

Organization name	Instituto Peabiru
Contact person	João Carlos Souza Meirelles de Filho
Title	General Director
Address	Rua Ó de Almeida, nº 1083, Reduto, Zip Code 66.053-190, Belém/PA, Brazil
Telephone	+55 (91) 3222-6000
Email	jmeirelles@peabiru.org.br

Organization name	Ambiens Soluções Ambientais
Contact person	Fernando Gaspari
Title	Project Director
Address	Rua Presidente Antônio Cândido, 152 - Zip Code: 05083-060 - Lapa - São Paulo/SP, Brazil
Telephone	+55 (11) 3831-5736
Email	fernando@ambiens.com.br

2.1.5 Physical Parameters (G1.3)

Agropalma REDD+ Project is located almost entirely in the mesoregion of Northeast Pará, covering the municipalities of Tailândia, Moju, Tomé Açu and Acará. It is close to PA-150, an important highway for the

flow of agricultural production in the state, and the banks of Acará River, which has its most important sources in Tailândia and Tomé Açu and flows into Belém/PA. The Project Area is located between parallels 2°10'S and 2°45'S, meridians 49°00'W and 48°25'W *(*

Figure 1).

Access to the location of the Project as follows:

- By land: access via Belém – PA, via PA-483/BR-155 to PA-252, and then following PA-150 to km 74, on the left side, in the municipality of Tailândia – PA, a trip of approximately 4 hours.

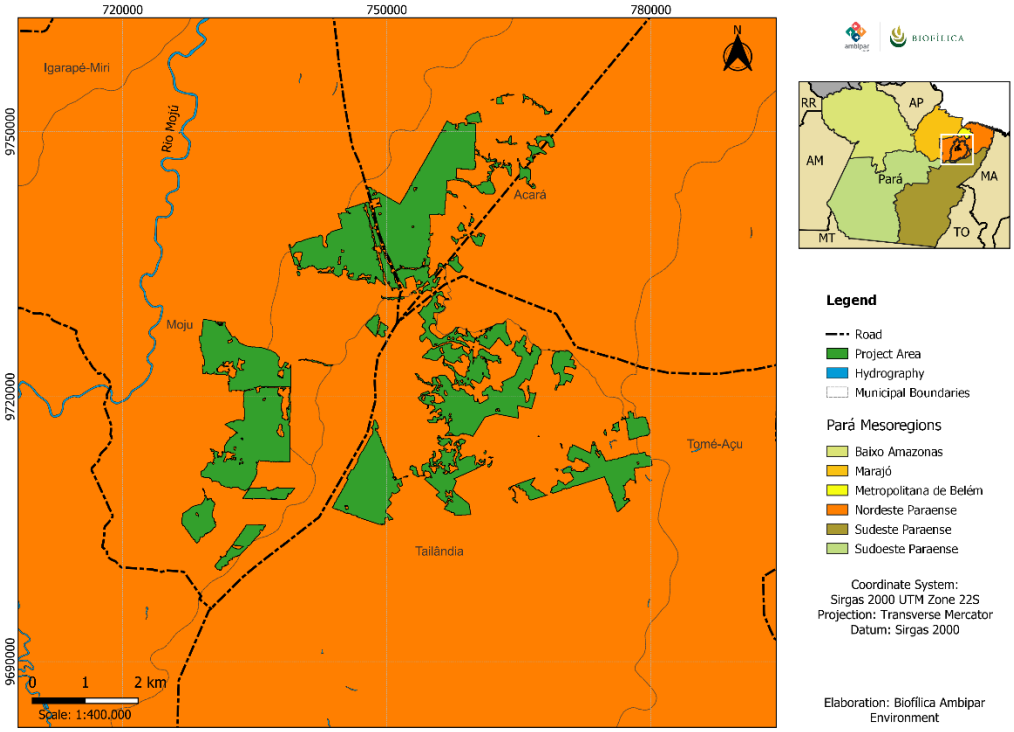

Figure 1 - Location of Agropalma REDD+ Project Area.

The geological, geomorphological, pedological, climatic and hydrological parameters were evaluated for the Project Area. For description of vegetation, the Reference Region was also considered, as shown below:

Geological Aspects

According to the Geological Map of the State of Pará(Vasquez and Rosa-Costa, 2008)[12], the Project Area is composed of the following formations: Barreiras Formation and Ipixuna Formation.

Barreiras Formation is deposited practically along the entire Brazilian coast due to continental tectonic forces and tertiary and quaternary climatic pulses (Nunes, 2011)[13]. In general, the sediments that make up this formation are predominantly sandy, poorly selected, with low textural and mineralogical maturity, suggesting that the transport was short and torrential.

According to (Góes, 1981)[14], the Barreiras Formation predominantly does not have structures, with some horizontal bedding in clays and cross and horizontal bedding in friable sands being present in a restricted way. On the laterization, ferruginous concretions and ferruginous sandstones are observed, with levels of ferruginous detrital concretions and fragments of ferruginous sandstone.

Regarding the Ipixuna Formation, it comprises kaolinic claystone sandstones and fine to coarse sandstones, originated in fluvial-lacustrine and estuarine environments, containing deposits of bauxite and kaolin. In Pará, this formation is exposed in the region of Capim river, on the east bank of Cametá Sub-basin, in the Marajó Graben System (Vasquez and Rosa-Costa, 2008).

Geomorphological Aspects

In the Project Area, the geomorphology is that of *Tabuleiros Paraenses*, which is characterized by altitudes varying between 30 and 70 m, with higher elevations in the southern region, which emerges in an area of low Amazonian plateau (Silva, 2012)[15]. These characteristics are located in the Domain of Sedimentary Basins and Unconsolidated Coverages, which means that, in the past, it was a deposition area (IBGE, 2008)[16].

In this type of formation, relief forms of tubular tops are observed, forming features of inclined ramps and spines, carved in sedimentary rocks. In general, there are shallow valleys, with ridges of low to medium slope – which are a consequence of the dissection process over flattening surfaces (IBGE, 2008).

[12] Vasquez, M.L., Rosa-Costa, L.T. da, 2008. Geologia e recursos minerais do estado do Pará.
[13] Nunes, F.C., 2011. Características, Gênese e Evidências de Neotectonismo 30.
[14] Góes, A.M., 1981. Estudo sedimentológico dos sedimentos Barreiras, Ipixuna e Itapecuru no nordeste do Pará e noroeste do Maranhão.
[15] Silva, A.K. de O., 2012. AB'SÁBER, AZIZ NACIB. OS DOMÍNIOS DE NATUREZA NO BRASIL: POTENCIALIDADES PAISAGÍSTICAS. SÃO PAULO: ATELIÊ EDITORIAL, 2003. Rev. Geogr. 29, 252–258.
[16] IBGE, 2008. Estado do Pará - Geomorfologia. URL https://www.ibge.gov.br/geociencias/informacoes-ambientais/geomorfologia/16028-geomorfologia-do-estado-de-ro-rr-to-ac-am-ma-mt-e-pa.html?=&t=acesso-ao-produto (accessed 12.22.22).

Pedological Aspects

The Project Area pedology is composed mainly of dystrophic yellow oxisol and ferri-humiluvic spodosol. The presence of neosols is also relevant in the vicinity of watercourses, due to the alluvial origin associated with Quaternary sediments.

Dystrophic yellow oxisols are commonly observed in the Barreiras Formation. These are soils developed from clayey or sandy-clayey materials, and meet the color requirements defined by the Brazilian Soil Classification System – SiBCS. In general, they have high cohesion, good physical conditions for moisture retention and good permeability. Because they are dystrophic, they have low fertility (Santos et al., 2021)[17].

In relation to the ferri-humiluvic spodosol, the presence of well-defined horizons is observed, differentiated mainly by color. Chemically, there is loss of aluminum compounds with or without iron in the presence of acidic humus and, along the depth of the profile, the accumulation of these compounds is observed, influencing the color. Also, it is worth remembering that they are characterized by low pH, with saturation by low bases. Textureally, they present greater presence of medium to coarse soils (predominantly sandy) (Zaroni and Santos, 2021)[18].

Climatic Aspects

According to the most universally used climate classification, proposed by Köppen, the state of Pará presents the predominant classes Af, Am and Aw. These refer to tropical rainy climate, ranging from always humid (without a dry season) to occurrences of summer rains (savannah climate – tropical with a dry season), also passing through a tropical monsoon climate.(Andrade et al., 2017). As far as the Project Area is concerned, it is located in an Af climate region, that is, tropical without a dry season.

When it comes to climatology, rainfall is also a fundamental element, since the intensity, frequency and duration of rain are decisive in the balance of systems .(Andrade et al., 2017)[19].

[17] Santos, H., Zaroni, M.J., Almeida, E., 2021. Latossolos Amarelos - Portal Embrapa. URL https://www.embrapa.br/agencia-de-informacao-tecnologica/tematicas/solos-tropicais/sibcs/chave-do-sibcs/latossolos/latossolos-amarelos (accessed 12.22.22).

[18] Zaroni, M.J., Santos, H., 2021. Espodossolos - Portal Embrapa. URL https://www.embrapa.br/agencia-de-informacao-tecnologica/tematicas/solos-tropicais/sibcs/chave-do-sibcs/espodossolos (accessed 12.22.22).

[19] Andrade, V., Cordeiro, I., Schwartz, G., Rangel-Vasconcelos, L., Oliveira, F., 2017. Nordeste Paraense: panorama geral e uso sustentável das florestas secundárias. [WWW Document]. URL https://www.embrapa.br/busca-de-publicacoes/-/publicacao/1073621/nordeste-paraense-panorama-geral-e-uso-sustentavel-das-florestas-secundarias (accessed 12.5.22).

Considering the 40-year historical series of climate data (1982 to 2021), Fazenda Urucure meteorological station (code: 248001), closer to the Project Area, registered average annual rainfall of 2,470.8 mm in the period (Figure 2).

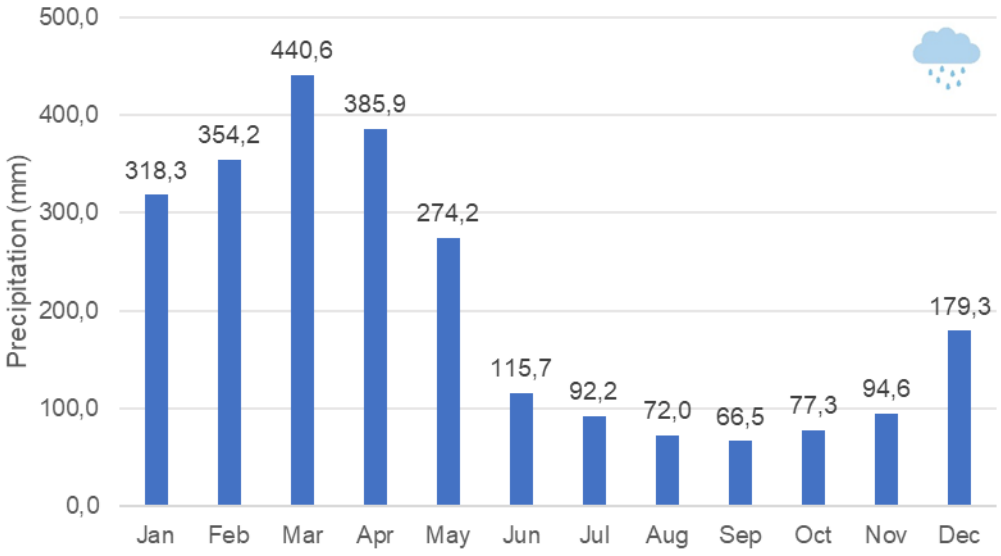

Figure 2 - Monthly accumulated rainfall from Fazenda Urucure meteorological station - PA - historical series from 1982 to 2021.

For the historical series analyzed, the months from January to May, with the highest volume of rainfall, are identified as the rainy season. The months with the lowest volume of rainfall, that is, June to December, present values between 50 and 150 mm, indicating that the always humid climate is predominant in the Project Area.

The daily rainfall data in the historical series of Fazenda Urucure meteorological station, presented in Figure 3, indicate that there are several events that concentrate rainfall greater than 100 mm, corresponding to a rainy month, in a single day. This corroborates with the natural tendency of the region to these extreme weather events.

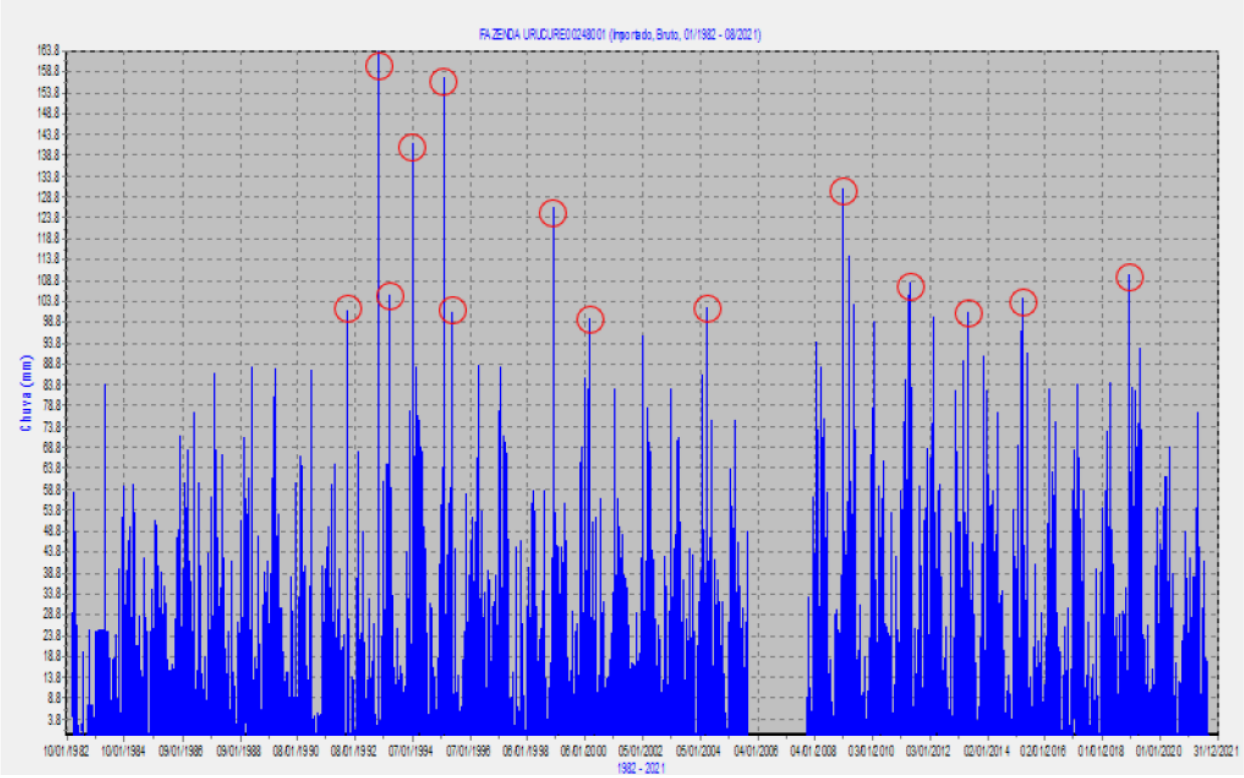

Figure 3 - Chart of daily rainfall in the historical series.

Hydrological Aspects

The Project Area is inserted in the Tocantins-Araguaia Basin (Figure 4), which stands out for being the largest hydrographic region in the country with a drainage area located entirely within the national territory, and the second largest in terms of area and flow, second only to the Amazon (ANA, 2009)[20].

The hydrography of the state is basically governed by the rivers of the Amazon Basin, the main tributaries being the Tapajós, Xingu, Curuá, Trombetas and Nhamundá. Within the Project Area, it is possible to observe the following rivers, with their respective lengths: Igarapé Turi-Muri, to the north, with approximately 11 km; Ucuré River, to the east, with about 12 km and an average width of 15 m; Acará River, in the central-eastern region, with approximately 71 km and an average width of 30 m; Igarapé Turi-Açú River, in the

[20] ANA, 2009. Plano da Bacia Hidrográfica do Rio Tocantins e Araguaia. URL https://www.to.gov.br/semarh/plano-da-bacia-hidrografica-do-rio-tocantins-e-araguaia/13qdka1qq2w5 (accessed 12.6.22).

center-west, with about 28 km and an average width of 10 m; and Igarapé Água Clara River, to the southwest, with approximately 12 km and an average width of 10 m.

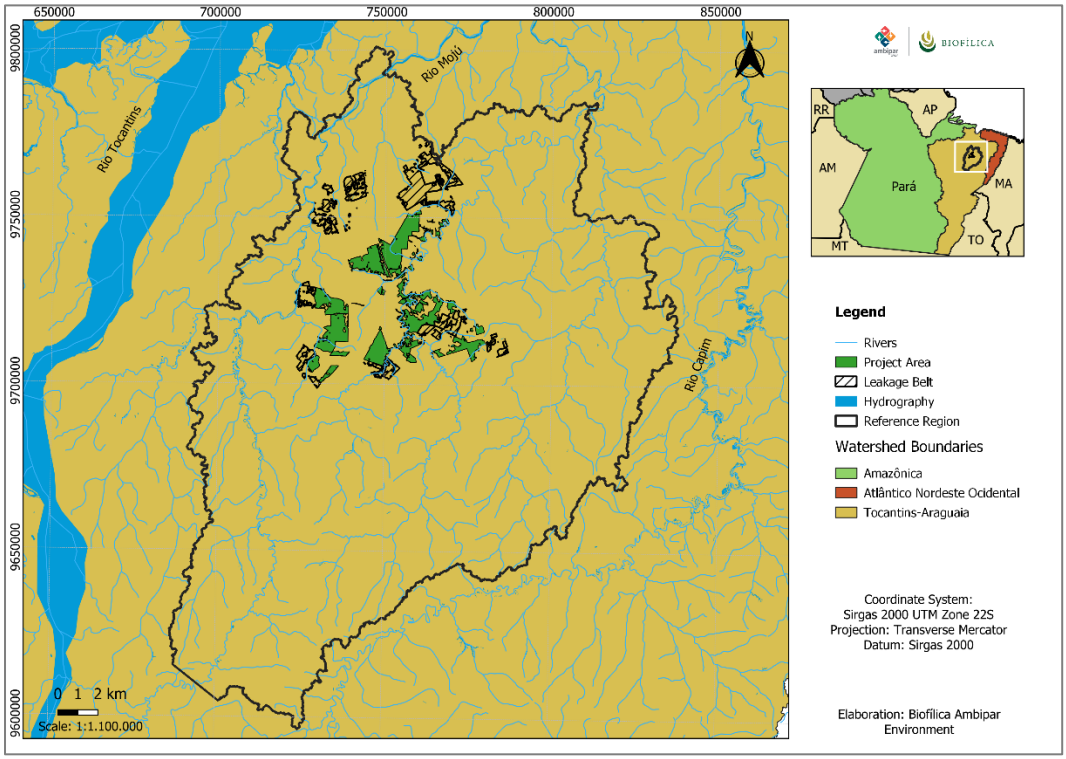

Figure 4 - Map highlighting the watersheds and main rivers found in the Project Area.

Vegetation

The Project Area and the Reference Region are fully inserted in the Amazon biome. This biome is made up of a vast number of distinct vegetation formations, where floodplain forests, *igapó* forests, *campinaranas*, savannahs (*cerrados*) and even herbaceous formations, typical of rural areas, are intermingled with the predominant firm eath formations (Braga et al., 2011)[21].

According to the IBGE database, updated in 2021 and produced at the scale of 1:250,000, the predominant native vegetation in the Reference Region (Figure 5) is the Dense Ombrophylous Forest of the Lowlands (mainland), which occurs interspersed with secondary vegetation or other land uses (agriculture and pastures), in some cases concentrating its part most preserved without secondary activities in the

[21] Braga, P., Silva, S., Braga, J., Nascimento, K., Rabelo, S., 2011. A VEGETAÇÃO DAS COMUNIDADES DA ÁREA DE INFLUÊNCIA DO PROJETO PIATAM E DO GASODUTO COARI-MANAUS, 2. ed. rev. ed. Reggo Edições, Manaus.

southwest region, totaling 1,069,489.55 ha (59.29% of the total area of the Reference Region). Next, there is the Auvial Dense Ombrophylous Forest, with 25,582.17 ha (1.42%); the Submontane Dense Ombrophylous Forest, with 3,495.96 ha (0.09%) and the Grass-Woody *Campinarana*, with 2,049.61 ha (0.11%). The other areas of the Reference Region are covered by other land use and land cover classes, classified as Dominant Anthropic Area, which total 698.661,68 ha (38.73%).

In the Project Area there is also a predominance of the Dense Ombrophylous Forest of the Lowlands (mainland) interspersed with secondary vegetation (Figure 5), with 50,519.00 ha (100% of the Project Area)

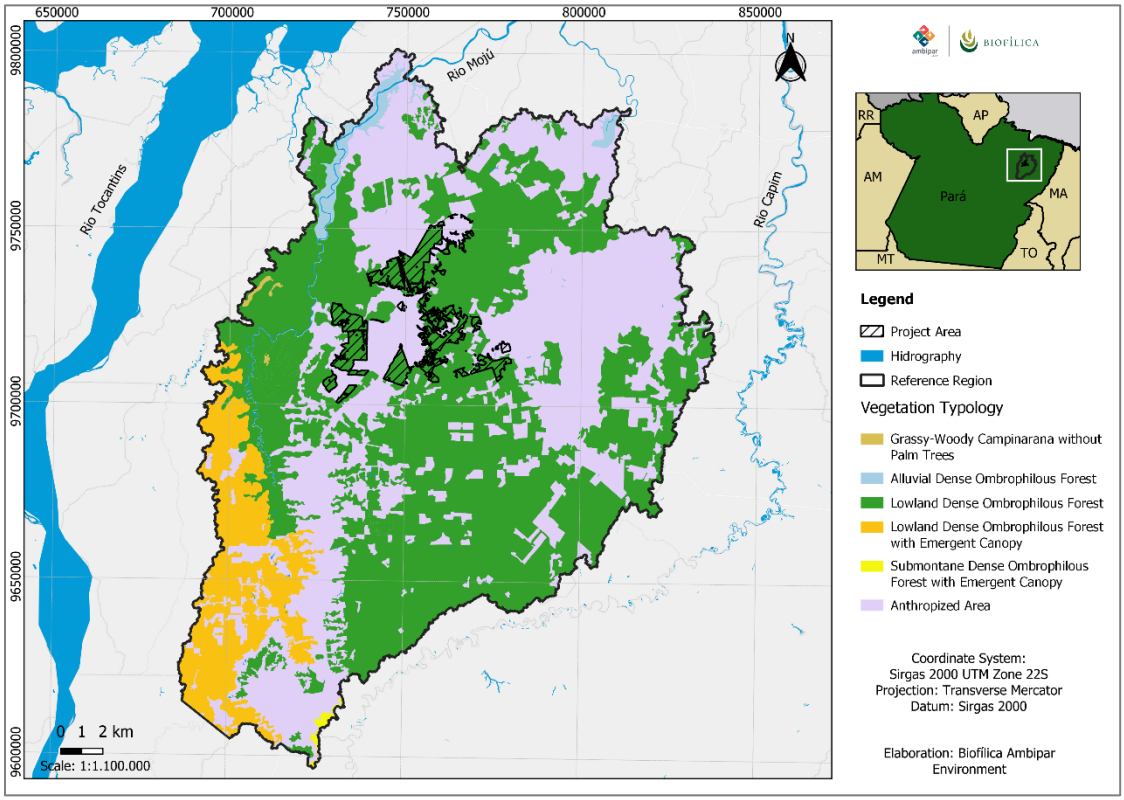

Figure 5 - Map of forest typologies found within the Project Area and Reference Region.

The Dense Ombrophylous Forest is the dominant vegetation type in the north of the country, and variations in environment and relief can result in different formations – alluvial, lowland, submontane, montane and upper montane – and with a uniform canopy physiognomy or with emergent trees. According to the Technical Manual of Brazilian Vegetation (IBGE, 2012)[22], the Dense Ombrophylous Forest is associated

[22] IBGE, 2012. Manual técnico da vegetação brasileira, 2a edição revista e ampliada. ed, Manuais técnicos em geociências. Instituto Brasileiro de Geografia e Estatística-IBGE, Rio de Janeiro.

with high temperatures, with an average of 25ºC, and high rainfall, well distributed throughout the year (0 - 60 dry days per year), considered without a biologically dry period.

The soils of mainland forests are poor in nutrients, but are better structured and allow the development of dense and rich vegetation (Souza et al., 1997)[23]. Many species are typical of these forests and are not found in any other type of environment, being very abundant. An example of this is the *Eschweilera coriácea* species, from the Lecythidaceae family, popularly known as *matá-matá.* While others, which are considered hardwoods exclusive to the mainland, are very rare, as is the case of the true kumaru, *Dipteryx odorata* of the Fabaceae family (Gama et al., 2005)[24]..

The Alluvial Dense Ombrophylous Forest, in turn, is a type of vegetation generally located on the banks of some watercourses, periphery of marshes, as well as in humid lowlands, and even in temporarily flooded areas (Araújo Filho, 2021)[25]. It is a hygrophilous, dense, medium-sized formation, where species such as *Ceiba pentandra* (L.) Gaertn. (kapok), *Virola surinamensi*s (Rol. ex Rottb.) Warb.(ucuúba), and *Tapirira guianensis* Aubl (pau-pombo) can be found (IBGE, 2012).

With regard to the Submontane Dense Ombrophylous Forest, it is characterized by species that vary according to latitude, also taking into account the importance of the time factor in such environmental variation. It occurs in dissected areas of mountainous relief and plateaus with moderately deep soils, with a uniform canopy (IBGE, 2012), with height of around 30 m. . RODERJAN *et al.* (1994)[26] state that the vegetation of this formation is not subject to limitations due to excess or lack of water in the soil and has a multistratified forest cover. The undergrowth is composed of naturally regenerating seedlings, shrubs, small palm trees and herbaceous vines in greater quantity. In this formation, tall trees are found and, in the Amazon, some can exceed 50 m in height (IBGE, 2012).

As for the Grass-Woody *Campinarana*, also known as Amazon meadow, it is a subgroup of purely herbaceous formation that arises along the flooded plains of blackwater rivers and also in the closed depressions of the tabular interfluves, capped by Spodosol. When located in depressions, they are

[23] SOUZA, A.L.; FERREIRA, R.L.C.; XAVIER, A. Análise de agrupamento aplicada à área florestal Viçosa: Sociedade de Investigações Florestais, 1997. 109 p. (Documento SIF, 16).
[24] Gama, J.R.V., Souza, A.L. de, Martins, S.V., Souza, D.R. de, 2005. Comparação entre florestas de várzea e de terra firme do Estado do Pará. Rev. Árvore 29, 607–616. https://doi.org/10.1590/S0100-67622005000400013
[25] Araújo Filho, J., 2021. Floresta Ombrófila Densa Aluvial - Portal Embrapa. URL https://www.embrapa.br/agencia-de-informacao-tecnologica/territorios/territorio-mata-sul-pernambucana/caracteristicas-do-territorio/recursos-naturais/vegetacao/floresta-ombrofila-densa-aluvial (accessed 12.7.22).
[26] RODERJAN, C.V.; KUNIYOSHI, Y.S.; GALVÃO, F. e HATSCHBACH, G.G. (1997) Levantamento da vegetação da Área de Proteção Ambiental de Guaratuba - APA de Guaratuba. UFPR – Departamento de Silviculctura e Manejo, 78 p. Relatório Técnico

waterlogged and swampy during the rainy season, becoming quite arid and dry at the height of the unfavorable season. During this period, in certain areas, fires occur that have significantly modified its structure and composition (IBGE, 2012).

2.1.6 Social Parameters (G1.3)

According to the surveys carried out in the Socio-Economic Diagnosis made for the Project, the municipalities of Acará, Moju, Tailândia and Tomé-Açu underwent different occupation processes, from the indigenous communities of Tembé, located in the region of Acará river, who cultivated subsistence agriculture, to the expansion of Portuguese exploration towards the interior of the Province of Grão-Pará using the "natural road" of the region rivers, with emphasis on Acará river. This process enabled the formation of new villages that were transformed into parishes, nuclei and municipalities. The main objective of these explorations was financial, since economic return was obtained with the extraction of wood and the use of fertile land suitable for agriculture (Silva, 2016)[27]..

Faced with logging in the Acará region, roads were opened to allow access to noble wood species and, thus, new population centers emerged, and land conflicts grew. As a way to reduce such conflicts, the creation of land reform settlement projects in these municipalities began in the 1970's.

Land use in the state of Pará has historically been favored by large agricultural projects, resulting in migration, pressure on ecosystems, pressure on traditional agriculture, as well as transforming the region into a mosaic of landscapes (Silva, 2016). That said, it appears that in Acará, Moju, Tailândia and Tomé-Açu, the economic activities carried out are mainly related to agriculture and livestock. This sector contributes significantly to the GDP of the municipality of Acará However, the counties of Moju. and Tomé-Açu and Tailândia have a greater contribution from the services sector in the composition of their GDP (IBGE, 2020)[28].

When it comes to non-timber forest extraction, the communities of these four municipalities, which in the surroundings of the Project Area total 24 communities – including those of family agriculture, traditional population, areas of occupation and settlement –, extract products such as Acai berries, cashew nuts, Brazil

[27] Silva, F.L. da, 2016. Dimensões de uso e cobertura da terra: uma análise voltada a classificar municípios do estado do Pará e promover serviços ecossistêmicos no município de Moju-PA. (Thesis). UFRA/Campus Belém.

[28] IBGE, 2020. IBGE | Cidades@ | Pará | Acará | Pesquisa | Produto Interno Bruto dos Municípios | PIB a preços correntes. URL https://cidades.ibge.gov.br/brasil/pa/acara/pesquisa/38/46996?localidade1=150470&localidade2=150800 (accessed 12.7.22).

nuts and hearts of palm. Among the products of greatest commercial importance for the municipalities, palm (palm oil) tops the list, followed by acai berries (IBGE, 2021)[29].

The municipality of Tailândia shows a greater amount of collected tons of palm (palm oil) compared to the other 3 municipalities analyzed. Regarding timber extraction, the region has the largest volume of logs extracted, with ample participation of the municipality of Tomé-Açu, which in 2021 extracted 57,979 m³.

Regarding the characterization of the region where Agropalma Farm is located (municipalities of Acará, Moju, Tailândia and Tomé-Açu), according to census data made available by IBGE on SIDRA (IBGE dAutomatic Recovery System) e IBGE Cidades platforms, when comparing counting from 2000 to 2010, the municipality of Tailândia had the greatest population increase, with 40,862 inhabitants (51.53%). The municipality of Moju has the second largest increase, with 17,077 inhabitants (24.39%). In Tomé-Açu, the percentage increase in population was 16.13% (9,114 inhabitants). In the municipality of Acará, the population growth was much less expressive, remaining at 1,443 inhabitants (2.69%). In the municipalities of Acará and Moju, the rural population is quite significant, with an urbanization rate in 2010 below 50%. However, the municipalities of Tomé-Açu and Tailândia have an urbanization rate greater than 50%, with emphasis on the latter, with a rate of 74.04% of urban population.

The expansion of population in the urban area of the municipality of Tailândia occurred through the migration of people from other municipalities in Pará and other states, who envisioned the possibility of employment and income in logging activities and in the supply chain that served this activity. Such displacement was favored by the infrastructure of highways, such as PA-150, which, in addition to enabling the integration of municipalities with large government projects such as the Transamazon Highway, also influenced the migration of people from other states to work as labor in the its implementation (Prado, 2006)[30].

According to data provided by Fundação Amazônia de Amparo a Estudos e Pesquisas – (FAPESPA, 2022)[31] the provision of health services in 2021 differs between municipalities, with Tailândia and Acará having the largest number of health facilities, totaling 39 and 32 units, respectively. Next are the municipalities of Tomé-Açu (29 establishments) and Moju (27 establishments). It is important to point out

[29] IBGE, 2021. IBGE | Cidades@ | Pará | Acará | Pesquisa | Extração vegetal e Silvicultura | Extração vegetal. URL https://cidades.ibge.gov.br/brasil/pa/acara/pesquisa/16/12705?localidade1=150470&localidade2=150800 (accessed 12.7.22).

[30] Prado, F.R., 2006. O Mito da cidade provisória: natureza, migração e conflito social em Tailândia (1977-2000).

[31] FAPESPA, 2022. Estatística Municipal | Fapespa. URL https://www.fapespa.pa.gov.br/node/201 (accessed 12.7.22).

that, with regard to the type of service provision, the four municipalities have most of the establishments belonging to SUS (Brazilian Health Service).

The municipalities of Acará and Moju had reductions in the number of health professionals, especially doctors, nurses and community health agents. In these municipalities, the total number of beds per inhabitant was lower than that recommended by the World Health Organization (WHO), which is 3 beds per 1,000 inhabitants. The only municipality that meets this recommendation is Tomé-Açu with 3.03 per thousand inhabitants in 2020 and 3.13 in 2015.

It is worth mentioning that in 13 of the 23 communities, health services were classified as insufficient or non-existent by the majority of respondents, with emphasis on the communities of Arauaí, Calmaria I, Cipoteua, Gonçalves, Jandira, Jupuuba e Nazaré-Auí-Açu, Nova Paz and Urucuré, in which the population seeks care in other municipalities because care at health units is precarious and most of the time it is carried out by community health agents from other communities who eventually provide care.

With regard to education, the municipalities offer all levels of education, from pre-school to higher education. It is worth mentioning the presence of public universities (UFRA and UEPA) in the municipalities of Tomé-Açu and Moju, and of a School of Technical Education of the State of Pará in Tailândia.

In the municipalities of Acará, Moju and Tailândia, there was a reduction in the number of establishments and the number of enrollments between 2015 and 2020, with emphasis on pre-school and elementary education. The municipality of Tailândia had significant reductions in the number of enrollments in pre-school, by 15.0%, and in elementary education, by 44.3%.

School dropouts decreased in all municipalities between 2015 and 2020, indicating an increase in the permanence of those enrolled in schools. The age-grade distortion indicator reduced in all municipalities, which shows the effort of the municipal education management to ensure that students remain in school and are able to reconcile school activities with tasks on their rural properties. It is important to highlight that during the period of isolation caused by the covid19 pandemic, schools were generally closed and, although a few had developed actions to maintain classes remotely, in rural areas these actions had no effect and the removal of children and teenagers from the schools located there was and still is a problem.

The human development index measured for the municipalities, which measures the level of development conditions taking into account educational levels, longevity indicators and income indicators, indicated low development of all municipalities until the year 2000, moving to medium in 2010. The values recorded for the income and longevity indicators for all municipalities suggest the concentration of income in a few individuals, which can be corroborated by the evolution in the number of beneficiaries of *Bolsa Família* (Family Allowance) Program.

The large number of *Bolsa Família* benefits per municipality indicates the level of poverty or extreme poverty of the population, with Moju registering the highest number of beneficiaries, and Tailândia having the lowest number among the four municipalities.

In the case of basic sanitation, among the communities around Agropalma Farm, these services were classified as inefficient or non-existent by 74.0% of them.

2.1.7 Project Zone Map (G1.4-7, G1.13, CM1.2, B1.2)

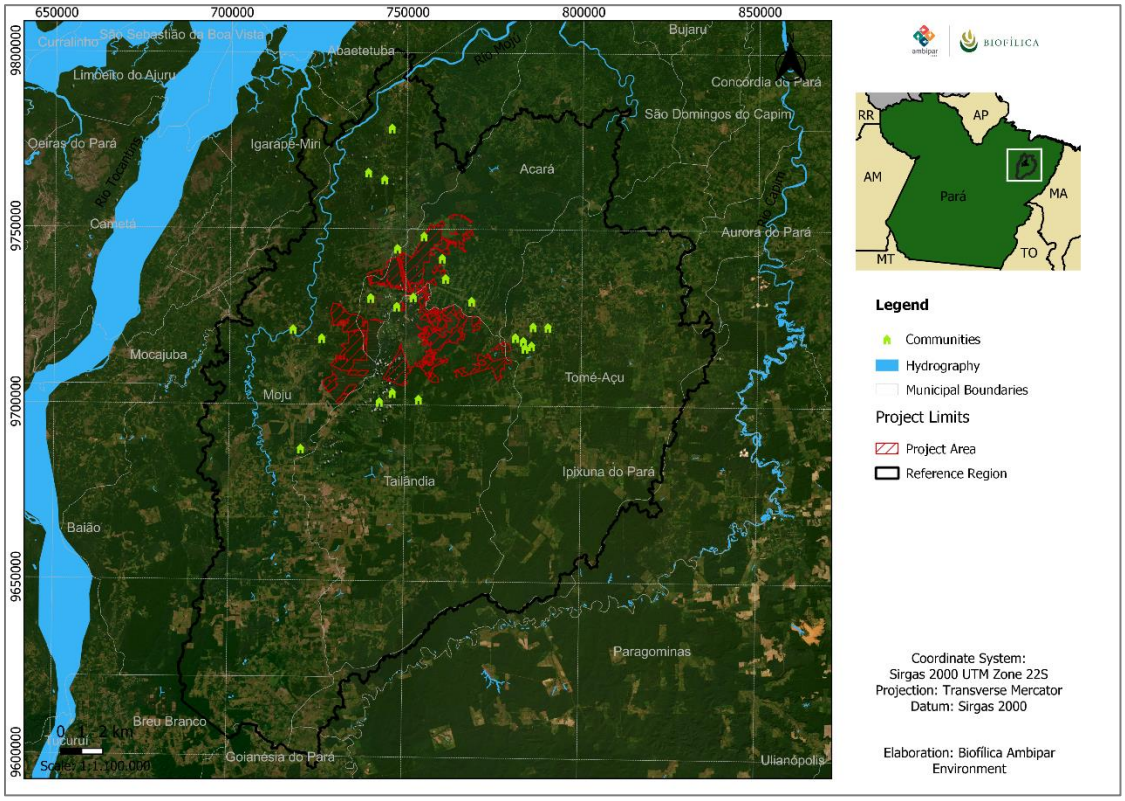

Figure 6 - Agropalma REDD+ Project Zone Map

2.1.8 Stakeholder Identification (G1.5)

The identification of stakeholders was carried out through socio-economic diagnosis prepared by Peabiru Institute. The diagnosis sought to identify stakeholders, differentiate them in categories and investigate

relationships among stakeholders, following the steps for stakeholder analysis proposed by the literature Reed et al. (2009)[32].

The identification of stakeholders in Agropalma REDD+ Project took place through the "snowball method", which is described as the interaction of individuals from categories of stakeholders who are initially interviewed and identify new categories of stakeholders and contacts to be included in the project. Through this diagnosis, together with Grupo Agropalma team, rural communities were identified that have a relationship and interaction, and/or exert influence or may be influenced by the activities of Agropalma REDD+ Project, and these communities are not residents in the project area.

In the diagnosis, official data sources and on-site research were used with previously mapped communities, as well as municipal public managers and other interest groups in the headquarters of municipalities in the area of influence of Agropalma REDD+ Project.

Data collection took place in the 23 communities surrounding Agropalma REDD+ Project area. A questionnaire was applied in each community, with a total of 338 respondents, as shown inTable 3 - Municipality, community and frequencies of interviews carried out. The questionnaire and more information are in the socio-economic diagnosis and will be presented to the audit team.

Table 3 - Municipality, community and frequencies of interviews carried out

Municipality	Community	Frequency	%
Acará	Gonçalves	10	3
Moju	Arauaí	7	2.1
	Betânia	13	3.8
	Boa Esperança	19	5.6
	Jupuuba	7	2.1
	Nova Esperança	12	3.6
	Nova Paz	13	3.8
	Olho D'água	20	5.9

[32] Reed, M.S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C.H., Stringer, L.C., 2009. Who's in and why? A typology of stakeholder analysis methods for natural resource management. J. Environ. Manage. 90, 1933–1949. https://doi.org/10.1016/j.jenvman.2009.01.001

Municipality	Community	Frequency	%
	São Francisco de Assis	7	2.1
	Soledade	6	1.8
	Calmaria II	24	7.1
Tailândia	Cipoteua	9	2.7
	Jandira	2	2.1
	Nazaré-Auí-Açu	7	2.1
	Palmares	43	12.7
	Turi-Açu	20	5.9
Tome-Açu	Calmaria I	26	7.7
	Forquilha	19	5.6
	Igapó Açu	17	5
	Ipiranga	10	3
	Santo Expedito	11	3.3
	Sempre Alegre	11	3.3
	Urucuré	20	5.9

The *quilombola* community of Balsa, legally recognized as *quilombolas*. did not express interest in communicating and responding to the questionnaire for integration into Agropalma REDD+ Project. The initial contacts were made through Peabiru Institute with the president of the Association of the Remnant Communities of Balsa, Turiaçu, Gonçalves and Vila Palmares do Vale do Acará (ARQVA) and by choice of the community, there was no continuity in its participation.

Field information collection was carried out from February 8 to 14, 2022. The dynamics of application of the questionnaires was as follows: (1) identify the community leader or community health agent or person who had the greatest understanding of the community and apply the questionnaire in more depth to some questions; (2) apply the questionnaire to other residents of the community using the method known as the snowball, considering people living in the community core and residents living in the rural area of the

community. (3) the average time to apply the questionnaire varied between 20 and 30 minutes, and in the case of the leaders, this time reached 45 minutes.

Interviews were carried out using a questionnaire with discursive and multiple-choice questions, with the following objectives:

- Identify and characterize the communities that influence and/or can be influenced by project activities, as well as agents, causes and drivers of deforestation in the surrounding project region;
- Survey socio-economic programs and projects carried out in the project area and its surroundings, to identify potential partners;
- Elaborate outline of the activities to be implemented within the social scope of Agropalma REDD+ Project;
- Characterize the profile of economic activities carried out around and within the project area and identify new business opportunities;
- Conduct a preliminary assessment of the project's impacts, both positive and negative, on the communities under the influence of the project; Data collection took place in the 23 communities surrounding Agropalma legal reserve area.

Some restrictions were imposed for the application of the interviews: being at least 18 years old; balance the application of interviews considering gender; and seek the greatest variability of respondents for the variable length of residence in the community. The report includes all research communities according to the municipality to which the community is linked, as defined by IBGE.

2.1.9 Stakeholder Descriptions (G1.6, G1.13)

The communities identified around Agropalma REDD+ Project Area are represented by groups of traditional populations, family farmers, occupation areas, agrarian reform settlements and urban centers, respectively. All communities identified are described in Table 4

Table 4 - Communities identified around the farms of Agropalma REDD+ Project.

Municipality	Community	Community Category
Acará	Gonçalves	Traditional population
Moju	Arauaí	Traditional population
	Betânia	Family farming
	Boa Esperança	Occupation area
	Jupuuba	Family farming
	Nova Esperança	Occupation area
	Nova Paz	Family farming
	Olho D'água	Settlement
	São Francisco de Assis	Occupation area
	Soledade	Traditional population
	Calmaria II	Settlement
Tailândia	Cipoteua	Traditional population
	Jandira	Traditional population
	Nazaré-Auí-Açu	Traditional population
	Palmares	Urban center
	Turi-Açu	Urban center
Tome-Açu	Calmaria I	Settlement
	Forquilha	Family farming
	Igapó Açu	Family farming
	Ipiranga	Family farming
	Santo Expedito	Family farming
	Sempre Alegre	Family farming

Municipality	Community	Community Category
	Urucuré	Occupation area

Community categories vary in number: traditional communities (6 communities), family farmers (8 communities), occupation areas (4 communities), agrarian reform settlements (3 communities) and urban centers (2 communities). These communities, in particular, will not be individualized in the data to be described.

Research within the scope of Agropalma REDD+ Project contemplated an investigation in the *quilombola* community of Balsa, but there was no continuity of interest in the communication and response to the questionnaire for integration in Agropalma REDD+ Project, as mentioned above. This fact resulted in the incompleteness of data on the social structure, as was made with the 23 other communities in the municipalities of Tome-Açu, Mojú, Tailância and Acará previously described in the context of Agropalma REDD+ Project. Faced with the difficulty of finding secondary information about the reality experienced by the community of Balsas in terms of socio-demographic characterization and agricultural production methods, and considering that the consulted documents refer to conflicts without characterizing the residents of the village, the main source of information collected can be found in (SILVA, 2020)[33].

Besides the communities, other stakeholders were identified, such as:

- Grupo Agropalma;
- Biofílica Ambipar Environmental;
- Rural properties around the farms of Agropalma REDD+ Project;
- Workers of Grupo Agropalma (Agropalma Tailândia unit);
- Public Agencies;
- Academic and research institutions.

Furthermore, referring to workers at Agropalma Tailândia, a total of 5,642 workers who work at Agropalma farm (Unit in Tailândia/Pará) were identified.

[33] Silva, E.P.D., 2020. NECROSABER E REGIMES DE VERIDIÇÃO: GOVERNAMENTALIDADE BIOECONÔMICA DA PLANTATION DO DENDÊ NO BRASIL E NA COLÔMBIA. UNIVERSIDADE FEDERAL DO PARÁ (UFPA). DOUTORADO EM DESENVOLVIMENTO SUSTENTÁVEL DO TRÓPICO ÚMIDO. Disponível em: http://repositorio.ufpa.br/jspui/handle/2011/13997 (accessed 12.21.22).

All stakeholders should be invited to take part in the discussions of Agropalma REDD+ Project, with the aim of having a space for articulation and communication between Agropalma and the communities and other stakeholders involved in the Project. The assessment of rights, interests and relevance of each group of actors in relation to Agropalma REDD+ Project was carried out, together with Agropalma employees and is specified in Table 5

Table 5 - Description of the actors involved in Agropalma REDD+ Project

Group of actors involved in the Project	Rights regarding the Project	Interests in their participation in the Project	Relevance of participation in the Project
Agropalma	Holder of credit rights, responsible for investments, development and implementation of the Project. Performance and local management of social activities. It is also the organization responsible for managing financial resources.	Ensure the inclusion of communities in Project activities and that Technical Assistance and Rural Extension also incorporate a look at issues such as education, health, guarantee of human rights, environment, culture and job and income creation.	High – Due to its great influence in the region it is a fundamental component in the containment of deforestation, in addition to the opportunity for the communities of the activities already carried out and those foreseen by the Project.
Communities surrounding the Project Area	Beneficiaries of social activities	Access alternative rural and socio-economic technical assistance services to improve their living conditions.	High – These are essential components of social activities, deforestation control and development of a local economy model based on sustainable practices that are harmonious with the forest.

Group of actors involved in the Project	Rights regarding the Project	Interests in their participation in the Project	Relevance of participation in the Project
Agropalma workers	Beneficiaries of social activities	With constant presence in the project area, workers help contain deforestation, in addition to accessing alternative rural and socio-economic technical assistance services to improve their living conditions.	High – many workers are also community workers, in this sense, they are essential components of social activities and prevention of deforestation, due to their constant presence in the project area.
Rural properties around the Project Area	Beneficiaries of social activities	Access alternative rural and socio-economic technical assistance services to improve their living conditions.	Access alternative rural and socio-economic technical assistance services to improve their living conditions.
Public Agencies	Coordinate with other actors to improve the implementation and permeability of public policies, support complementary actions to implement the Project	Bring the government closer to the community demands and strengthen governmental relations, which currently present themselves as fragile. Participate in monitoring the development of private and voluntary REDD+ initiatives, cooperate with the development of public policies.	Medium - These are the actors officially responsible for developing and implementing socio-environmental and economic public policies

Group of actors involved in the Project	Rights regarding the Project	Interests in their participation in the Project	Relevance of participation in the Project
Public, private, non-governmental organizations, associations and others	Not applicable.	Develop partnerships, provide technical assistance, promote job creation, expand operations, improve local governance, carry out research, produce and disseminate knowledge, promote forest management for sustainable production, ensure the permanence of traditional communities, develop and publish scientific works, guarantee of an area with a rich socio-economic and environmental context, etc.	High – In order to promote maximum effectiveness of the Project social activities in practice, the Project will seek to establish partnerships in the region, whether public, private, third sector and/or organizations. Through partnerships, it is expected that there will be greater strengthening and involvement of all stakeholders, as well as mutual collaboration and exchange of expertise in the demands mapped by the Project.

2.1.10 Sectoral Scope and Project Type

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

2.1.11 Project Activities and Theory of Change (G1.8)

The process for conception of Agropalma REDD+ Project activities was defined adopting the Theory of Change approach. This tool allows you to establish hypotheses or assumptions about how the project

intends to achieve certain objectives and goals, such as generating benefits, amendments or significant changes in a given location or target audience.

Based on theoretical and empirical assumptions that support the action strategy that will mitigate an identified problem, the Theory of Change allows predicting the likely long-term impacts that will be achieved if intermediate results are previously achieved in the short and medium term. Thus, it is an approach that establishes a cause and effect relationship, with interdependent results, capable of supporting not only the formulation process, but also the stages of implementation and monitoring of project activities, in addition to proving the effectiveness of initiatives that seek to generate benefits for a given context over time.

The activities of Agropalma REDD+ Project were built based on the understanding of local problems arising from initial studies and consultations with communities. Thus, it aims to promote actions for the conservation and protection of biodiversity and natural resources, the reduction of unplanned deforestation, sustainable socio-economic development, social inclusion, stakeholder engagement and involvement, the conservation of fauna and flora and the promotion of local governance.

In the process of designing the activities, it is understood that some expected results influence each other, since the actions were designed to be carried out jointly with the aim of acting around the main agents and vectors of deforestation, reducing greenhouse gas emissions from deforestation and forest degradation, while providing social and biodiversity impacts.

The summary of the activities of Agropalma REDD+ Project, as well as the determination of each scope, is described below.

a. General scope

Initial studies and articulations

This initial activity refers to the interventions necessary to make the Project viable and contemplates from the signing of the contract, where a long-term partnership was defined between the proponents aiming at environmental conservation and socio-economic development of the region, in addition to meetings with technical partners to start the initial studies of the Project.

Initial studies provide technical basis for preparing the project management plan. Among the studies carried out are: the estimate of the forest carbon stock and the elaboration of the deforestation baseline; socio-economic diagnosis of the region, environmental diagnoses and consultation with communities. Based on primary and secondary data, the aforementioned diagnoses were essential for understanding the regional problems and enabled the outlining of potential activities. Finally, consultation with communities and other

stakeholders was important to refine the activities initially proposed, based on understanding the demands, concerns, expectations and propositions of the stakeholders impacted by the Project.

Thus, the initial articulations and approaches described supported the construction of actions that proposed additionality to Agropalma REDD+ Project in relation to climatic, social and biodiversity benefits.

Implementation, monitoring and evaluation of activities developed by the Project

As an essential part of delivering net benefits, a REDD+ Project must have very well-defined procedures for monitoring activities, actions and indicators. For this to happen, good management of the Project is necessary, ensuring that the activities are carried out, that possible risks are mitigated and that there is always continuous improvement in the implementation of the proposed activities. In short, this activity will focus, therefore, on improving the management of the Project, continually checking possible failures and risks and establishing adequate records of the Project's historical milestones, the changes that have occurred and adaptations carried out over the period of credit generation. This will bring a more effective adaptive management, promoting more assertive decisions as well as aligned with the premises designed in the DPD.

Thus, the activity “Implementation, monitoring and evaluation of activities developed by the Project” aims to conduct efficient management throughout the life cycle of the Project, thus achieving the expected positive impacts. In order for this objective to be achieved, actions such as the production of reports on the Project's activities, evaluation of indicators and results, planning and prioritization of tasks, strategic definition of target audience and partners, tactical plans and implementation of tools that can express the historical milestones and the adaptive changes made are suggested.

Also, if well conducted, the actions will lead to a greater understanding of the impacts generated and opportunities to redirect demands into priority levels, establishing procedures and protocols to be followed by stakeholders. That said, constant alignment and common strategies between stakeholders and proponents are indispensable for this activity to actually take place and demonstrate, in detail, the efforts of the actors in the implementation and monitoring of the Project.

b. Climate scope

Strengthening asset surveillance

Currently, Grupo Agropalma has a program to protect its forest reserves with the operation of a ground surveillance team. The team has a routine for monitoring border areas, recording incident reports and a

non-violent approach. However, the occurrence of invasions and illegal activity practices, such as theft of wood and predatory hunting, is still reported.

Thus, the proposed activity intends to strengthen the actions already implemented and incorporate the existing asset surveillance program, the remote and continuous monitoring of deforestation and forest fires, both in the Project Area and in the Leakage Belt, as well as in sensitive areas such as the High Conservation Value Areas (HCVA). Through remote monitoring, greater speed is expected in the on-site verification of deforestation and identified hot spots.

In addition to introducing new tools in the surveillance routine, the activity will seek to improve the training of actors involved in terrestrial surveillance, structuring communication channels between surveillance teams, proponents and other stakeholders, with the aim of standardizing procedures, guaranteeing the transparency of field activities, improving efficiency in the exchange of data and information and, consequently, providing greater effectiveness in controlling deforestation and preventing illegal activities, mainly within the Project Area.

Thus, based on the actions described, the long-term objective of this activity is to guarantee the conservation of forest resources and the preservation of ecosystem resources, providing climate benefits through the reduction of greenhouse gas emissions from degradation and deforestation and the maintenance of carbon stocks, one of the main objectives of a REDD+ Project. Figure 7 presents the flowchart of results and actions that lead to the expected impact of the activity.

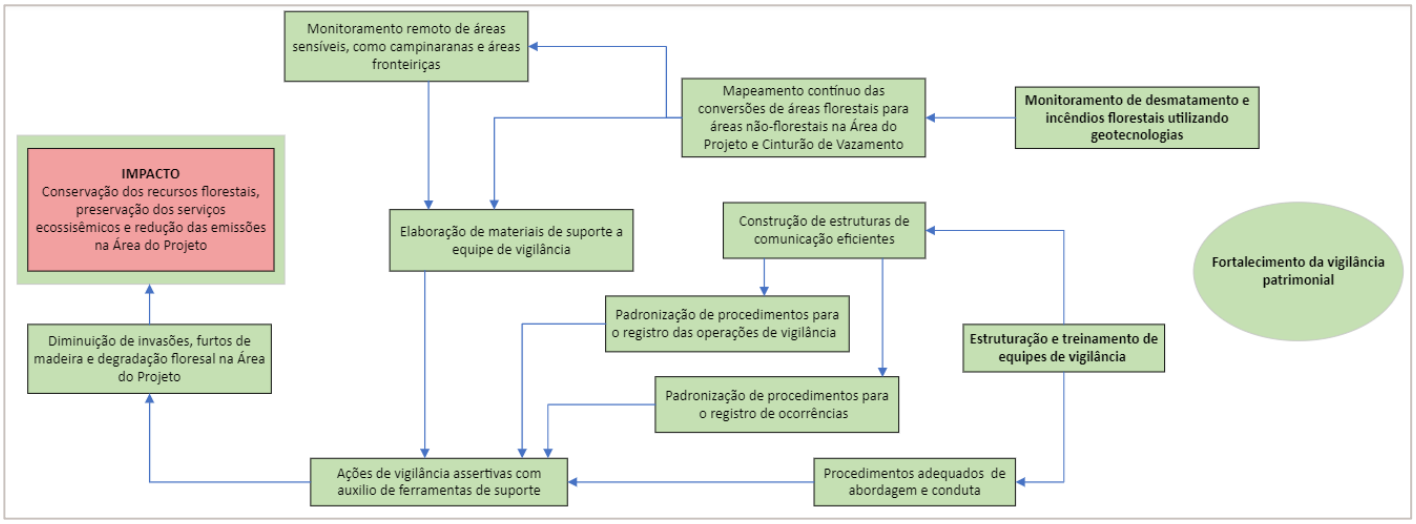

Figure 7 - Fluxogram of results and actions to strengh vigilance at Project REDD+ Agropalma

c. Social scope

Strengthening local governance

Building cooperation and articulation mechanisms that encourage a cohesive network of social relationships among the different actors that make up a territory is one of the fundamental conditions for boosting local development. Still, in the case of a long-term project, construction and maintenance over time of a good relationship between stakeholders and proponents is essential to enable the implementation and monitoring of the activities proposed by the Project, in addition to allowing effective follow-up of response to demands and results obtained, contributing to the peaceful and fair resolution of possible conflicts and mitigating possible risks.

Thus, this activity intends to strengthen local governance, not only restricting itself to actions to promote good relationship between stakeholders and Project proponents, but also by encouraging partnerships and good relations between communities in the Project Zone. These actions include strengthening the community's social organization by empowering local leaders, creating safe environments for discussion and knowledge exchange, in addition to transparency and communication mechanisms that will be implemented throughout the Project.

The strengthening of relations between proponents and stakeholders will be carried out by structuring procedures that guarantee transparency in the management of activities developed by Agropalma REDD+ Project, such as communication and consultation channels, participatory councils, assemblies, among other collaborative formats described in detail in Section 2.3.8.These mechanisms will be fundamental to the success of the Project and will be strengthened and encouraged by this activity. In addition, the activity also intends to promote and strengthen local social organization, above all as a strategy for tackling issues of collective interest, such as environmental, economic, land ownership guidelines, in the search for basic rights.

Thus, based on the actions described, the long-term objective of this activity is to strengthen cohesion in social relations among stakeholders, encouraging mutual trust, empowering vulnerable groups, representativeness and equality in decision-making. Based on this, the aim is to encourage the construction of formal and informal participatory governance structures that allow for greater articulation in the pursuit of collective goods and interests and, consequently, promote strengthening of social capital in the Project Zone. Figure 8 presents the flowchart of results and actions that lead to the expected impact of the activity.

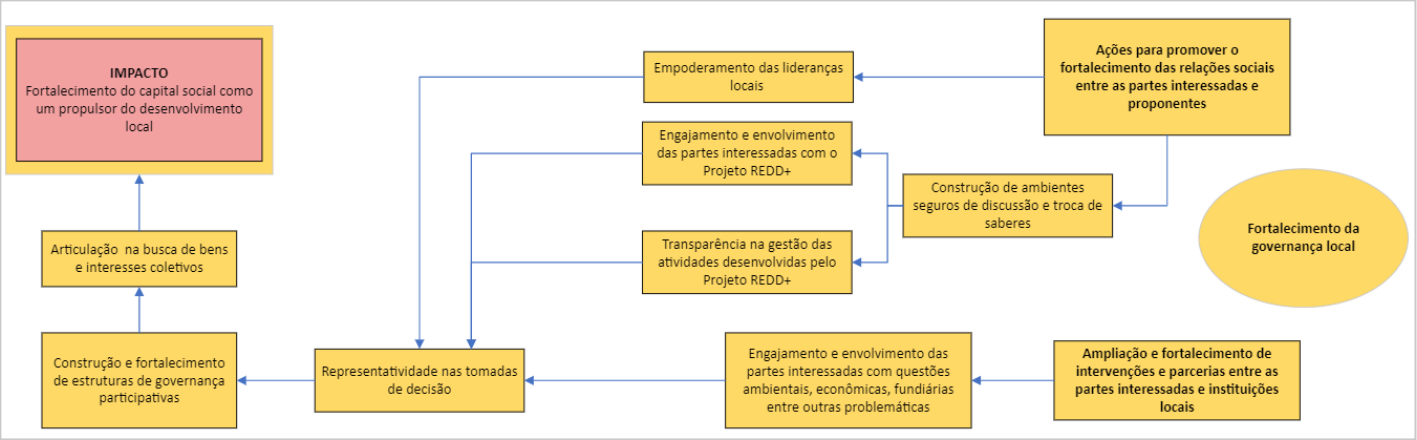

Figure 8 - Fluxogram of actions and results of Agropalma REDD+ Project

Promotion of sustainable agricultural practices

From the socio-economic diagnosis it was found that small rural producers and family farmers are considered one of the main agents of deforestation in the region. The deforestation carried out is related to culturally established agricultural practices, which harm soil fertility, have low productivity and are associated with little diversified production models. Thus, the opening of new production areas in search of more fertile soils and the practice of burning to clear new areas are common in the region.

Other potential agents of indirect deforestation are medium and large rural producers who seek to increase their productive areas for the production of commodities such as corn, soybeans and cattle, using methods such as land speculation to acquire new production areas that have been recently deforested.

From this context, the activity proposes to act mainly around small rural producers and family farmers, promoting actions such as encouraging the implementation of alternative agricultural production systems and models, which are sustainable and assimilate cultures already established and widespread in the region, such as açaí, manioc, black pepper and especially the oil palm, one of the most developed and adapted agricultural cultures for the region. Sustainable agricultural production practices and models can provide diversification of production, increase productivity, discourage rural exodus, reduce pressure for deforestation and the effects of land speculation. The necessary actions for this initially involve building trust and cooperation relationships among the target audience, establishing strategic partnerships for in locu actions, promoting training and technical development and structuring networks of technical assistance and rural extension.

Thus, based on the actions described, the long-term objective of this activity is to enable food security combined with forest conservation by strengthening sustainable agricultural practices. Thus, the proposed

actions encourage the permanence of small producers and family farmers in the countryside and increase resilience in relation to their migration to activities that are vectors of deforestation in the region, such as the production of charcoal, illegal timber trade or extensive cattle ranching with low levels of productivity carried out through predatory and disorderly occupation of forest areas. Furthermore, encouraging the permanence of vulnerable families in the countryside and reinforcing their sense of belonging is also a strategy to reduce the effects of land speculation and break the cycle of deforestation due to predatory occupation. Figure 9 presents the flowchart with the causal chain of results and actions that lead to the expected impact of the activity.

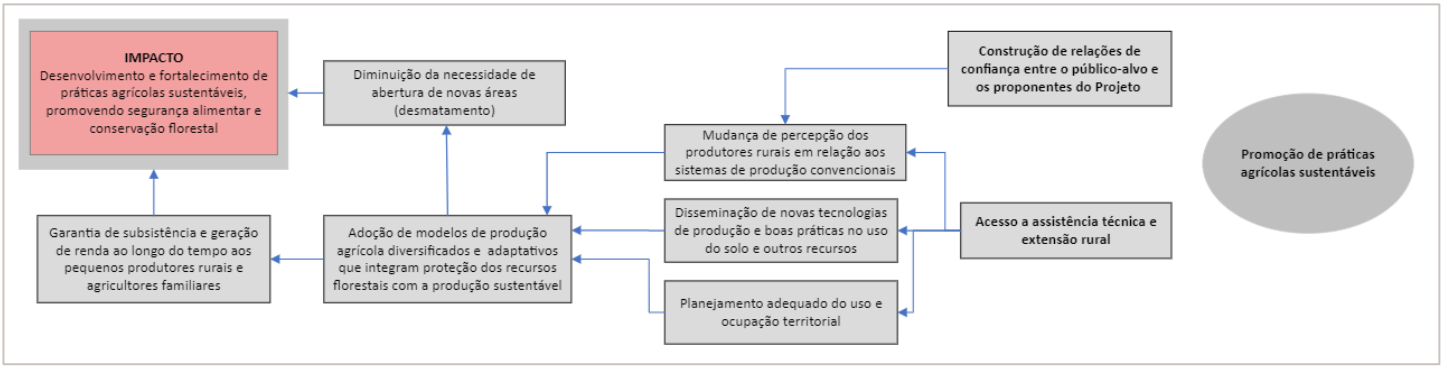

Figure 9 - Flowchart with the results and actions to promote sustainable agriculture practice of Agropalma REDD+ Project Fluxograma de resultados e ações para promoção de práticas agrícolas sustentáveis do Projeto REDD+ Agropalma.

Development and strengthening of value chains

Most of the communities surrounding the Project Area are made up of family farmers. Therefore, there are problems intrinsic to this social group, mainly related to planning, both territorial and production, in addition to problems related to marketing, such as product pricing and difficulties in accessing the market.

Thus, the activity seeks to promote actions focused on improving the management of family agricultural production units, especially in the process of planning, production, valuation and commercialization of agricultural and forestry products. For this, the structuring of technical assistance and rural extension programs will be essential to promote efficiency and diversification of production through the adoption of integrated production systems, an action that will be reinforced by *Activity 4 – Promotion of sustainable agricultural practices.* In addition, there is a need to offer planning and management instruments, with a focus on democratizing technical knowledge, defining procedures and quality standards, in addition to building the necessary skills to guarantee access to the most vulnerable families to local markets.

Another action front is strengthening the social organization of family farmers as a means of facilitating access to resources, whether financial or physical, which allow increasing small rural enterprises and facilitate access to different marketing channels. In view of this, the activity will also seek to promote the building of trust between family farmers and local institutions, as well as structure and consolidate collective organizations, such as associations and cooperatives, interventions that will also be strengthened by *Activity 3 – Strengthening of local governance.* With this, it is expected that the proposed initiatives facilitate access to different marketing channels, promote the appreciation of local production and help in the construction or strengthening of value chains or local productive arrangements.

Thus, the long-term objective of this activity is to improve the socio-economic conditions and the well-being of family farmers in the communities. The proposed actions seek to encourage food security, autonomy and financial resilience provided by the development and strengthening of local production chains. Figure 10 presents the flowchart with the causal chain of results and actions that lead to the expected impact of the activity.

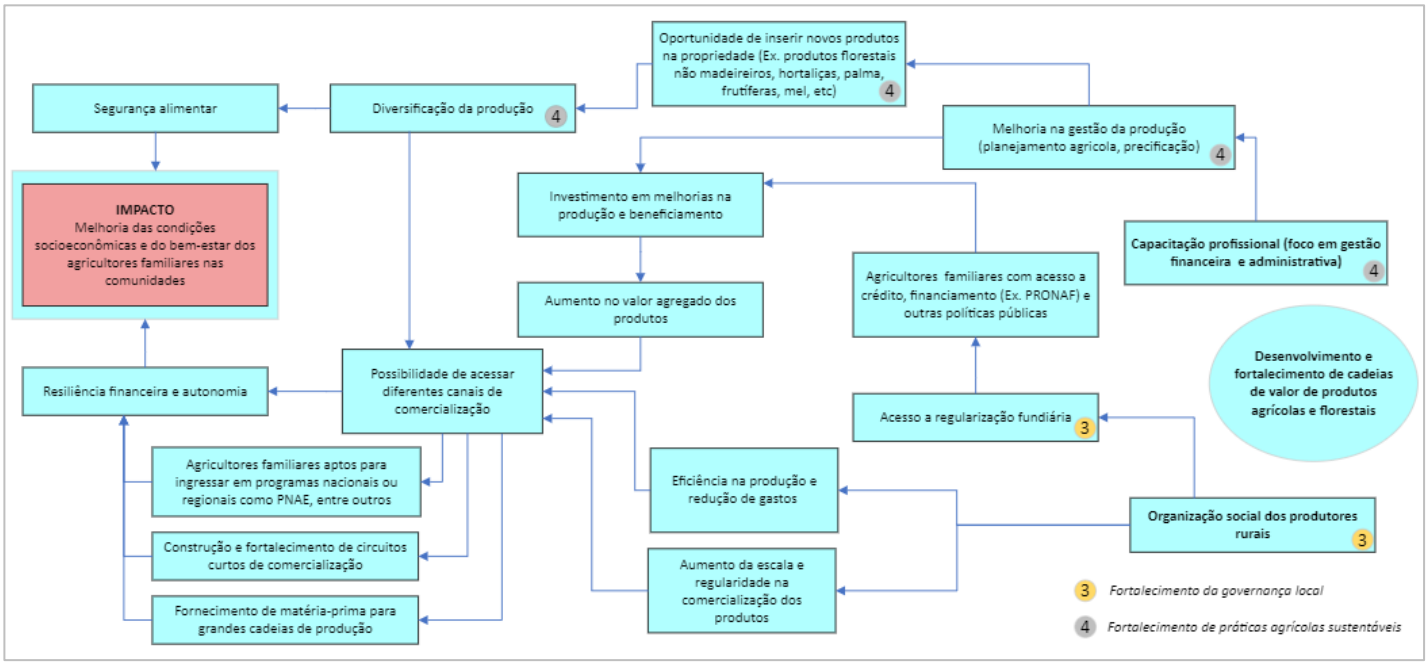

Figure 10 - Flowchart with results and actions to develop and strength value chains of Agropalma REDD+ Project

Biodiversity scope

Biodiversity conservation program

The Project Zone is located in the Belém Endemism Center (CEB), a region with a large concentration of endangered and endemic species. Habitat loss due to deforestation, hunting of wild animals, among other

damages to the environment caused by anthropic action, compromise the maintenance of genetic resources in these areas considered to be of high importance for conservation.

From this, the activity proposes to promote actions that make it possible to face the problems that threaten local biodiversity through environmental education, through systematic monitoring and the promotion of sustainable activities as alternatives to hunting. Environmental education initiatives will be carried out through communication, guidance and awareness campaigns, as well as through the use of participatory methodologies for monitoring biodiversity in forest areas outside the Project Area, promoting active participation of stakeholders and reinforcing change in perception regarding the importance of the local fauna and flora. Systematic in situ monitoring of biodiversity in the Project Area will also be planned, an important activity to monitor environmental conditions and sustain assertive actions in the conservation of key species.

In addition to encouraging environmental education initiatives and systematic in situ monitoring, it is understood the importance of promoting activities that enable food security and income generation, such as diversified and sustainable agricultural production and small-scale animal production, being alternative activities that discourage hunting. The results of this action will be mutually influenced by Activity 4 – Strengthening sustainable agricultural practices and Activity 5 – Developing and strengthening value chains.

Thus, the long-term objective of this activity is the preservation of biodiversity and genetic resources in the Project Zone, mainly the maintenance of rare, endemic and endangered species. Figure 11 presents the flowchart with the causal chain of results and actions that lead to the expected impact of the activity.

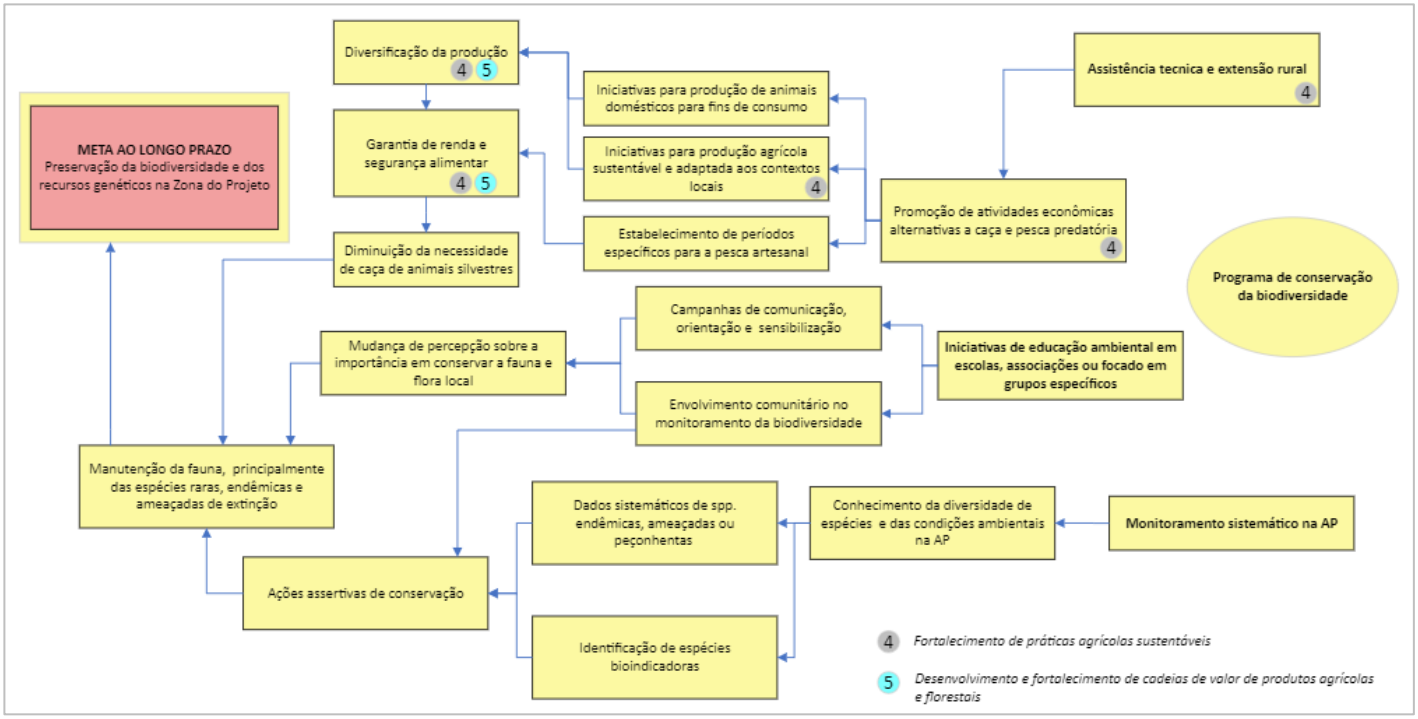

Figure 11 - Flowchart of results and actions to biodiversity conservation of Agropalma REDD+ Project

Table 6 provides a description of activities and key outcomes and impacts that will contribute to achieving the Project's anticipated Climate, Community and Biodiversity benefits.

Table 6 - Description of activities and key outcomes and impacts that will contribute to achieving the Project's anticipated Climate, Community and Biodiversity benefits.

Theme	Activity description	Expected climate, community, and/or biodiversity		
		Outputs (short term)	Outcomes (medium term)	Impacts (long term)
Initial studies and articulations	Estimate of carbon stock	- Estimate of the carbon stock for the Forest class through the Forest inventory in the Project Area; - Generation of technical report	- Knowledge about the carbon stock, including differentiation between managed and non-managed areas.	- Generation of inputs for long-term forest monitoring; - Identification of priority areas for stock conservation.

Theme	Activity description	Expected climate, community, and/or biodiversity		
		Outputs (short term)	Outcomes (medium term)	Impacts (long term)
			- Contribution to the accounting of reduced emissions.	
	Baseline determination	- Study to determine the spatial limits of the project carried out and the deforestation baseline constructed; - Generation of technical report; - Modeling of future deforestation	- Generation of knowledge about the dynamics of deforestation in the region; - Contribution to the accounting of reduced emissions; - Determination of the highest risk area to conduct surveillance actions.	- Generation of inputs for long-term forest monitoring; - Generation of relevant data to be used by the government in the projection of future jurisdictional systems.
	Socio-economic diagnosis	- Contextualization of municipalities, communities, rural priorities and Agropalma workers; - Socio-economic study carried out; - Generation of technical reports	- Updated knowledge about the socio-economic context of the region; - Supply of inputs for the design of proposed activities in line with the local context; - Providing input to the work of other stakeholders.	- Improvement of socio-economic conditions; - Long-term prevention of deforestation in the Project zone; - Ensure proper management of productive areas, forests and other natural resources.
	Biodiversity Diagnosis	- Contextualization of aspects of local biodiversity;	- Updated biodiversity studies;	Improved knowledge about local biodiversity;

Theme	Activity description	Expected climate, community, and/or biodiversity		
		Outputs (short term)	Outcomes (medium term)	Impacts (long term)
		- Biodiversity study carried out; - Generation of technical report	- Provision of inputs for the design of in situ biodiversity monitoring activities proposed; - Providing input to the work of other stakeholders.	- Long-term prevention of deforestation in the Project zone; - Ensure proper management of productive areas, forests and other natural resources.
	Feedback with communities	Inform stakeholders of the REDD+ Project; - Identification, understanding and prioritization of the problems encountered in the region communities; - Conduct interviews and workshops with communities directly and indirectly involved, so as to design and present the Project activities; - Generation of technical reports.	- Allow for adaptable management of the project to incorporate the needs and reality of families; - Definition of Parameters to measure the benefits and impacts of the Project on the communities; - Share information about REDD+ and promote community involvement.	- Strengthening communication among stakeholders; - Improvement of quality of life and socio-economic aspects of communities; - Empowerment of communities regarding their rights, duties and importance of involvement in the Project.
	The activity aims to continuously and	- Remote and continuous	- Decrease in invasions, theft of	- Conservation of forest resources

Theme	Activity description	Expected climate, community, and/or biodiversity		
		Outputs (short term)	Outcomes (medium term)	Impacts (long term)
Strengthening asset surveillance	remotely monitor deforestation and forest fires in the Project Area, Leakage Belt and High Conservation Value Areas (HCVA's). In addition, it also intends to structure and train surveillance teams to use new support tools, as well as structure efficient communication channels between the ground surveillance team, proponents and stakeholders.	monitoring of deforestation and fires in the Project Area, in the Leakage Belt and in High Conservation Value Areas (HCVA's); - Communication strategies between the surveillance team and defined proponents - Procedures for recording daily activities and field surveillance operations defined and standardized - Conducted trainings	wood and forest degradation in the Project Area; - Consolidation of the communication plan between the surveillance team, proponents and other stakeholders; - Decrease of fires and burns in the Project Area; - Protection of HCVA's; - Greater efficiency in field surveillance operations; - Maintenance of forest cover in the Project Area	and preservation of ecosystem services in the Project Area; - Conservation of forest carbon stock - Reduction in GHG emissions
Strengthening local governance	The objective of the activity is to establish strategic partnerships to carry out actions in loco, strengthen actions that have already been carried out in the Project Zone and expand the target audience, promote and encourage	- Agreements with strategic partners carried out; - Methodologies and strategies to carry out the defined interventions; - Defined target audience;	- Communication channels and transparency mechanism implemented; - Local participatory governance structures built; - Increased collective engagement in	- Improvement in the social organization of the territory and in the relationships between stakeholders; - Strengthening of social stock

Theme	Activity description	Expected climate, community, and/or biodiversity		
		Outputs (short term)	Outcomes (medium term)	Impacts (long term)
	social organization in communities in the Project Zone. Furthermore, the proposed actions also seek to establish transparency and consultation mechanisms between stakeholders and proponents.	- Conducting meetings, encounters and dialogs with community leaders and other stakeholders; - Structuring of community spaces for dialog; - Communication and consultation strategies between stakeholders and proponents defined.	claiming basic rights and services	
Promotion of sustainable agricultural practices	The objective of the activity is to establish strategic partnerships to carry out actions in loco, structure spaces for meetings and exchange of knowledge, promote technical assistance and rural extension networks for the development of the most common agricultural crops in the region, especially for the oil palm, above all, promote diversified, sustainable and	- Agreements concluded with strategic partners; - Methodologies and strategies to carry out the defined interventions; - Defined target audience; - Established community discussion spaces;	- Implemented sustainable production systems and models; - Decrease in fires; - Decrease in deforestation; - Increased agricultural productivity; - Strengthening of human capital.	- Strengthening of sustainable and adaptive agricultural practices; - Food security; - Decrease in rural exodus; - Conservation of forest resources

Theme	Activity description	Expected climate, community, and/or biodiversity		
		Outputs (short term)	Outcomes (medium term)	Impacts (long term)
	adaptive agricultural production systems and models.	- Technical visits carried out to rural properties; - Conducted trainings	- Increased local knowledge in sustainable agriculture techniques	
Development and strengthening of value chains	The objective of the activity is to establish strategic partnerships to carry out actions in loco, offer technical training aimed at managing a family agricultural production unit and encourage social organization of rural producers	- Agreements with strategic partners carried out; - Methodologies and strategies to carry out the defined interventions; - Defined target audience; - Technical visits carried out to rural properties; - Structured community discussion spaces; - Conducted trainings	- Strengthening of human capital; - Diversification of production on family farms; - Increased productivity on family farms; - Products traded with market value; - Increase in the proportion of producers with mastery of information on prices, markets and marketing channels; - Higher level of cooperativism and associations in the communities; - Strengthening of value chains or local productive arrangements	- Improving the well-being of communities; - Food security in communities; - Economic resilience and autonomy of family farmers - Decrease in rural exodus

Theme	Activity description	Expected climate, community, and/or biodiversity		
		Outputs (short term)	Outcomes (medium term)	Impacts (long term)
Biodiversity conservation program	The objective of the activity is to establish strategic partnerships for the performance of actions in loco, to promote economic activities alternative to hunting, to promote environmental education actions in schools, associations or in specific groups, focused on awareness campaigns and active participation. In addition, the activity proposes to carry out systematic monitoring in the Project Area	- Agreements concluded with local partners; - Methodologies and strategies to carry out the defined interventions; - Defined target audience; - Environmental awareness and education actions and campaigns carried out; - Family farmers trained on sustainable production models; - In situ monitoring carried out in the Project Area	- Diversification of production on family properties; - Guarantee of subsistence and income; - Increased productivity on family properties; - Increased level of awareness about the need to protect fauna and flora; - Conservation of endangered species in the Project Area; - Increase or maintenance of fauna and flora species in the Project Area; - Conservation of key species	- Preservation of biodiversity; - Conservation of genetic resources; - Economic resilience and food security for family farmers

2.1.12 Sustainable Development

One of the objectives of Agropalma REDD+ Project is to promote sustainable development in the region, with joint actions by all stakeholders, facilitated and encouraged by Agropalma, driving net benefits for the climate, biodiversity and local communities. Based on this support and according to the expected impacts, the project will contribute to the following UN sustainable development goals:

SDG 2 – ZERO HUNGER, ACHIEVE FOOD SECURITY, IMPROVE NUTRITION AND PROMOTE SUSTAINABLE AGRICULTURE

United Nations (UN) Goals: 2.4 - By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen the capacity to adapt to climate change, extreme weather conditions, droughts, floods and other disasters, and progressively improve land and soil quality

National Goal (Brazil): Goal maintained unchanged, in relation to the official text of goal 2.4, due to the fact that it is very comprehensive and, therefore, contemplates the specificities of the Brazilian reality.

Justification for application in the project: The project combines the socio-economic demands of communities with local opportunities aimed at more resilient economic activities, through the "Promotion of sustainable agricultural practices". To this end, the project enables training and technical development actions aimed at communities, in association with different partners and extension agents, in order to promote knowledge about the importance of reconciling good production practices with the preservation and maintenance of natural resources and encourage the adoption of sustainable and adaptive production systems.

SDG 4 – ENSURE INCLUSIVE AND QUALITY EDUCATION AND PROMOTE LIFELONG LEARNING OPPORTUNITIES FOR ALL

United Nations (UN) Goals: 4.4 - By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, proper work and entrepreneurship.

4.7- By 2030, ensure that all apprentices acquire the knowledge and skills necessary to promote sustainable development, including, but not limited to, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development.

National Goal (Brazil): 4.4- By 2030, substantially increase the number of youth and adults who have the necessary skills, especially technical and vocational skills, for employment, proper work and entrepreneurship.

4.7 - Goal maintained unchanged, in relation to the official text of goal 4.7, due to the fact that it is very comprehensive and, therefore, contemplates the specificities of the Brazilian reality.

Justification for application in the project: The project enables and encourages access to education through technical courses and training focused on the environmental and socio-economic areas, especially on resilient agricultural production practices, development and strengthening of value chains, incentives for social organization and environmental education for preservation of endangered species. In addition, it provides specific training for the property surveillance team in the Project Area. For this, it has the support and collaboration of specialized partners, in order to guarantee the effectiveness and engagement of stakeholders. These training activities promoted by the project make it possible to strengthen human capital, consolidate the feeling of belonging, access to information, better employment conditions and income diversification; mainly for small rural producers, resulting, consequently, in the maintenance of the forest and its resources.

SDG 6 - ENSURE AVAILABILITY AND SUSTAINABLE MANAGEMENT OF WATER AND SANITATION FOR ALL

United Nations (UN) Goals: 6.6 - By 2030, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes.

National Goal (Brazil): 6.6 - By 2030, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes, reducing the impacts of human action.

Justification for application in the project: The main objective of a REDD+ Project is the conservation of forest cover and its respective carbon stocks by curbing deforestation and forest degradation. An important project activity is the strengthening of asset surveillance, ensuring protection of the Project Area's forest cover, in addition to other activities that encourage the adoption of sustainable production practices as alternatives to deforestation. Thus, the maintenance of forests is essential for the provision of water ecosystem services and, consequently, the availability of water for all. They contribute to the process of regulating the hydrological cycle, influencing some factors such as rainfall, water availability and purification, soil protection, lakes and water courses.

SDG 12 – ENSURE SUSTAINABLE CONSUMPTION AND PRODUCTION PATTERNS

United Nations (UN) Goals: 12.2- By 2030, achieve sustainable management and efficient use of natural resources.

12.8- By 2030, ensure that people everywhere have relevant information and awareness for sustainable development and lifestyles in harmony with nature.

National Goal (Brazil): 12.2 - Goal kept unchanged in relation to the official text of global goal 12.2

12.8 - By 2030 ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature, in accordance with the National Environmental Education Program (PRONEA).

Justification for application in the project: The Project encourages the "Promotion of sustainable agricultural practices" with actions aimed at identifying potential activities related to resilient subsistence agriculture, extractivism and management of forest products; according to the demand and profile of local communities. In this sense, the project acts in the dissemination of knowledge, instructions and experiences focused on the efficient use of natural resources and environmental preservation; in addition to the "Development and Strengthening of Value Chains", encouraging sustainable business chains through greater integration between stakeholders and regional markets, thus generating; income, well-being and cultural identity for the fostered communities. With this, learning, engagement and predisposition of these families in activities to improve productive and extractive practices, increase the project's governance and help maintain the forest cover and preserve its ecological aspects.

SDG 13 – TAKE URGENT MEASURES TO COMBAT CLIMATE CHANGE AND ITS IMPACTS

United Nations (UN) Goals: 13.3 - Improve education, raise awareness and human and institutional capacity on climate global mitigation, adaptation, impact reduction and early warning.

National Goal (Brazil): 13.3 - Improve education, raise awareness and human and institutional capacity on climate change, its risks, mitigation, adaptation, impacts, and early warning.

Justification for application in the project: The activities developed by the project are focused on sustainable practices, which contribute to the reduction of unplanned deforestation and forest degradation, and consequently, the reduction of greenhouse gas emissions. The Project has the potential to reduce 6,717,438 tCO2 of GHG emissions in 10 years, with prevention of deforestation in native forest. The asset

surveillance strengthening activity will be carried out through the presence of agents in the Project Area, in an integrated manner with remote and continuous monitoring activities of deforestation and forest fires, allowing refinement of prevention actions, combating illegal activities and maintenance of the forest.

SDG 15 – PROTECT, RESTORE AND PROMOTE THE SUSTAINABLE USE OF TERRESTRIAL ECOSYSTEMS, SUSTAINABLY MANAGE FORESTS, COMBAT DESERTIFICATION, HALT AND REVERSE LAND DEGRADATION AND HALT BIODIVERSITY LOSS

United Nations (UN) Goals: 15.1- By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, in accordance with obligations under international agreements.

15.2 - By 2020, promote the implementation of sustainable management of all types of forests, halt deforestation, restore degraded forests, and substantially increase afforestation and reforestation.

National Goal (Brazil): 15.1 - By 2020, areas such as Permanent Preservation Areas (PPA's), Legal Reserves (LR's) and indigenous lands with native vegetation, at least 30% of the Amazon, 17% of each of other terrestrial biomes and 10% of marine and coastal areas, mainly areas of special importance for biodiversity and ecosystem services will be conserved, through systems of conservation units provided for in the Law of the National System of Conservation Units (SNUC), as well as other categories of areas officially protected, ensuring and respecting the demarcation, regularization and effective and equitable management, with a view to ensuring interconnection, integration and ecological representation in broader terrestrial and marine landscapes.

15.2 - By 2030, eliminate illegal deforestation in all Brazilian biomes, expand the area of forests under sustainable environmental management and recover 12 million hectares of forests and other forms of degraded native vegetation, in all biomes and preferably in Preservation Areas (PPA's) and Legal Reserves (LR's) and, in areas of alternative land use, expand the area of planted forests by 1.4 million hectares.

Justification for application in the project: The main objective of a REDD+ Project is the conservation of forest cover and its respective carbon stocks by curbing deforestation and forest degradation. The Project is part of and protects a large part of a region classified, by the Ministry of Environment (Ordinance No. 463, of 12/18/2018), as a Priority Area for the Conservation, Sustainable Use and Sharing of Benefits of Brazilian Biodiversity and serves as an ecological corridor for preserved areas in the region, protecting endangered fauna and flora species. Furthermore, Agropalma REDD+ Project is part of the Belém Endemism Center (CEB), a region with a high concentration of endangered and endemic species. From

this context, the Project aims to minimize habitat loss, landscape changes, over-exploitation of species and climate change. To this end, it seeks to engage, involve and raise awareness of all stakeholders regarding the importance of fauna and flora biodiversity in providing ecosystem services, maintaining landscape connectivity, controlling environmental degradation and limiting the excessive use of natural resources. Also, the systematic in situ monitoring of fauna and flora, the studies on the natural and socio-economic resources already carried out, necessary to comply with the CCB certification, will also contribute to integrate the values of ecosystems and biodiversity into national and local planning, in the development processes and in poverty reduction and biodiversity conservation strategies.

2.1.13 Implementation Schedule (G1.9)

The schedule of implementation presents the main dates and milestones for the development of Agropalma REDD+ Project, as presented in the Section 2.1.11. More details can be seen in Table 7, below.

Table 7 - Detailed schedule of implementation of the main activities related to Agropalma REDD+ Project

Date	Milestone(s) in the project's development and implementation
1 to 1.5 years before validation and first verification	Activities planning meeting
	Articulation between institutions and identification of partnerships
	Consolidation of the Activities Schedule
	Conducting socio-economic and environmental diagnoses
	Estimate of carbon stock
	Baseline determination and crediting potential
	Planning and Workshops for project design
	Feedback and stakeholder consultation
	Consolidation of design, action plan and draft of the project conception document
	Review and translation of the project design description (DPD)
	Elaboration of the monitoring report

Date	Milestone(s) in the project's development and implementation
In the year of validation and first verification	Selection and Hiring of the Validation/Verification body and the Credit Registry platform
	Production of follow-up bulletins for validation/verification audit
	Field audit follow-up
	Project and Credit Registration
From year 3 to year 30	Development and Monitoring of socio-environmental management activities
	Monitoring of deforestation and emissions
	Monitoring Biodiversity (fauna and flora) and High Conservation Value Areas (HCVA)
	Verification of credits (Selection and contracting of the verification body; Production of Follow-up Bulletins for verification; Field audit monitoring; Registration of credits)
	Conducting the credit marketing process

2.1.14 Project Start Date

From the formalization of the partnership contract between the proponents (Agropalma S/A and Biofílica Ambipar Environmental Investments) on July 26th, 2021 for the development of the Project REDD+ Agropalma it was possible to start the first actions for conservation and reduction of deforestation.

Thus the starting date of the Project REDD+ Agropalma was set on August 04th, 2021. This date represents the kickoff of the project, being the day of the first planning meeting and definitions of the beginning of the project where the objectives, schedule, budget and management processes were discussed, being the first action executed by the project.

2.1.15 Benefits Assessment and Crediting Period (G1.9)

The crediting period of Agropalma REDD+ Project will refer to the full period of 30 years, starting on August 04, 2021. and ending on August 03, 2051.

Monitoring in Agropalma REDD+ Project of the benefits to the climate, communities and biodiversity will be continuous, being submitted to verification by CCB, ideally every three years, throughout the duration of the Project.

2.1.16 Differences in Assessment/Project Crediting Periods (G1.9)

The Project crediting period is marked by the first kickoff meeting formalizing the partnership proposal for the development of the Agropalma REDD+ Project, between the Agropalma Group and the Biophilic Ambipar Environment Investments, as cited in Section 2.1.14.

After the partnership was made official with the beginning of the project, the first investments were made to develop technical studies to support the writing of the DPD, such as determination of the baseline and the socio-economic and environmental diagnoses.

Subsequently, there is the development of activities related to the scope of climate, community and biodiversity, along with the monitoring of attributes related to these scopes. At that moment, the collection of the first carbon credits commercialized takes place, which come from the first verification of the Project by VCS certification in order to financially encourage the development of these activities and monitoring.

In this way, the assessment of changes related to climate, community and biodiversity benefits begins in a period shortly after the start of the crediting period of the Project.

2.1.17 Estimated GHG Emission Reductions or Removals

Table 8 - Estimated reductions or removals of GHG emissions for Agropalma REDD+ Project

Years	Estimated GHG emission reductions (tCO2e)
2022	316,405
2023	360,389
2024	389,571
2025	510,739
2026	532,084
2027	738,341
2028	716,515

Years	Estimated GHG emission reductions (tCO2e)
2029	1,019,922
2030	1,038,161
2031	1,095,311
Total estimated Ers	**6,717,438**
Total number of credit years	**30**
Average annual Ers	**671,744**

2.1.18 Risks to the Project (G1.10)

Using the "AFOLU Non-Permanence Risk Tool v3.2", the probable natural and human-induced risks to climate benefits, reported in the Non-Permanence Risk Report of Agropalma REDD+ Project, were verified, as summarized in the table below (Table 9). The Non-Permanence Risk analysis using the aforementioned tool generated a buffer of 10%.

Table 9 - Final score of the Non-permanence risk for Agropalma REDD+ Project.

Category	Punctuation
Internal Risk	0.00
External Risk	0.00
Natural Risk	1.00
General punctuation (a + b + c)	10

2.1.19 Benefit Permanence (G1.11)

All the activities designed for the Project and their short, medium and long-term positive results have been carefully designed and planned, and the need for the results to be self-sustaining in the long term has been considered.

Thus, in order to maintain and enhance the climate, community, and biodiversity benefits during the 30-year term and beyond, a number of Project actions are focused on improving local governance and management capabilities, enhancing human capital and decision-making, and increasing awareness and capacity for sustainable resource management for all stakeholders. These activities will have short, medium and long-term outcomes and therefore help to empower and guide all stakeholders in self-determining

sustainable pathways to achieve climate, community and biodiversity benefits far beyond the Project lifetime.

The strategies associated with each activity for benefits to occur during the Project lifecycle and beyond are:

I) strengthening of patrimonial vigilance in Agropalma Farm, by remote and continuous monitoring, allied to terrestrial vigilance, with the purpose of avoiding invasions, deforestation and any kind of degradation in forest areas. The project aims to increase the efficiency of the surveillance operations. This way, surveillance operations will have a great increment in the intelligence process related to monitoring and territorial management, which should reflect directly in the maintenance of climate benefits beyond the life of the Project;

II) to develop and strengthen productive value chains of the main cultures of the region, mainly the oil palm, encouraging the social and productive organization, means for the valorization of the products and market access, as a way to stimulate the autonomy and the socio-economic development of the involved parties

III) to promote to the familiar farmers and small rural producers agricultural practices that lead to sustainable production, allowing the families to remain in the field, reducing deforestation and guaranteeing income and food security

IV) structuring a biodiversity conservation program, promoting environmental education actions, encouraging alternative activities to predatory hunting and fishing, and environmental awareness campaigns, in addition to the continuous monitoring of biodiversity on the Agropalma Farm;

V) strengthening local governance, with the empowerment of local leaderships, building or strengthening formal and informal collective structures of social organization, encouraging the search for basic rights and the engagement of stakeholders to discuss and solve environmental, structural, social and land demands of collective interest.

Thus, the Project aims through the activities and actions described the promotion of socioeconomic development of the region, the empowerment of communities, reduction of impacts generated by hunting and predatory fishing actions, consequently, the knowledge about these issues, promoting a mitigation and prevention of deforestation and proposing alternatives to unsustainable activities, in addition to the consequent reduction of emissions and pressure on local biodiversity. Therefore, the skills, training, and results of the proposed activities will be assimilated by stakeholders throughout the Project, providing lessons learned and direct and indirect impacts for the climate, biodiversity, and communities beyond the life of the Project.

2.1.20 Financial Sustainability (G1.12)

The proponents of the Project have a solid partnership signed in 2021 with the objective of making investments in the conservation of Agropalma's forest reserves possible through the commercialization of environmental assets. Agropalma REDD+ Project will be an initiative that should enable, in the medium and long term, the continuous investment of resources aimed solely at conservation and sustainable development in the region.

Considering the current assumptions of the carbon market and the potential to generate GHG Emissions Reductions, the financial flow of Agropalma REDD+ Project presents very attractive results. In this model, proponents expect to recover the investment made in the Project when the commercialization of GHG Emissions Reductions begins.

Other information related to the financial analysis of Agropalma REDD+ Project and demonstrations of the financial health of partner institutions (project proponents) are considered commercially sensitive information and were shared with the audit team on a confidential basis.

2.1.21 Grouped Projects

Not applicable.

2.2 Without-project Land Use Scenario and Additionality

2.2.1 Land Use Scenarios without the Project (G2.1)

To determine the land use scenario in the absence of the Project (baseline scenario) the approved methodology VCS VM0015 version 1.1 was used together with the approved VCS tool “VT0001 - Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities”, version 3.0.

The analysis of deforestation, vectors and hidden causes, as well as the probable land use scenarios in the absence of the Project were performed based on the baseline scenario, therefore more details can be found in Section 3.1.4.

2.2.2 Most-Likely Scenario Justification (G2.1)

The Reference Region has an area of 1,802,252 hectares and presents a historical deforestation rate, verified through the PRODES deforestation data, which occurred between August 1, 2011 and August 2,

2021 of 72,108 hectares (8.5% of the forest cover relative to August 1, 2011), and during 2011 and 2021 an average deforestation rate of 7,210 hectares per year (0.85% per year) was observed, respectively.

Among the realistic alternative land use scenarios that would occur within the Project boundaries in the absence of the AFOLU Project activity recorded in the VCS were:

I) Continuation of land use prior to the Project (baseline scenario):

The Project Area is inserted as a private area in the middle of a mosaic of forest areas, which over the last decades has suffered major threats to its biodiversity with a history of degradation related to timber theft, invasions, hunting, squatting, among other activities, so that despite the protection determined by law, the security and surveillance of these areas are extremely fragile, enabling such illegal activities.

The deforestation is caused, in general, by the illegal extraction of wood, and by the historical practice of production based on "slash and burn", mainly for beef cattle raising and commodities agriculture, especially grains, also having anthropic pressure against the deforestation by small and medium rural properties. Besides being directly linked to expansion projects for infrastructure and logistics.

Between 2011 and 2021, 79,318 hectares were deforested in the Reference Region for these activities. The projected deforestation for the next decade (2022-2031) in the Reference Region is estimated at 210,132 ha while the total projected deforestation for the Project Area for the crediting period was 13,951 ha, with an annual average of 1,395 ha.

In this scenario, this process tends to remain until a large part of the forest cover is altered, not contributing to climate change mitigation and generating an immeasurable impact on local biodiversity, besides further deepening social and economic problems;

II) Scenario with conservation activities in PPA and LR with surplus, carried out by Agropalma, without registration of VCS AFOLU project: this scenario represents compliance with all relevant regulations, norms, standards and legislation regarding Permanent Preservation Areas (PAA) and Legal Reserve (LR) with conservation activities to protect these areas and their surplus carried out by Agropalma, not registered as a VCS AFOLU project.

The exploitation of the surplus vegetation of the legal reserve by Agropalma is possible to be performed, according to the Law, however the company has no intention of performing this activity. Thus, the maintenance of these areas causes increased costs to Agropalma, as well as the need for greater investments to be applied in the surveillance and protection of forests and their biodiversity. This cost of maintenance of forest areas is approximately 2 million reais per year for Agropalma, to be applied in the surveillance and protection of forests and their biodiversity.

Detailed information on the land use scenarios proposed by the Project activity can be found in Section 3.1.5.

2.2.3 Community and Biodiversity Additionality (G2.2)

The current scenario, which considers the absence of the Project, would be limited in generating climate, community and biodiversity benefits. This panorama without the activities of REDD+ Project tends to induce and enhance illegal practices, such as exploitation of wood of commercial value by lumber companies, sawmills and charcoal plants; associated with converting land to subsistence agriculture under conventional "slash and burn" practices, agricultural production of grains, raising beef cattle on extensive pastures and the possibility of implementing and maintaining infrastructure and logistics projects. As a result, environmental degradation would be leveraged by increased deforestation pressure in the reference region, gradually advancing to the limits of Agropalma Farm. This context is further presented, described and explored in Sections 2.3.4 (Community costs, risks and benefits), step 3 (Analysis of agents, determinants and underlying causes of deforestation and its probable future development), 4.1.4 (Without-project scenario: Community) and 5.1.3 (Without-project scenario: Biodiversity).

The scenario with the development of the REDD+ Agropalma Project, through activities focused on climate, biodiversity and local socioeconomics; would be positive from the environmental, social and economic point of view.

The strengthening of patrimonial vigilance in Agropalma's Farm, through remote and continuous monitoring, allied to terrestrial vigilance is relevant considering the local historical problems and with the intention to avoid invasions, deforestation and any kind of degradation in the forest areas of Agropalma's Farm. Additionally, activities such as encouraging the development and strengthening of productive value chains of the main crops in the region, especially the oil palm, encouraging social and productive organization, through the valorization of products and market access, as a way to encourage autonomy and socioeconomic development of the parties involved in the context of the REDD+ Agropalma Project.

Specifically, the promotion of improvements for family farmers and small rural producers in their agricultural practices that lead to sustainable production, allowing them to retain families in the field, reduce deforestation, and ensure income and food security.

In a practical way, the structuring of a biodiversity conservation program, with environmental education actions, incentives for alternative activities to hunting and predatory fishing, and awareness campaigns on environmental issues, in addition to the continuous monitoring of biodiversity on the Agropalma Farm would also help to contain illegal deforestation and conserve local biodiversity.

In this sense, the strengthening of local governance, with the empowerment of local leaderships, construction or strengthening of formal and informal collective structures of social organization,

encouraging the search for basic rights and the engagement of stakeholders to discuss and solve environmental, structural, social and land demands of collective interest is also foreseen, because all the actions previously mentioned, together, contribute significantly to reduce illegal activities that harm the fauna and flora of the region.

In parallel, initiatives to articulate, develop, and consolidate partnerships between stakeholders and local agents ensure effectiveness and continuous improvement in the implementation of the activities proposed by the project, taking into account the local reality and demands. This integration and engagement allows for the constant and thorough evaluation of the project's actions, strategic decision-making, the involvement of all stakeholders, and the strengthening of governance in the communities.

Therefore, the REDD+ project, through a set of technical, governance and management mechanisms, aims to ensure the preservation of standing forest, providing, consequently, benefits to biodiversity conservation, maintenance of ecosystem services, climate regulation and local socioeconomic development. Thus, remaining conserved forests are moving towards anthropized and degraded areas, through deforestation, in the scenario without the Project. This is different from the context with the implementation and execution of REDD+ Project activities, as shown above.

Given the scenarios presented "with" and "without" the REDD+ Project, and through the primary and secondary information collected and verified in the environmental and socioeconomic diagnoses, it is clear the importance of the implementation and development of the Project on the Agropalma Farm. Therefore, considering that the impacts of the Agropalma REDD+ Project are essentially due to avoided deforestation, improvements in agricultural production and commercialization practices; monitoring of deforestation and biodiversity, environmental education, patrimonial vigilance, strengthening of governance and other activities carried out during its duration, the main net benefits of the community and biodiversity project that would not occur in its absence are:

For Communities:

- Access to training services and capacity building on sustainable agricultural practices through partnerships;

- Improved land quality and agricultural productivity through the introduction of new production techniques;

- Strengthening skills, knowledge and human capacity on economic productivity and sustainable use of resources;

- Promotion and generation of new sustainable businesses, increase and diversification of income in the surrounding communities and integration with new markets;

- Environmental awareness and permanence of families on their land;

- Establishment of partnerships, strengthened social organization, efficient communication and improved joint work.

For Biodiversity:

- Direct action against habitat loss and forest fragmentation;

- Promotion of biodiversity conservation of fauna and flora;

- Conservation of diagnosed species and high conservation value attributes (HCVAs), including those with some degree of threat;

- Reducing extinction risks, guaranteeing genetic diversity;

- Stimulating, deepening and improving knowledge about local biodiversity through studies and long-term monitoring;

- Mapping of new areas of relevance for conservation and maintenance of connectivity in the landscape.

As described in Section 2.5.7, there are several laws, norms and decrees (federal and state) that address issues related to conservation of environmental and ecological heritage and respect for the rights of traditional peoples and communities. Among these regulations are, for example, Federal Laws 13.123/2015 and 12.651/2012. However, as described in the common practice scenario, these legislations, in short, are not applied in practice.

That is, there is a legal fragility and inefficiency regarding the access and use of land in Brazil and the protection of natural ecosystems and their resources, as well as the protection of threatened species of fauna and flora; reinforcing that the existence of such regulations does not guarantee their effective compliance and enforcement.

In addition, the analysis of the scenario without the Project demonstrates the existence of several barriers to the implementation of activities that could have positive impacts, such as those mentioned above. More details on Project additionality for the community and biodiversity can be obtained and consulted in Sections 4.1.4 and 5.1.3.

2.2.4 Benefits to be used as Offsets (G2.2)

There was a demonstration of additionality for biodiversity and the community, as presented in Section 2.2.3 . It should be noted that the benefits generated will not be used in other compensation programs, as Agropalma REDD+ Project only aims to produce compensation related to Reduced Emissions by Avoiding Deforestation, as described in Section 3 - Climate.

2.3 Stakeholder Engagement

2.3.1 Stakeholder Access to Project Documents (G3.1)

Access to the documents of Agropalma REDD+ Project by stakeholders will be done by physical, virtual and oral means, where the main objective is to guarantee access of stakeholders to the documents and relevant information referring to the Project.

The availability of the full description of the DPD documentation of Agropalma REDD+ Project and the monitoring report will be available to the community and other stakeholders throughout the life of the project virtually on Biofílica Ambipar Environmental Investments website, on Agropalma website and Verra website. Also, news about the project may be made available via e-mail groups, as well as social media on LinkedIn and Instagram of Biofílica (https://www.linkedin.com/company/biofilicabr/mycompany/ and https://www.instagram.com/biofilica_br/) and Agropalma (https://www.linkedin.com/company/agropalma/ and https://www.instagram.com/agropalma_/), respectively.

In addition, printed copies of the project design description, monitoring reports and other information regarding the carbon project will be made available to all stakeholders at the sustainability department of Agropalma Tailândia, located at PA-150, KM-74, Rural Area S/N. Tailândia – Pará. P.O. Box 108. Zip Code 68695-000.

Access to project information may also occur through the availability of copies of Viver Bem (communication channel described in Section 2.3.8) with relevant information to stakeholders, as well as, with forwarding links to access project documents.

Project information may also be transmitted during meetings, events or other face-to-face gatherings.

Verra's public consultation event will be widely publicized to stakeholders who will have access to the draft project design description (DPD), as well as the opportunity to express criticisms and/or comments.

2.3.2 Dissemination of Summary Project Documents (G3.1)

Access by communities and other stakeholders to the summary of the DPD and other documents of the Carbon Project will be physically available at the sustainability department of Agropalma Tailândia and on the websites also mentioned in the previous topic, so that all interested individuals, communities and institutions can access said documents free of charge and transparently.

Also, as described in Section 2.3.1, summarized information about the project will be disclosed through Viver Bem channel, and during events, workshops and other face-to-face meetings.

Other forms of dissemination can also be used to provide total transparency and communication of the project, such as the use of Agropalma communication channels as well as additional social networks and information folders, according to the demands of the Project. Further details will be provided on the communication channels used by Agropalma that may be used by this Agropalma REDD+ Project (Section 2.3.8).

2.3.3 Informational Meetings with Stakeholders (G3.1)

In order to implement appropriate social activities for the surrounding communities, the socio-economic Diagnosis (SED) was carried out by the Project proponents together with Peabiru Institute, in which Agropalma REDD+ Project was presented in an effective and accessible way, in addition to collection of information necessary for the construction of the Project. The approach used was through the collection of secondary data, dialogs, interviews and application of questionnaires. The survey was carried out with the stakeholders already described in Section 2.1.9.

In addition, meetings, encounters and workshops with the proponents of Agropalma REDD+ Project and the stakeholders for dialog on the planning, structuring and reporting of the carbon project initiatives with the community and other stakeholders will take place throughout the design phases, development, execution and monitoring of activities. These events will happen more intensely in the first years of the project.

Whenever necessary, informative meetings and workshops will take place with the proponents of Agropalma REDD+ Project and the social actors of the aforementioned carbon project, depending on demand and local availability. All planning of the meetings will be mainly and previously disclosed through the delivery of invitations and letters in hand to the stakeholders, as well as via e-mail, WhatsApp and calls. Additionally, Agropalma means of communication informed in Section 2.3.8 may also be used.

Finally, between November 21 and 24, 2022, as part of the project validation process, feedback to communities and other local stakeholders was carried out to bring results from the SED, in addition to the next steps of the Project, presentation of channels of communication and validation of the proposed activities described in. Section 2.1.11.

2.3.4 Community Costs, Risks, and Benefits (G3.2)

As previously explained, a Socio-economic Diagnosis (SED) was carried out involving the communities around Agropalma REDD+ Project zone (details in Section 2.1.9 – Description of the Actors). The activities carried out together with the communities allowed analysis of scenarios through interviews.

Among the strengths of the communities, it is important to highlight the production and sale of non-timber forest products such as acai berries, palm oil and cupuaçu for pulp processing and sale, in addition to cassava crops and the production of flour, black pepper, corn, passion fruit and rice, among other products produced in agroforestry systems. In addition, formal and non-formal social organizations representing the communities, which play an important role, were identified and may be an opportunity to form potential partnerships for the project actions, in addition to increasing the possibility of access to new markets.

With regard to the weak points of communities, it is important to highlight the low enforcement of environmental legislation, property rights, low organization of producers, low insertion in the market, low quality products, low transparency in integration contracts, asymmetric information among producers, middlemen and company, unilateral price formation, non-distribution of added value with outgrowers, low cost management capacity, limited entrepreneurial potential of community members, very low profit for producers, among other social factors. The main weak points stand out as the low level of interaction among rural communities, and between Agropalma and the 23 communities. Some factors contribute to the occurrence of these weaknesses, such as the low organization of producers, low result with collective activity, informal and unpaid employment, cultural factors and traditions not considered, low education and social well-being, which need be faced by the project.

The results obtained from the questionnaires, dialogs and interviews were the basis for the preparation of the plan of activities presented in Agropalma REDD+ Project, described in Section 2.1.11. In addition, the results were returned to communities and the activities proposed by the Project were validated, as described in Section 2.3.7.

Also, throughout the project, more appropriate and relevant information on costs, risks and potential benefits to communities should be provided at Project meetings and consultation on activity development, and during follow-up meetings. Additionally, it was initially clarified, and should be reinforced throughout the Project, that participation is voluntary and the decision to participate or not is not final nor results in any type of restriction.

2.3.5 Information to Stakeholders on Validation and Verification Process (G3.3)

Communities potentially participating in the Project and other stakeholders will be informed about the CCB validation and verification through the available Agropalma communication means described in Section2.3.8., in advance of the event.

Virtual channels, such as Biofílica and Agropalma websites, will also be used to inform other stakeholders and the general public, as well as sending messages in email groups.

In addition, as explained in the previous sections, information about the Project has already been disclosed during the Socio-Economic Diagnosis (SED) and feedback on the results obtained and presentation of the proposed activities to the stakeholders.

2.3.6 Site Visit Information and Opportunities to Communicate with Auditor (G3.3)

Visit to the Project site by the auditor will be informed to the communities, proponents, partners and other stakeholders participating in Agropalma REDD+ Project by sending emails and/or letters, WhatsApp messages, calls and other available means of communication (Section 2.3.9), in advance of the event. Agropalma workers will also be informed about the period of field visits by the auditors.

In addition, when returning the results of the Socio-Economic Diagnosis and validating the activities proposed by the Project with the stakeholders, the stages and next steps of the Project were also mentioned, as well as the audit event.

Communication between communities and other actors with the auditor, as well as disclosure of information will be facilitated through the distribution of folders, channels, Biofílica website, Agropalma website, in addition to the entire Agropalma communication structure described in Section 2.3.9, directed to the Project's stakeholders. During the audit event, all stakeholders will have broad access and availability to communicate with the auditor.

2.3.7 Stakeholder Consultations (G3.4)

Articulation of stakeholders of Agropalma REDD+ Project began in 2020, with the beginning of the first negotiations through the submission of a proposal. The final proposal was presented in September 2020 and the signing of the contract between the proponents (Biofílica and Agropalma) took place on July 26, 2021. After formalization of the agreement, the next step was the identification of actors and partnerships to assist in the development of technical studies for implementation of the project. The process of defining partnerships for technical studies started in the second half of 2021. With the technical partners defined, diagnoses started in September 2021 and were concluded in August 2022. The kickoff workshop was held on August 4, 2021 and the preliminary results presentation workshop on May 11, 2022, both with the objective of sharing knowledge among the parties, aligning the main problems encountered and describing the scope of activities and their casual relationships.

During such workshops, participants were divided into working groups in which technical and descriptive points about certification standards and their requirements in relation to fauna, flora, socio-economic, physical environment, carbon inventory and baseline determination were discussed. These working groups

defined, among the strategic actions of the Project, the Field Work Plan and prior assessment of the communities that would be selected to be directly involved in the first phase of the Project.

Subsequently, between February 8 and 14, 2022, the first consultation was carried out with the communities initially selected for the Project, a process that gave rise to the report developed by Peabiru Institute, in which they gathered the results of the socio-economic diagnosis (SED) carried out in field (Section 2.1.16 for more details). The SED carried out “in loco” interviews to collect information and the results of participatory workshops where strengths and weaknesses of the stakeholders (communities and Agropalma workers) were listed, aligned and related to their potentialities and opportunities and which resulted in the activities and actions proposed by the Project. The main results found in this research that were considered in the construction of the Project are described in Section2.3.4.

The combination of this information gave rise to the main points included in the Project's activities regarding the direct and indirect impact on the communities, as described in Section 2.1.11, with the main objective of stimulating socio-economic development through the promotion of agricultural practices and production models sustainability, strengthening local governance, developing and strengthening value chains and a biodiversity conservation program, in addition to strengthening asset surveillance in order to guarantee integrity of the forest cover in the Project Area.

With the conclusion of technical studies, feedback was given to the communities and stakeholders between November 21 and 25, 2022. Contact with the 23 communities was through the delivery of invitation letters to community leaders in person in each community, happened between November 14 and 18, 2022. In addition, municipal institutions such as environment secretaries from Pará State and municipalities (SEMAS), Technical Assistance and Rural Extension Company of the State of Pará (EMATER) e Agricultural Defense Agency of the State of Pará (ADEPARA). were invited. We emphasize to everyone that participation was voluntary and the decision to participate or not is not final nor results in any type of restriction.

During the feedback, participants were presented with the results of the socio-economic diagnosis of the region and the proposed activities that will be carried out by Agropalma and Biofílica throughout the project. The objective was to present the Project and open a place for participants to ask questions and make suggestions about the design of the Project and its activities and impacts. During the events, all participants had the opportunity to express their ideas and opinions on the content presented, in order to improve the proposed activities. In addition, the proposed communication channels to be structured and used throughout the project were also presented as well the next steps.

Participants did not make requests or suggestions for changes to the proposed Action Plan, only a commitment to monitor the progress of the Project and willingness to be involved in the future was

demonstrated. Additionally, with the aim of expanding the disclosure of information about the Project, all participants received Project posters to distribute in their respective communities.

Photos, attendance lists were taken and voluntary questionnaires were applied to the participants to record their understanding of what was being passed, as well as to have a space to make criticisms and suggestions about the Project and the dynamics followed in the feedback. All documents, including a full report of the feedback activities and additional evidence were made available to the audit team.

In addition to these events, the expansion of stakeholder consultation was reinforced by sending letters to relevant local institutions in the states of Pará, among others that have direct and indirect involvement in the forest conservation and environment sector, such as trade unions, non-governmental organizations (NGO's), private sector, State Public Prosecutor's Office and other government agencies in the areas of federal agriculture and environment, where updated information was presented on the status of the project, the communication channels used and invitation to participate in the Public Consultation as described in Section 2.5.8.

2.3.8 Continued Consultation and Adaptive Management (G3.4)

The communication plan created to continue communication and consultation among project proponents, communities and other stakeholders follows the following structure:

Communication channels: communication will be carried out through consolidated channels of Agropalma, e-mail, WhatsApp, telephone, social networks and websites of the proponents Biofílica Ambipar (https://www.biofilica.com.br/) and Agropalma (https://www.biofilica.com.br/). In addition, it can happen through meetings, lectures and other face-to-face events and visits to communities.

- Alô Agropalma: Agropalma's communication channel, aimed at internal and external audiences, in which stakeholders can register doubts, suggestions and complaints, via e-mail (aloagropalma@agropalma.com.br) and telephone (0800 709 0706) with access to the WhatsApp messaging application too.

- Viver Bem: quarterly material, produced by Agropalma's Corporate Communication team, aimed at the communities surrounding the three operating units of Agropalma. Topics covered focus on health, safety, well-being, quality of life and other subjects that may be of interest. The material has a simple, objective, illustrative and attractive language, to facilitate access to information. The print run is 1500 copies, which can be modified according to the need and are distributed at strategic points in the communities, such as shops and community spaces.

- Interaction Newsletter: Agropalma's Corporate Communication produces the company's newsletter, combining texts and images, with monthly occurrence. The Interaction Bulletin is distributed by email, made available on the intranet, displayed on bulletin boards and distributed in print to supervisors in the Agricultural area, for the transfer of information to employees who carry out rural activities. In this vehicle, projects, events, training, campaigns and actions, carried out inside or outside the four units of Grupo Agropalma, are highlighted.

- Corporate Communication Notice Board and TV: are official communication channels, under the responsibility of Agropalma's Corporate Communication. Normally, they are updated on a weekly basis, except when there is no new content to replace the posters on display. The published information is of interest to the internal public, covering subjects such as campaigns, events, internal communications, training, among others. If there is no new content, the update of such boards may not be carried out.

- Internal Communications: Internal Communications are always forwarded by email, and when they are of interest to everyone, they are also posted on the Corporate Communication notice boards. Both notices (in electronic or printed form) are standardized by Corporate Communications. Request for internal communications must always be made by the area, formally, by email. The communication must always have the signature of the manager or director of the area responsible for such information. Before publication, the material will always be approved by the manager or director of the requesting area. The turnaround time is 5 days

- Newsletter EXTRA!: It is aimed at information of public interest, generally extraordinary announcements, which have the need for instant disclosure. It is produced by the Corporate Communication area and disseminated by email. If necessary, it can also be posted on the Corporate Communication notice boards. The newsletter must always be approved by the coordinator, manager or director of the area. The turnaround time is 24 hours.

Social mobilization strategy: social mobilizations will take place in order to carry out meetings, activities, lectures, training, among other meetings. Mobilizations will be made through mailing (e-mail), telephone, WhatsApp, in person and other means of communication that may be necessary, always making use of the submission of official letters. In each event, it will be defined which parties will be mobilized depending on the theme and negotiations.

Communication procedures: through a defined structure, demands of stakeholders will be received by the described means of communication, recorded in a standard form, analyzed and forwarded to the responsible areas, if necessary, and resolved in a predetermined time by the parties involved. Responsibility for such response depends on the complexity of the demand, and may be carried out by the person responsible for the communication of the Project, by the specific areas or by the management of Agropalma, including the communication channels described in Section 2.3.9.

Conflict management: conflict management will be based on the peaceful resolution of opposing interests directly linked to Agropalma REDD+ Project, seeking all possible means of negotiation, being that decision-making will harmoniously meet all parties involved, taking into account the well -being of everyone. All definitions for managing and resolving conflicts in the 1st, 2nd and 3rd instances contained in the CCB Impact Assessment Manual for Society and Biodiversity for REDD+ will also be followed. They will be carried out by any means of communication mentioned above, also prioritizing the means that the parties feel more comfortable and with less time for resolution.

The communication plan of Agropalma REDD+ Project can be adapted throughout the life of the project as needed, in order to improve communication among stakeholders and responses to demands.

2.3.9 Stakeholder Consultation Channels (G3.5)

The activities of the Project are designed and implemented taking into account the aspirations, characteristics and limitations of each community as defined and verified during the Socio-Economic Diagnosis (SED) workshops and the feedback meeting. As described in Section 2.3.4., workshops as part of the SED and meetings between the communities and workers of Agropalma and the Project proponents have already been held.

Such communication and accessibility for discussion on the progress of Project activities between stakeholders and proponents will occur continuously throughout the duration of the Project through the available communication channels, as described in more detail in Section 2.3.8 above.

Furthermore, feedback was provided to the communities, as described in Section 2.3.6, increasing the level of information sharing.

Additionally, a special edition of the *Viver Bem* Journal was created for the project and disclosure of the public consultation at Verra, so that information could reach the local communities, reinforcing the invitation to stakeholders to participate and have more information about the project as described in the Section 2.5.8.

2.3.10 Stakeholder Participation in Decision-Making and Implementation (G3.6)

The processes related to decision-making and implementation, as well as the various activities related to the Project, are open to community participation. Furthermore, the project will seek equal participation of young people and women in decision-making and implementation of Project activities.

Involvement in the design, implementation, monitoring and evaluation of the Project takes place through the available communication channels (Sections 2.3.8 and 2.3.9) and informational meetings, in which all interested communities have the opportunity to participate.

Also, as shown in section 2.3.7, participatory events were held with the stakeholders for development and design of the Project.

2.3.11 Anti-Discrimination Assurance (G3.7)

Agropalma has a solid policy related to human rights and social responsibility, counting on a Code of Ethics and Conduct, environmental policy and also a health and safety policy. The Code of Ethics and Conduct serves as a guideline that should guide the conduct of the company's members in relation to contact with the internal and external public, promoting the dissemination and sharing of values and stimulating the improvement of behaviors and attitudes.

Furthermore, the scopes of Agropalma's Code of Ethics and Conduct, which values the practice of values in all relationships, whether with internal or external audiences, do not admit attitudes of discrimination or prejudice of any nature (race, religion, age, gender, political conviction, origin, marital status, sexual orientation or physical condition), as well as abusive attitudes.

Agropalma formed a Gender and Diversity Committee whose attributions include raising awareness, identifying and addressing issues regarding the promotion of gender equity and opportunities and improvements for women, who currently make up 22% of its staff. In addition, Agropalma provides equal remuneration for the same scope of work, with employees of the same function earning the same salary, according to the legal requirement of CLT Article 461.

Agropalma's Conduct Manual (item 6.38) contains clear, direct and express prohibition of any form of harassment, in order to prevent sexual harassment and all other forms of harassment and violence, being implemented and communicated at all levels of the workforce. The manual indicates how to proceed in case of this type of occurrence and informs that there will be a confidential investigation to allow appropriate measures to be taken in accordance with Law 13718/2018. DEL, 5.452 Art.483. (CLT).

Moreover, Biofílica Ambipar Environmental Investments, belonging to the Ambipar Group, has a code of ethics and conduct that represents all the companies of the Group. Thus, the document serves as a primordial instrument to guide the conduct of all parties involved, in the adoption of good practices in relationships and in doing business, guiding attitudes of respect for diversity, to combat any form of prejudice.

The communication channels of Agropalma REDD+ Project (Section 2.3.9), will be available to report any attitude that goes against the values described by the Code and complaints can be received specifically through Alô Agropalma channel described below (Section 2.3.12).

2.3.12 Feedback and Grievance Redress Procedure (G3.8)

Agropalma, together with Biofílica Ambipar Environmental Investments, created an accessible conflict resolution procedure, in which the processes and means of communication are described, in addition to conflict management and the Feedback procedure (Communication Plan Section 2.3.8), and the channel Alô REDD+ Agropalma, described below:

- Alô Agropalma: Managed by Corporate Communications, Alô Agropalma is the relationship channel between us and internal and external audiences. We act in accordance with the Conduct and Ethics Manual for Agropalma Employees and the legislation in force in Brazil. The main objective is to promote ethics and transparency within each unit of the Group and to deal confidentially and impartially with the complaints, compliments, suggestions, questions and claims we receive through this channel. The channel is also available for queries, doubts, suggestions and other connections from interested audiences related to Agropalma REDD+ Project.

Upon receiving the demand, via call center by telephone (0800 7090 706) and e-mail aloagropalma@agropalma.com.br) , the Corporate Communication area transcribes the audio and forwards it to the manager of the area responsible for the investigation and/or dealing, with a copy to manager of the Internal Audit area (AUDICON), for knowledge. The manager responsible for the demand must analyze it and, if necessary, take the appropriate steps to resolve it within a period of three weeks. The response on what action to take must be forwarded to Corporate Communications, which will provide feedback to the channel user. Demands assessed as critical by AUDICON may have a reduced or extended period for investigation and handling, as requested by the Internal Audit department to the responsible area manager. Details of the handling of the demand must be sent by the managers to Corporate Communication, with all the records used in the exchange of information and/or investigations, such as emails or copies of documents, so that the control and archiving of the entire process, until closure, are done. It is also up to Corporate Communication to register each demand on the Alô Agropalma Form and on the Alô Agropalma Registration Follow-up.

The investigation and handling of demands is the sole responsibility of those proponents responsible for the Project, in which demands related to environmental issues can be made through these resources, but will also be immediately forwarded to Agropalma's Environment area.

Moreover, Agropalma and Biofílica Ambipar team verbally reviewed the communication plan and explained how any community member or stakeholder can submit comments, suggestions, complaints, through the communication channels described in the Project.

The proponents, upon becoming aware of complaints, doubts, suggestions, compliments, grievances, and requests related to Agropalma REDD+ Project, will consider the following processes within the complaints feedback and redress procedure: receipt, analysis, response, and attempted resolution within a reasonable timeframe for the complaints and grievances, making use of traditional methods used by the community and other stakeholders for conflict resolution whenever possible.

There will be time limits for feedbacks, complaints and denunciations to be considered regarding the greater conflict resolution efforts in the first stage of the three different phases that comprise the process: attempted resolution, mediation, and trial in courts. In cases where there is no resolution at the first stage, there will be an attempt of mediation, and if this is not effective to solve upon a neutral consultation with the parties involved, there will be arbitration as a last resort, applied in extreme cases with trial.

We emphasize that the means of communication proposed for the project were presented and validated at the feedback event.

2.3.13 Accessibility of the Feedback and Grievance Redress Procedure (G3.8)

As mentioned in the previous topic, Agropalma REDD+ Project will adopt the receipt of feedback, complaints and claims in addition to the conflict management and Feedback procedure (Communication Plan Section 2.3.8 and Alô Agropalma Section 2.3.12), by telephone and email of Alô Agropalma. Its developers will ensure that the entire history of complaints, doubts, suggestions, compliments, claims and requests, and their respective developments in procedures and decision-making, are disclosed and accessible in a clear and transparent way to all individuals, community members and institutions, both in physical files (for example notebook/folder of records) and virtual files.

It is worth reinforcing that, in all the channels for receiving feedbacks, complaints and denunciations, the records may be anonymous, except in cases in which the individuals require identification. In general, the time limit for return of up to 3 weeks will be considered.

2.3.14 Worker Training (G3.9)

The qualification and empowerment of local actors are essential to assure quality in the implementation of the actions proposed by the Project, as well as to ensure the permanence of results and positive impacts

in the long term. It is understood that, in order to guarantee effectiveness in the implementation of Agropalma REDD+ Project, it is essential to work on the generation of local human capital, focused mainly on the management responsible for natural resources. Thus, among the various actions proposed by the Project (as detailed in Section 2.1.11), one part involves training and engaging local actors. The main proposals that aim to promote the training of local actors, income generation and direct and indirect jobs are described below.

- Strengthening asset surveillance: the activity should involve training and qualification of employees who work in asset surveillance at Agropalma Farm. Training and qualifications aim to improve the asset surveillance techniques that already occur within the Farm, also improving working conditions and helping to contain invasions and illegal activities;

- Strengthening of local governance: involves strengthening and expansion of social actions already developed by Agropalma in the region and the formation of partnerships, mainly for acting in locu. The Project, through this activity and its purpose of strengthening the capital stock and engagement of communities in relation to the search for basic rights, can stimulate the creation of indirect jobs and attract investments to the region;

- Strengthening of sustainable agricultural practices: the activity involves the promotion of qualifications and training within the lines mapped by the Project, in addition to mapping stakeholders with potential to adhere to actions to promote sustainable practices and technical development. Also, the activity promotes improvement of practices developed by the communities, promoting strengthening of human capital as one of the means for sustainable development;

-Development and strengthening of value chains of agricultural and forestry products: the activity involves the promotion of skills for valuing and marketing agricultural and forestry products, promoting sustainable development. In addition, the Project proposes to map the main opportunities and implement partnerships for the development of activities, increasing investments and improving the income of families that depend on these activities for their food and financial security;

- Biodiversity conservation program: the activity involves in situ monitoring of biodiversity carried out by local partners, in addition to the participation of stakeholders, mainly community members and workers at Agropalma Farm, in environmental education actions, promoting technical development and environmental awareness, in addition to strengthening the management of the territory and promoting conservation of biodiversity.

In order to guarantee the efficiency and permanence of these actions listed above, proponents must seek the best techniques and procedures to conduct training for those people involved in the activities, always seeking to ensure successful qualification of the team to work with the communities and meet project goals.

These processes will follow all relevant laws and regulations related to worker rights, as described in Section 2.1.16, bringing team involvement to meet the project schedule and targets, with the aim of optimizing investments and avoiding loss of human resources due to staff turnover. Other measures adopted to avoid the loss of acquired capacity will be the constant recording and reporting of procedures and monitoring of results obtained, since, in the event of staff turnover, the procedures can be easily reproduced, mitigating impacts on the implementation of the project plan.

In addition to what was previously described, Agropalma also has the following activities that will be included in the activities of Agropalma REDD+ Project, aimed at training the workforce:

- Program to regularly educate the workforce on the status of RTE conservation of species;
- Appropriate disciplinary measures are applied and documented in accordance with company rules and national law, if an individual working for the company is caught capturing, harming, collecting, trading, trapping or killing these species to be protected;
- The company integrates all new employees and, at that moment, information is passed on about the protection of biodiversity and prohibition of hunting and fishing in the company's areas;
- Documented training programs are in place, accessible to all staff, administrative, operational workers, producers and integrated family farmers, taking into account gender specific needs, which cover applicable aspects of the RSPO P&C, so that they understand and that includes training evaluation;
- The partner producers receive the “Orientation Guide for Palm Producers” and have been trained in its content that addresses the RSPO. Legal requirement: NR 5; NR 9, NR 31; NR 13; NR 10; NR 11; NR 12; NR 23; NR 18; NR 35.

Furthermore, the Project intends to seek partnerships with qualified institutions for the development of the proposed activities.

All activities are open to participation by all residents of communities surrounding the Project Area. The participation of women, young people and marginalized people is encouraged by the proponents and the hiring process for Agropalma workers involves all people residing in the communities as described in Section 2.3.15.

2.3.15 Community Employment Opportunities (G3.10)

Employment opportunities offered by Agropalma are equal to the surrounding communities, including management positions, if the job requirements are met. All job positions generated locally by the Project

follow the Recruitment and Selection process of Agropalma, which carries out the entire process according to the need and availability of job positions.

Recruitment and selection, hiring, access to training and promotion are based on skills, abilities, qualities and medical aptitude required for the job positions available. Processes are based on skills, capabilities, qualities and medical fitness according to documented procedures and are in compliance with Law 9029/05.

No criteria of race, gender, sexual orientation, color, religion, age, ethnic origin, physical or mental disability or social class are adopted. All stages of the selection processes, as well as hiring the professional, are based on criteria established in the description of positions offered and minimum qualification is desirable.

Furthermore, all service or labor providers contracted, as well as all Fresh Fruit Boxes (FFB) providers, comply with legal requirements. There is the existence and maintenance of an up-to-date list of contractors, where all contracts, including those of CFF suppliers, contain specific clauses requiring legal compliance such as prohibition of child labor, forced labor and trafficked labor.

It should be noted that the project proponents already have members of the communities in their composed teams of Agropalma, which highlights that Agropalma REDD+ Project will only reinforce the actions already taken in this regard. This way, residents of the surroundings or people living in the Farm are hired.

2.3.16 Relevant Laws and Regulations Related to Worker's Rights (G3.11)

Compliance with labor standards and laws applied by Biofílica Ambipar Environmental Investments is verified annually by means of audit. This is due to the fact that it is a limited liability company, in which its financial statements are published on JusBrasil website, the largest open legal community in Latin America.

Compliance with labor standards and laws applied by Agropalma is verified annually by means of audit, Roundtable on Sustainable Palm Oil (RSPO). This audit is known worldwide for the palm oil and palm kernel oil production sector, addressing the company's environmental, social and economic aspects.

After being hired and before starting the worker's activities, there is training and qualification on technical procedures and promotion of empowerment regarding their rights and applicable laws.

Additionally, employees are advised to associate with institutions responsible for their rights, the respective labor unions.

The relevant laws and regulations that protect the rights of workers in Brazil, as well as the

international agreements ratified by Brazil on labor issues are listed below:

Federal Law and Regulations:

- Decree-Law No. 5452, of May 1, 1943: Approves the Consolidation of Labor Laws.

- Law No. 6514, of December 22, 1977: Amendments to Chapter V of Title II of the Consolidation of Labor Laws, on occupational health and safety and other measures.

- Regulatory norm no. 31, of 03/03/2005: deals with safety and health at work in agriculture, livestock, forestry and aquaculture

International agreements ratified by Brazil:

- Convention of the International Labor Organization No. 29 of 1930, ratified by Brazil on April 25, 1957: Provides for the abolition of forced labor.

- International Labor Organization Convention No. 87, of 1940: Provides for freedom of association.

- Convention of the International Labor Organization No. 97 of 1949, ratified by Brazil on June 18, 1965: Provides for migrant workers.

- Convention of the International Labor Organization No. 98 of 1949, ratified by Brazil on November 18, 1952: Provides for the right to organize unions and collective bargaining.

- Convention of the International Labor Organization No. 100 of 1951, ratified by Brazil on April 25, 1957: Provides for equal pay for men and women.

- Convention of the International Labor Organization No. 105, ratified by Brazil on June 18, 1965: Provides for the abolition of forced labor.

- Convention of the International Labor Organization No. 111 of 1958, ratified by Brazil on March 1, 1965: Provides for discrimination with regard to employment and occupation.

- Convention of the International Labor Organization No. 131 of 1970, ratified by Brazil on May 4, 1983: Provides for the setting of the minimum wage, especially in developing countries.

- Convention of the International Labor Organization No. 87 and 138 of 1973, ratified by Brazil on June 28, 2001: Provides for the minimum age for admission.

- Convention of the International Labor Organization No. 142 of 1975, ratified by Brazil on November 24, 1981: Provides for the development of human resources.

- International Labor Organization Convention No. 143, of 1975: Provides for the development of illegal human resources, immigration and the promotion of equal opportunities for migrant workers.

- Convention of the International Labor Organization No. 155 of 1981, ratified by Brazil on May 18, 1992: Provides safety and health to workers.

- Convention of the International Labor Organization No. 169 of 1989, ratified by Brazil on July 25, 2002: Provides for indigenous and tribal rights.

- Convention of the International Labor Organization No. 182, ratified by Brazil on February 2, 2000: Provides for the prohibition of the worst forms of child labor and immediate actions for its elimination.

It is ensured that all employees and service providers are legally hired in accordance with Brazilian labor legislation. In addition, international agreements ratified by Brazil and issues related to worker well-being are respected.

2.3.17 Occupational Safety Assessment (G3.12)

An important component of the Project involves strict and effective care for the safety of workers, taking into account the internal regulations and official norms established by the federal and state governments. Bearing in mind that the work processes and the work environment can cause damage to health, it is necessary to establish and implement a series of measures regarding the assessment of existing risks, promotion and maintenance of physical and social well-being of workers, prevention of occupational diseases, protection of workers against the risks resulting from factors adverse to health and placement and conservation of workers in the work environment suitable for their physical and psychological aptitudes. These Programs and their provisions are reviewed and updated annually, in accordance with the requirements of labor legislation and are intended to prevent, track and diagnose work-related health problems at an early stage.

Occupational Health Medical Control (PCMSO)

The PCMSO has the character of prevention, tracking and early diagnosis of work-related health problems, including those of a subclinical nature, in addition to verifying the existence of cases of occupational diseases or irreversible damage to the health of workers. The success of the Occupational Health Medical Control Program depends on the establishment of a partnership system between the medical service, the company's management and its workers, since each one, in its own way, has an important and specific role in the promotion, prevention and health protection in the work environment.

They are specific collective programs for certain conditions described in the PCMSO or detected from its development. They can be useful in the prevention and/or monitoring of arterial hypertension, diabetes, obesity, chemical dependency, smoking, STD/AIDS, in order to minimize complications. Based on the occupational risk factors identified in the preparation of the PPRA and PCMSO and on the medical licensing statistics presented by the employees, the Coordinating Occupational Physician plans and develops education and training activities focused on “how to work while preserving health”. The themes are specific

and the syllabus must consider the risk factors in question, their possible consequences on health and forms of prevention.

The PCMSO Annual Report must be prepared after 12 months of its effective date, and a date must be defined in the Action Schedule for its presentation and discussion with the Company's management and with the participation of the Internal Commission for Accident Prevention (CIPA). Include in the Report the activities carried out for education and training of employees aimed at preventing illness of an occupational nature, and also the profile of the employees evaluated and the number of employees injured at work or affected by an occupational illness, with and without leave, with diagnosis and sector identification. We conclude that all works referring to the current period and that the problems detected should be the object of the annual report included in this PCMSO, including clinical evaluations and complementary exams, statistics of results considered abnormal, as well as planning and prevention and improvements in the conditions of workers' health for the following year.

With the implementation of the PCMSO, an improvement in the working conditions and health of the company's employees is expected through preventive and curative measures. The aim is to identify and neutralize potentially harmful factors, detect occupational pathologies at an early stage, acting before the appearance of sequelae, treating cases or even referring them to specialized treatment, when necessary. This PCMSO must be complied with according to the NR7 Rules, Ordinance No. 24/94, 08/96 of the Ministry of Labor. Other Programs must be designed to minimize the environmental risks assessed in the PCMSO and PPRA.

Grupo Agropalma has the Occupational Health Medical Control (PCMSO), in which all activities carried out by the company are described through operating procedures, work instructions, environmental procedures, damage and disease control and prevention; and dissemination and communication of information.

The PCMSO is an integral part of the Company's broader set of initiatives in the field of workers' health, and must be articulated with the provisions of the following legal texts:

- Regulatory Norm No. 07 (NR-07), approved by Ordinance No. 3214, of June 8, 1978, of the MTE;
- Ordinance No. 24, of December 29, 1994, which approves the text set forth in NR-07;
- Ordinance No. 08, of May 8, 1996, which amends NR-07;
- Law No. 6514, of December 22, 1977, which amends Chapter V of Title II of the CLT, relating to occupational safety and medicine and other measures;
- Law No. 8112, of December 11, 1990, in its Articles 69, 72, 186 and 212;
- Regulatory Norm No. 7 and Ordinance No. 25, of December 1994 from the Occupational Health and Safety Department.

The PCMSO is planned and implemented based on the health risks qualitatively identified, after a previous survey of the requirements of the activities performed by workers.

Safety Performance Index

Agropalma's primary responsibility is to ensure a safe workplace that is constantly monitored, analyzed and improved. In recent years, a significant reduction in the number of accidents has been witnessed. This is believed to be primarily due to the deployment of the newly developed Safety Performance Index (IPS), which tracks all safety behavioral deviations by type, severity and location, providing an overview of which areas are most at risk related to occupational safety. With this, one can seek improvements in the use of PPE, in addition to education and awareness.

With the reduction in the total number of accidents, an increase in the severity rates is observed. This is mainly because many minor accidents have been eliminated, providing fewer accidents that are more serious and more difficult to prevent.

At Agropalma, there is a Health, Safety and Environment Department dedicated and focused on improving occupational safety in our operations. Through the mechanization and agricultural innovation program, several factors that traditionally cause significant amounts of minor accidents are eliminated. These include loose fruit picking, where the risk of cuts and thorns is high, hand spraying, which can cause chemical damage, and CFF carriers, which often cause back injuries.

Employees and local communities depend mainly on public health services, but emergency medical help is also offered at Agropalma outpatient clinic. All work-related illnesses or injuries are treated on company premises or at partner establishments, and 100% of costs are covered by the company.

In addition, assistance for general health issues is available to all employees through the private health plan. In 2019, the program was expanded so that employees could also choose to enroll in the dental plan.

As in many other parts of the world, lifestyle-related illnesses such as diabetes and heart disease are a significant concern in Brazil, with over 20% of the population classified as obese and around 10% suffering from type 2 diabetes. To support employees who want to leave a healthier lifestyle, we offer a new line of healthy food in the food system, ensuring that employees who eat in our cafeteria, as well as those who receive food delivered to the field, can select meals with less fat, salt and sugar.

In this context, a frequency of training and qualifications aimed at preparing own employees and third parties working in agricultural production activities and other jobs at Agropalma Farm are offered; such as: use of gloves; ear plugs; respirators; effects of noise on health; agricultural machinery and equipment;

general standards of safety and hygiene at work; and security and maintenance measures. Through internal rules and improvements in occupational health and safety practices, all positions and situations that could pose some types of occupational risk were deeply avoided and mitigated.

Roundtable Sustainable Palm Oil certification

Agropalma follows Roundtable Sustainable Palm Oil (RSPO) Certification for its entire scope of occupational safety assessment. In this sense, the parameters followed according to certification for occupational safety will be presented to the audit team.

2.4 Management Capacity

2.4.1 Project Governance Structures (G4.1)

The management of Agropalma REDD+ Project will be responsibility of Biofílica Ambipar Environmental Investments and Grupo Agropalma. The obligations and commitments of the parties are described below:

-Biofilica Responsibilities: general coordination of socio-economic and environmental diagnoses (SEED), baseline studies and carbon stock; construction of the DPD (Project Design Description); remote monitoring of forest cover and implementation/coordination of additional actions aimed at reducing/mitigating greenhouse gas (GHG) emissions; conducting validation/verification audits; dissemination of the Project; commercialization of credits and co-management of the Project throughout its duration.

-Agropalma Responsibilities: Investments necessary for the implementation and validation of the Project (Capex); co-management of the project, as well as development of all related activities in the environmental and social scopes, and support in infrastructure and logistics for Biofílica and other professionals involved in the Project. In addition, it must provide all the necessary support for auditing processes, the creation of disclosure materials and other commercial processes.

During the development of the project, other organizations (mentioned in Section 2.1.4 were involved in carrying out the diagnostic studies. Accordingly, the responsibilities are described below:

-Ambiens Soluções Ambientais: development of environmental studies, such as characterization of the physical environment and biodiversity of the region (flora and fauna).

-Biodendro: development of the carbon stock estimate study for Agropalma REDD+ Project.

-Peabiru Institute: development of the socio-economic study of Agropalma REDD+ Project.

As presented, Agropalma REDD+ Project is supported by human resources that helped in its development and implementation.

2.4.2 Required Technical Skills (G4.2)

The main technical skills needed for the implementation of Agropalma REDD+ Project are knowledge about the development and management of forest conservation projects in the Amazon biome, experience in implementing, developing and assisting programs for communities, implementing effective land security and asset surveillance.

All proponents involved in the project have the necessary technical skills for the successful completion of Agropalma REDD+ Project. Biofílica Ambipar Environmental Investments is a Brazilian company that promotes the management of forest areas in the Amazon and Atlantic Forest biomes. The company has a specialized team and is a reference in the development of forest conservation projects, guaranteeing the quality and effectiveness of the REDD+ activities carried out.

Grupo Agropalma was established in 1982 and currently comprises three companies: Agropalma S/A, Companhia Refinadora da Amazônia (CRA) and Indústrias Xhara LTDA, the refinery. The company is part of Conglomerado Alfa, a Brazilian private economic group that operates in a wide range of sectors, including finance, agribusiness, food, building materials, communication & culture, leather industry and hospitality. The business strategy and development of the three companies are guided by a group of experienced directors, which meets twice a month and is made up of eight Brazilians. Grupo Agropalma is structured in two business units: one responsible for the production of crude palm oil (CPO) and palm kernel oil (PKO) [plantations and extraction industries] and another dedicated to refined oils and derivative products. Both units have a team of senior managers that oversee operations and share various support functions such as finance, IT and group human resources.

Agropalma is a vertically integrated manufacturer of premium palm oil products, operating plantations, extractive industries and refineries. Thus, the company is responsible for the operation of five extraction industries and two refineries capable of producing an infinite variety of fractions and totally segregated palm products, operating in the national and international market, exporting around 15% of production and approximately 95% of exports going to Europe and 5% to the USA.

Furthermore, Agropalma's field operations cover 39,000 hectares of palm plantations certified by the Roundtable on Sustainable Palm Oil (RSPO), of which around 10% are certified as organic and fair trade. The company also has a reserve of 64,000 hectares of Amazon rainforest, being its main caretaker and guardian.

The company aims to reduce deforestation and carbon emissions into the atmosphere, conserve biodiversity and water resources and promote social inclusion and the development of communities living in the Amazon biome through the sale of credits for environmental services, development and funding of scientific research activities and the development of sustainable business chains. Biofílica aims to make environmental conservation an economically interesting activity for forest owners, communities and investors.

In this sense, the owners of Grupo Agropalma want to develop conservation projects and environmental services aimed at ensuring the long-term conservation of carbon stocks and local biodiversity and adding value to the forestry asset.

2.4.3 Management Team Experience (G4.2)

Biofílica Ambipar Environmental Investments

Proponent: Plínio Ribeiro – Executive Director

Plínio Ribeiro holds a degree in Business Administration from the Instituto de Ensino e Pesquisa - INSPER and a Master's degree in Public Administration and Environment from Columbia University and the Earth Institute (USA). He has participated in several conservation projects on the lower Negro River, through the Institute of Ecological Research – IPÊ since 2005, and was one of the producers of the documentary "Retorno à Amazônia", by Jean Michel Cousteau. He has been working at Biofílica since 2008, where he has led Projects, Operations and Business Management. Currently, he is Executive Director and shareholder of the company.

Cláudio Padua – Scientific Director

Cláudio Pádua holds a degree in Business Administration and Biology, a Master's in Latin American Studies and a PhD in Ecology from the University of Florida in Gainsville (USA). Retired professor at the University of Brasilia, Pádua is currently dean of the Superior School of Conservation and Sustainability and vice-president of the Institute of Ecological Research (IPÊ). He is also Senior Associate Researcher at the Center for Environment and Conservation Studies at Columbia University (USA) and Director of International Conservation at the Wildlife Trust Alliance, as well as a consultant for the Brazilian Biodiversity Fund (FUNBIO) and WWF Brazil. Pádua represents Brazil before the International Advisory Group (IAG) of the G7 Pilot Program. In 2003, together with his wife, Suzana Pádua, he was named "Hero of the Planet" by Time magazine for his activities in favor of biodiversity conservation. Between 1997 and 2007, he won six conservation awards, three national and three international. Pádua has published two books and more

than 30 articles in national and international scientific journals. Since 2008 he has directed Biofílica's involvement and scientific production as Scientific Director and advisor.

Paula Conde – Financial and Administrative Analyst

Paula Conde has a degree in Business Administration from PUC of São Luís and a postgraduate degree in Accounting and Financial Administration from FAAP. She has extensive experience, most of it in one of the largest media and education groups in Latin America - Editora Abril, where she worked with Financial Control and Reporting, Treasury, Accounting and Financial Reconciliation, Accounts Payable and Receivable and Royalties. At Biofílica, she is responsible for administrative and financial activities, logistical support for the team and projects.

Soraya Pires – Operational Director

Agronomist, graduated from Esalq/USP with specialization in strategic management and finance from FGV, with 15 years of experience in management and development of agribusiness businesses and career developed in large multinational companies in the sugar-energy sector (Adecoagro, BP and BP Bunge).

Caio Gallego – Operational Manager

Caio Gallego is a Forestry Engineer graduated from the University of São Paulo (USP/ESALQ). Specialist in geoprocessing and remote sensing focused on the area of environmental conservation, mapping and analysis of changes in land use. He has knowledge focused on Sustainable Forest Management, environmental modeling and the use of alternative GIS for forestry and agribusiness. He has advanced knowledge in the use of GIS software and analysis of changes in land use and land cover such as ArcGIS, QuantumGIS and DinâmicaEGO.

Laion Pazian – Commercial Manager

Laion Pazian is an Economist from the University of São Paulo (USP/ESALQ) and an MBA in Commercial Management from Fundação Getúlio Vargas. He manages the commercial team for carbon credits, key-accounts, commercial policy and strategy at Biofilica. In addition, he monitors and directs the analysis of carbon market intelligence, being responsible for the area's pricing and planning policy.

Luana Geraldini – Project Coordinator

Luana Geraldini is a Forestry Engineer, graduated from Universidade Estadual Paulista (Botucatu Campus) and postgraduated in Project Management from USP/ESALQ. During graduation she worked with environmental education projects and research on forest restoration. She has extensive experience in the environmental area as an environmental analyst in environmental licensing and geoprocessing projects.

Ricardo Cordeiro – Communication Coordinator

Ricardo Cordeiro is an advertiser, On and Offline art director with more than 10 years of experience, he has worked in digital agencies, trade and live marketing. Experience in UX, planning and digital strategies. Specialization in Digital Marketing and Web Project Management. At Biofílica, he acts as communication coordinator, responsible for digital marketing, branding and institutional communication actions.

Márcio Sales – Specialist in Statistical Modeling

Márcio Sales is a statistician, graduated from the Federal University of Pará, Master in Geography from the University of California, Santa Barbara and PhD student in Production Ecology and Resource Conservation from the University of Wageningen, in the Netherlands. He specializes in data analysis and conducts research in geostatistical modeling of processes distributed in space and time. He works at Biofílica in the production of projections of GHG emissions from future deforestation for the baselines of the projects and in the monitoring of deforestation by satellite.

Nathanael Campos – Project Analyst

Nathanael Campos is a Forestry Engineer and has a degree in Agricultural Sciences both from the University of São Paulo (USP/ESALQ). During graduation he worked with public policies for family farming and inventory of greenhouse gas emissions. He also has professional experience with GIS tools and remote sensing, with an emphasis on environmental analysis.

Raphael Ramiro – FP&A Specialist

Raphael Ramiro is an Administrator, graduated from Universidade Estadual Paulista and postgraduated in Corporate Finance from Universidade Federal de São Carlos. Professional with more than twelve years of experience in analysis and evaluation of projects from an economic-financial point of view.

Samara Silva – Project Analyst

Samara Martins Silva is an Environmental Manager graduated from the University of Brasilia (UnB), Master and PhD in Forestry Resources from the University of São Paulo (USP/ESALQ). She is currently a student in the Professional Master's Degree in Economic Management of the Environment (UnB). She has experience in general climatology and global climate change, Brazilian forest policy and legislation, conservation of forest ecosystems and management of native tropical forests with a focus on the Cerrado and Amazon. She works specifically with the environmental quantification and economic valuation of its services aiming at the use of related economic instruments in the public and private sectors.

Nayra Santos – Project Analyst

Nayra Gomes Nicolau dos Santos is a Forestry Engineer graduated from the Federal Rural University of Rio de Janeiro (UFRRJ), with a postgraduate degree in Forestry Management from the Federal University of Paraná (UFPR). She is currently a student in the Professional Master's Degree course in Environmental Engineering at the Polytechnic School of the Federal University of Rio de Janeiro (Poli / UFRJ). She has extensive experience in designing, managing and executing projects and environmental studies, technical coordination of environmental programs, as well as in institutional management with federal and state environmental agencies in the process of prior licensing and installation of projects related to the infrastructure sector.

Grupo Agropalma

Proponent: Túlio Dias Brito – Sponsor

Tulio Dias Brito holds a degree in Agronomic Engineering from the University of São Paulo (2002) and a Master's degree in Agribusiness from the University of Brasília. He has worked in applied research, diagnostics, specialized technical services and environmental consulting. He has been working for Grupo Agropalma for 15 years in business sustainability management. He has extensive experience in sustainability certifications in the oil palm sector and has good performance and interaction with several national and international players in this sector. He is currently Director of Sustainability at Conglomerado Alfa, which owns several companies from different sectors.

André Gasparini - Commercial Director

André Gasparini is Commercial, Marketing and R&D Director at AGROPALMA – Graduated in Food Engineering, MBA in strategic and economic business management and specialist in International Trade by FOSFA (Federation of Oils Seeds and Fats Associations Ltd), he is inserted in the oils segment and fats for over 20 years.

Andréa Bastos - Marketing Coordinator

Andrea Bastos is Marketing Manager. She has a degree in communication with specialization in publicity and advertising, a postgraduate degree in marketing and brand management. 20 years of experience in managing communication and marketing campaigns, aligned with business and brand strategies.

João Heliton – Forestry Supervisor

João Heliton is an Administrative Support Supervisor, Occupational Safety technician; team supervisor, human relations; 11 years acting directly in the protection of fauna and flora, assuming leadership roles at the head of the Asset and Forestry Security teams of Grupo Agropalma;

Marcelo Bastos - Legal Manager

Marcelo Bastos is a lawyer, with a Bachelor's degree in Law and a postgraduate degree in Labor Law and Procedure from the University of Amazônia – UNAMA. He currently holds the position of Legal and Contracts Manager of Grupo Agropalma, having more than 20 years of experience in management positions, providing strategic support to the legal and contractual demands of the group's companies.

Marcos La Cruz Costa – Director

Marcos Costa is Chief Financial Officer (CFO) and has been in this position for almost 20 years. He took materials engineering and university extension courses in business and finance.

Paloma Silva – Social and Environmental Responsibility Manager

Paloma Silva holds a degree in Environmental Engineering from Faculdades Oswaldo Cruz and is specialist in Sustainable Business Management from the University of Cambridge. Connected to agribusiness, focusing on partner producers and communities, she has already worked in the coffee, orange and grain

segment. Currently in the Palm Oil sector, she leads Agropalma's socio-environmental responsibility and communication relationships.

Rodrigo Pastana - Forest Safety Coordinator

Rodrigo Pastana has a degree in Business Administration with emphasis on Management Processes and military training at NPOR Belém. He served for 08 years as an Officer in the Brazilian Army in several operations on the Brazil-Peru-Bolivia border strip. Later assuming the Supervision and then the Regional Coordination of Security of the states PA/AP/MA in the company Prosegur Brasil for more than 07 years, also being responsible for the operational training of the security guards in addition to the shooting training and driving an armored car. Having experience in covert presidential security and negotiation in critical situations. In addition to being an Armament and Shooting Instructor and over 18 disciplines accredited by the Federal Police.

Wander Antunes - Social and Environmental Responsibility Coordinator

Wander Antunes holds a Bachelor's degree in Business Administration and a postgraduate degree in Business Management from the University of Amazônia. He has been part of Agropalma's sustainability area for 12 years. During this journey he worked in Corporate Communication and Socio-Environmental Responsibility. He currently leads the Social and Environmental Responsibility Department, responsible for maintaining the Group's sustainability certifications, managing partnership contracts in conservation projects, protection of flora, fauna, biodiversity, etc.

2.4.4 Project Management Partnerships/Team Development (G4.2)

Agropalma REDD+ Project has all the necessary partnerships for the construction and implementation of forest asset conservation activities. Currently, the partner institutions, mentioned in Section 2.1.4, are responsible for preparing the Socio-Economic and Environmental Diagnoses, Carbon Stock and Baseline, which make up the Project Design Description, through service supply contracts. When other initiatives throughout the development of the Project require new technical knowledge and partners, the proponents of Agropalma REDD+ Project will articulate association with governmental, non-governmental and private sector organizations, in order to enable the generation of net positive impacts to society and to biodiversity

2.4.5 Financial Health of Implementing Organization(s) (G4.3)

Biofílica Ambipar Environmental Investments is a Brazilian company with 15 years of experience in the environmental services market in Brazil, through the generation and commercialization of carbon credits from nature-based solutions (NBS), having a diversified line of business and investors that support the company's business.

Grupo Agropalma, created in 2005, has approximately 5,000 employees working in four business units and operates with a fully traceable supply chain, guaranteeing a productive process guided by sustainable practices that range from cultivation and preservation of the forest and biodiversity to the economic and social development of communities that work together with the Group.

Agropalma operates five extraction industries with integrated palmistries and one of them is used to extract organic oils, also certified by the Roundtable on Sustainable Palm Oil (RSPO), Preserved Identity and Fair Trade (IBDFair Trade), being that these seals and credentials add value to the brand. The five extractors process just over 750,000 tons of Clusters of Fresh Fruits of palm (CFF) annually, and 25% of this raw material comes from external sources – 6% from family farmers and 16% from integrated producers. Grupo Agropalma acquires the remaining 3% of CFF from a neighboring company, which owns around 40,000 ha of palm plantations.

Agropalma's products are intended for various industries and used mainly in the bakery, confectionery, culinary, dairy and ice cream, industrial frying, cosmetics and oleochemicals segments. The portfolio of Grupo Agropalma also includes organic formulations and customized solutions created according to the most varied needs.

Documents proving the financial health of both institutions are classified as commercially sensitive information and were shared with the audit team on a confidential basis. Additionally, more details on these topics can be found in section 2.4.2 above.

2.4.6 Avoidance of Corruption and Other Unethical Behavior (G4.3)

Biofílica Ambipar Environmental Investments supports annual financial audit processes ensuring that its resources are allocated responsibly and free of corruption. Financial statements and minutes of meetings relating to the company are published on the website of JusBrasil, the largest open legal community in Latin America.

Like Biofílica Ambipar Environment Investments, Grupo Agropalma, as part of its “no exceptions” culture, has a zero tolerance approach to bribery and corruption, reiterated in the company's Corporate Responsibility Policy and in compliance with the Brazilian Clean Company Law of 2013, which holds companies accountable for the corrupt actions of their employees and imposes strict liability for these crimes with penalties that can include fines of up to 20% of the company's gross revenues in the previous

year, suspension or dissolution of the company. Through its detailed Code of Conduct for suppliers and service providers, strict rules are described for working together with Grupo Agropalma, including comprehensive anti-corruption measures, such as limits on gifts and hospitality, requirement to assume full responsibility for legal compliance, including, but not limited to working conditions and wages, for suppliers and service providers, currently forming part of the standard contract with its suppliers.

In addition to the above, Grupo Agropalma is a signatory of the Business Pact for Integrity and Against Corruption, an initiative of Ethos Institute, which annually monitors the policies and performance of the signatories.

2.4.7 Commercially Sensitive Information (*Rules* 3.5.13 – 3.5.14)

Some information required by the VCS and/or CCB standards is considered confidential or commercially sensitive and cannot be publicly disclosed by the Project proponents. This information was fully provided to the audit team during the validation process attached to this document, but was not included in the public version. Below is a list of information that has been made available:

- Land Documents and Legal Situation;

- Financial Statements of Agropalma S/A;

- Financial Statements of Biofílica Ambipar;

- Project Financial Performance Spreadsheet (budget) and other related documents;

- Agreements and contracts signed between the parties involved;

- Diagnostic Inventories

2.5 Legal Status and Property Rights

2.5.1 Statutory and Customary Property Rights (G5.1)

Agropalma, Agropar, Amapalma, Palmares, Trevo, CRAI, Zilmar, Roda de Fogo and Castanheira farms belong to Grupo Agropalma, which is the legitimate owner of the property called Agropalma Farm, where Agropalma REDD+ Project is located. The properties of Grupo Agropalma S/A cover the municipalities of Moju, Acará, Tailândia and Tomé Açu, in the State of Pará, and were acquired through a public deed of purchase and sale. In addition to the deeds, the registrations, which present the registration of ownership and the descriptive memorial of the properties, are attached to the DPD. Other official documents will also

be presented to attest to the ownership and location of the registry offices where they were registered, proving the legitimacy of the property.

In addition, the areas that Agropalma occupies by way of possession were acquired in good faith, comprising Castanheiras and Roda de Fogo Farms and part of Amapalma Farm, which have a request for land regularization in progress at State Land Institute of Pará (ITERPA).

In Brazil, all lands, since its colonization, have original State property. In other words, until the lands are designated by the Government, they are public and anyone who is occupying them will be there by way of possession. Over the years, the form of this allocation has undergone several changes, such as: granting of *sesmaria* (property) letter, parish (or vicar) registration, legitimization of possession, provisional titles, tenure titles, among others.

Therefore, disregarding legitimate ownership would be to put an end to the land regularization system itself, which, in the absolute majority of cases, initially takes place on ownership that fulfills the social function. There are several examples of this, such as in the state of Pará, the main one being the environmental legislation itself, which provides for the possibility of obtaining an environmental license for production in possession areas, dispensing ownership as a requirement for certain activities, among them, agriculture (Decree No. 216/2011). That is, the state legislation itself already recognizes possession areas as legally productive, issuing environmental licenses for their development.

Therefore, the demonstration of the right to use the Project area is respected in accordance with the criteria of the VCS Standard v4.2 (p. 24):

1) Right of use resulting from or granted under statute, regulation or decree by a competent authority;

2) Right of use arising from the law;

4) Right of use arising from statutory, patrimonial or contractual right over the land, vegetation or conservation process, or management that generates reductions and/or removals of GHG emissions (where this right includes the right of use of such reductions or removals and the project proponent has not been stripped of such right of use).

2.5.2 Recognition of Property Rights (G5.1)

Agropalma REDD+ Project recognizes and respects all property rights, complying with significant statutory and regular requirements, as well as having all necessary approvals from local authorities. The Project recognizes and supports any rights to lands, territories and resources, including the statutory and traditional rights of indigenous peoples, communities and other actors.

The project proponents act as mediators of potential conflicts, in addition to valuing good relationship with neighboring communities. In this way, the following aspects are described in detail:

- The company Agropalma S.A owns the rights of use and economic exploitation of the properties, as well as obtains the right of access to the natural resources therein, under the terms of the Federal Constitution of Brazil and the Civil Code, by virtue of being the owner of the properties where Agropalma REDD+ Project will take place.

2.5.3 Free, Prior and Informed Consent (G5.2)

Free, Prior and Informed Consent will be carried out throughout the Project's life cycle, always with an approach of dialog and consent between the parties involved. In addition, the Project does not intend to develop any activity on private properties owned by others, by traditional and indigenous communities or by the government. Regarding social and biodiversity activities, it is guaranteed that no activity will be carried out without the free, prior and informed consent of the parties involved.

No activity related to the Project will result in relocation of activities that are important for the culture or livelihood of Holders of Property Rights, nor will it aim at the involuntary relocation or removal of their lands or territories. Any proposed removal or relocation needs to take place only after obtaining the Free, Prior and Informed Consent from the appropriate Holders of Property Rights.

Furthermore, all actors that could be impacted in some way by Agropalma REDD+ Project were consulted. In the communities surrounding the Project, workshops were held in order to pass on information regarding the Project, as well as consultations regarding the opinions of the community in relation to the Project, as described in Section 2.3.7 These consultations will continue to be carried out throughout the Project's life cycle. In addition, all information about Agropalma REDD+ Project can be acquired through the project's communication channels described in Section 2.3.8.

2.5.4 Property Rights Protection (G5.3)

The implementation and development of Agropalma REDD+ Project must not lead to the involuntary removal or relocation of any part, as none of the identified communities (Section 2.1.8) depend solely and exclusively on the Project Area for livelihood activities. Communities residing in the Project Zone must be respected and supported by the Project. Thus, the Project proposes social activities that seek to promote sustainable agricultural practices, strengthen and improve existing economic activities, in addition to developing and strengthening value chains for agricultural and forestry products. These initiatives seek to discourage the practice of illegal activities and aim to guarantee the financial and food security of the

impacted communities, but without disregarding the cultural and traditional aspects of the impacted communities.

Furthermore, land tenure regularization in the area is supported by Agropalma and supported by the responsible public institutions. As previously mentioned, possible judicial inconsistencies are resolved following all procedures established by the local jurisdiction.

2.5.5 Illegal Activity Identification (G5.4)

Deforestation is the main illegal activity that can negatively impact the development of Agropalma REDD+ Project, as well as hunting and predatory exploitation of fauna and flora. Family farmers, medium and large rural landowners, sawmills, logging companies and local charcoal plants were identified as the main causes of such illegal deforestation. Between 2011 and 2021, approximately 72,108 hectares were deforested in the Reference Region, which corresponds to a reduction of 8.5% of the existing forest in 2011. For the next 10 years, a loss of 210,132 hectares of native forest is expected in a without-project scenario, of which 13,951 hectares should be deforested in the Project Area.

The Project seeks to control and combat these illegal activities commonly found in the Project region through mitigating and preventive measures such as strengthening asset surveillance, in addition to encouraging the involvement of other actors and stakeholders, social inclusion and local socio-economic development through the encouragement of economic activities alternative to deforestation and discouragement of predatory hunting and fishing.

With the application of these measures encouraged by the Project's activities, it is expected to improve the well-being of the communities without generating burdens for the native forest and local biodiversity. Asset surveillance aims to curb illegal practices of deforestation, extraction of plant species and hunting and capture of wild animals by third parties. Mechanisms and procedures for preventing illegal activities are summarized in Table 10.

Table 10 - Mechanisms and procedures for the prevention of illegal activities

Mechanisms and procedures for the prevention of illegal activities	
General conditions	- Carry out regular patrols with the purpose of ensuring protection of Agropalma's land assets; - Avoid deforestation, forest fires or other acts of aggression to the environment; - Prevent illegal timber extraction and trade;

	- Maintain good relationship with communities and other stakeholders; - Carry out the entry and exit control of Agropalma Farm; - Promote environmental education in communities that practice predatory hunting and fishing and encourage the practice of alternative and sustainable economic activities; - Request support from police and supervisory authorities, when necessary; - Displacement of a surveillance team to the place of occurrence to investigate the fact and application of appropriate measures; - Activation of the legal sector for measures; - Record of occurrences involving invasion of property, damage to property and illegal extraction of forest products; - Occurrences involving damage to the environment must be registered with the responsible bodies (IBAMA, Environmental Police, etc.); - In all situations involving land conflicts, it is necessary to avoid confrontation between the parties, respecting the laws in force in the country.
Forms of records	- Police report; - Photographic record of occurrences; - Continuous remote monitoring program; - Report on property security activities; - Report of general activities of the Project

2.5.6 Ongoing Disputes (G5.5)

Under development.

2.5.7 National and Local Laws (G5.6)

Compliance with Laws, Statutes and other significant regulatory instances for Agropalma REDD+ Project is related to the forest management activity. In the State of Pará, the project's activities are being licensed

by the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), thus applying federal legislation. Subject to federal legislation, the laws at the state level applies.

With regard to REDD+ activities, one can note a history of initiatives despite the construction and negotiation of this concept through agreements and meetings at the United Nations Framework Convention on Climate Change (UNFCCC). In December 2015, the National Strategy for REDD+ in Brazil (ENREDD+) was instituted by Ordinance MMA No. 370, being a document that formalizes to Brazilian society and UNFCCC signatory countries how the Brazilian government has structured its efforts and intends to improve them by 2020, contributing to the mitigation of climate change by controlling deforestation and forest degradation, promoting forest recovery and fostering sustainable development. In this context, in Brazil, Decree No. 10,144 (of 11/28/2019) established the National Commission for REDD+ (CONAREDD+) in order to coordinate, monitor, follow up and review the National Strategy for REDD+ and guide the preparation of requirements for accessing payments for results of REDD+ policies and actions in the country. The following year, CONAREDD+ internal regulations were published, through an Ordinance (No. 544, of 10/26/2020).

At the same time, Bill No. 572/2020 is under analysis, which “Establishes the national system for reduction of emissions from deforestation and degradation, conservation, sustainable forest management, maintenance and increase of forest carbon stocks (REDD+) and other measures”, which is pending in the Chamber of Deputies.

As for the carbon market, there is a Bill (PL No. 528 of 2021) pending in the Chamber of Deputies that aims to establish the Brazilian Market for Reduction of Emissions (MBRE) and regulate the purchase and sale of carbon credits in the country arising from activities for the Reduction of Emissions from Deforestation and Forest Degradation, for example. The promotion of this voluntary carbon market is provided for in the Law that established the National Policy on Climate Change (Law No. 12187, of 12/29/2009).

After years of discussion and stagnation of PL No. 528 of 2021 in the National Congress, more recently, Decree No. 11075 of 05/19/2022 was enacted, which addresses the implementation of a regulated carbon credit market in Brazil through the creation of the National System for the Reduction of Greenhouse Gas Emissions (Sinare) and establishes procedures for the preparation of Sectorial Plans for Mitigation of Climate Change. In addition to these measures, the document also brings unprecedented concepts regarding methane credit, recording the carbon footprint of processes and activities, carbon from native vegetation, soil carbon and blue carbon.

Below, the main relevant legislation and regulations at federal and state levels are listed and detailed. In addition, a brief analysis of the international climate agreements that has been guiding the creation and development of REDD+ initiatives around the world were carried out.

INTERNATIONAL COVENANTS

- FCCC/CP/2005/Misc.1: Reducing emissions from deforestation in developing countries: approaches to stimulate action. Submission from Parties. (Translation: Reduzindo emissões de desmatamento em países em desenvolvimento: abordagem para estimular ação. Submissão das partes. COP 11, Montreal, 2005.)

- FCCC/CP/2007/6/add.1: Report of the Conference of the Parties on its thirteenth session, held in Bali from 3 to 15 December 2007. Addendum. Part two: Action taken by the Conference of the Parties at its thirteenth session. (Translation: Relatório da Conferência das Partes sobre sua décima terceira sessão, ocorrida em Bali de 3 a 5 de dezembro de 2007. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua décima terceira sessão ou "Action Bali Plan". COP 13, Bali, 2007.)

- FCCC/CP/2009/Add.1: Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009. Addendum. Part Two: Action taken by the Conference of the Parties at its fifteenth session. (Translation: Relatório da Conferência das Partes sobre sua décima quinta sessão, ocorrida em Copenhagen de 7 a 19 de dezembro de 2009. Addendum. Parte Dois: Ação tomada pela Conferência das Partes na sua décima quinta sessão ou "Copenhagem Accord". COP 15, Copenhagen, 2009.)

- FCCC/CP/2010/7/Add. 1: Report of the Conference of the Parties on its sixteenth session, held in Cancun from 29 November to 10 December 2010. Addendum. Part Two: Action taken by the Conference of the Parties at its sixteenth session. (Translation: Relatório da Conferência das Partes sobre sua décima sexta sessão, ocorrida em Cancun de 19 de novembro a 10 de dezembro de 2010. Addendum. Parte Dois: Ação tomada pela Conferência das Partes na sua décima sexta sessão ou "Cancun Agreement". COP 16, Cancun, 2010.)

- FCCC/CP/2011/9/Add. 1: Report of the Conference of the Parties on its seventeenth session, held in Durban from 28 November to 11 December 2011. Addendum. Part Two: Action taken by the Conferenceof the Parties at its seventeenth session. (Translation: Relatório da Conferência das Partes sobre sua décima sétima sessão, ocorrida em Durban de 28 de novembro a 11 de dezembro de 2011. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua décima sétima sessão. COP 17, Durban, 2011.)

- FCCC/CP/2012/8/Add.1: Report of the Conference of the Parties on its eighteenth session, held in Doha from 26 November to 8 December 2012. Addendum. Part two: Action taken by the Conference of the Parties

at its eighteenth session. (Translation: Relatório de Conferência das Partes sobre sua décima oitava sessão, ocorrida em Doha de 26 de novembro a 8 de dezembro. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua décima oitava sessão.)

- FCCC/CP/2013/Add.1: Warsaw Framework for REDD-plus, held in Warsaw, Poland, from 11 to 22 November 2013 (Tradução: Pacote de Varsóvia para REDD+, ocorrida em Varsóvia, Polônia, de 11 a 22 de Novembro de 2013), em especial as seguintes decisões:

- Decision9/CP.19: Work programme on results-based finance to progress the full implementation of the activities referred to in decision 1/CP. 16, paragraph 70. (Translation: Programa de trabalho em financiamento baseados em resultados para o progresso da implementação completa das atividades referidas na decisão 1/CP. 16, parágrafo 70.)

- Decision10/CP.19: Coordination of support for the implementation of activities in relation to mitigation actions in the forest sector by developing countries, including institutional arrangements. (Translation: Coordenação do suporte para a implementação de atividades relacionadas a ações de mitigação no setor florestal por países em desenvolvimento, incluindo arranjos institucionais.)

- Decision12/CP.19: The timing and the frequency of presentations of the summary of information on how all the safeguards referred to in decision1/CP.16, appendix I, are being addressed and respected. (Translation: O tempo e a frequência na qual são apresentadas as informações resumidas de como todos as salvaguardas referidas na dicisão1/CP.16, apêndice I, estão sendo abordadas e respeitadas.)

- Decision13/CP.19: Guidelines and procedures for the technical assessment of submissions from Parties on proposed forest reference emission levels and/or forest reference levels. (Translation: Guia e procedimentos para avaliação técnica das submissões das Partes em propostas de níveis de referência em emissões florestais e/ou níveis de referência florestal.)

- Decision14/CP.19: Modalities for measuring, reporting and verifying. (Translation: Modalidades para medir, reportar e verificar.)

- Decision15/CP.19: Addressing the drivers of deforestation and forest degradation. (Abordagem dos vetores de desmatamento e degradação florestal.)

- FCCC/CP/2015/Add.1: Report of the Conference of the Parties on its twenty-first session, held in Paris from 30 November to 13 December 2015. Addendum. Part two: Action taken by the Conference of the Parties at its twenty-first session. (Translation: Relatório de Conferência das Partes sobre sua vigésima primeira sessão, ocorrida em Paris de 30 de novembro a 13 de dezembro. Addendum. Parte Dois: Ação tomada pela Conferência das Partes em sua vigésima primeira sessão).

- FCCC/CP/2015 Paris Agreement: Global, legally-binding agreement that sets out a global framework to avoid dangerous climate change by limiting global warming to well below 2°C and pursuing efforts to limit it to 1.5°C. Entry into force on 4 November 2016.

- FCCC/CP/2016 Decisions adopted by the Conference of the Parties (COP): Especially decisions 1 (preparation into force of the Paris Agreement), 3 (Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts), 6 (National adaptation plans) and 7 (Long-term climate finance).

- FCCC/CP/2017, FCCC/CP/2018, FCCC/CP/2019 Decisions adopted by the COP: Especially decision 1 reporting on developments of the implementation of the Paris Agreement.

- Nationally Determined Contribution (NDC): Brazilian NDC submitted in September 2015 to the United Nations Framework Convention on Climate Change for mitigation, adaptation and means of implementation, consistent with the purpose of contributions to achieve the ultimate objective of the Convention, pursuant to decision 1/CP .20, paragraph 9.

- CITES, de 03/03/1973: "Convention on International Trade in Endangered Species of Wild Fauna and Flora", assinada em Washington D.C. em 03 de março de 1973, alterado em Bonn em 22 de junho de 1979.

- Article 6 of the Paris Agreement (2021): Decision 1/CP.21 mandated the SBSTA to operationalize the provisions of this Article through recommending a set of decisions to the COP serving as the meeting of the Parties to the Paris Agreement at its first session. At COP26, the Parties to the Paris Agreement at its third session (CMA 3) adopted three main decisions related to Article 6: decision 2 (on Article 6.2), decision 3 (on Article 6.4) and decision 4 (on Article 6.8).

- Glasgow Leaders' Declaration on Forests and Land Use (2021): Signatories (including Brazil) promise to reverse and end deforestation by 2030.

- Brazilian Nationally Determined Contribution (NDC): First Brazilian NDC submitted in in September 2015 to the UN Framework Convention on Climate Change for mitigation, adaptation and means of implementation, in a manner consistent with the purpose of contributions to achieve the ultimate objective of the Convention, pursuant to Decision 1/CP.20, paragraph 9. The updated Brazilian NDC was presented at the COP26 on December 8th, 2022.

FEDERAL LEGISLATION

- Law No. 14119, of January 13, 2021: Institutes the National Payment Policy for Environmental Services; and amends Laws No. 8212, of July 24, 1991; 8629, of February 25, 1993; and, 6015, of December 31, 1973, to adapt them to the new policy.

- Law No. 12727, of December 17, 2012: Provides for the protection of native vegetation; amends Laws No. 6938, of August 31, 1981; 9393, of December 19, 1996; and, 11428, of December 22, 2006; and revokes Laws No. 4771, of September 15, 1965; and, 7754, of April 14, 1989; Provisional Measure No. 2166-67, of August 24, 2001, item 22 of section II of Art. 167 of Law No. 6015, of December 31, 1973, and § 2 of Art. 4 of Law No. 12651, of May 25, 2012.

- Law No. 12651, of May 25, 2012: Provides for the protection of native vegetation; amends Laws No. 6938, of August 31, 1981; 9393, of December 19, 1996; and, 11428, of December 22, 2006; and revokes Laws No. 4771, of September 15, 1965; and, 7754, of April 14, 1989; Provisional Measure No. 2166-67, of August 24, 2001, and other measures.

- Law No. 12187, of December 29, 2009: Institutes the National Policy on Climate Change – PNMC and takes other measures.

- Decree No. 11075, of May 19, 2022: Establishes procedures for the preparation of Sector Plans for Mitigating Climate Change, establishes the National System for Reducing Greenhouse Gas Emissions and amends Decree No. 11003, of March 21, 2022.

- Decree No. 10144, of November 28, 2019: Establishes the National Commission for the Reduction of Greenhouse Gas Emissions from Deforestation and Forest Degradation, Conservation of Forest Carbon Stocks, Sustainable Management of Forests and Increase of Forest Carbon Stocks – REDD+.

- Decree No. 58054, of March 23, 1966: Promulgates the Convention for protection of flora, fauna and scenic beauty of the countries of America.

- Decree No. 2661, of July 08, 1998: Regulates the sole paragraph of Art. 27 of Law No. 4771, of September 15, 1965 (Forestry Code), through the establishment of precautionary norms related to the use of fire in agropastoral and forestry practices, and other provisions.

- Decree No. 5975, of November 30, 2006: Regulates Art. 12, final part, 15, 16, 19, 20 and 21 of Law No. 4771, of September 15, 1965; Art. 4, section III, of Law No. 6938, of August 31, 1981; Art. 2 of Law No. 10650, of April 16, 2003; amends and adds provisions to Decrees Nos. 6514/08 and 3420/00, and other provisions.

- CONAMA Resolution No. 16, of December 7, 1989: Establishes the Legal Amazon Environmental Assessment and Control Integrated Program.

- CONAMA Resolution No. 378, of October 19, 2006: Defines undertakings potentially causing national or regional environmental impact for the purposes of the provisions of section III, § 1, Art. 19 of Law No. 4771, of September 15, 1965, and other provisions.

- CONAMA Resolution No. 379, of October 19, 2006: Creates and regulates data and information system on forest management within the scope of the National Environmental System - SISNAMA.

- IBAMA Ordinance No. 218, of May 4, 1989: Provides for the felling and exploitation of native forests and forest formations native to the Atlantic Forest, and other provisions.

- IBAMA Ordinance No. 438, of August 9, 1989: Changes the wording of Article 4 of Ordinance No. 218, of May 4, 1989.

- MMA Ordinance No. 103, of April 5, 2006: Provides for the implementation of the Document of Forest Origin - DOF, and other measures.

- MMA Ordinance No. 253, of August 18, 2006: Establishes, as of September 1, 2006, within the scope of the Brazilian Institute of the Environment and Renewable Natural Resources - IBAMA, the Document of Forest Origin - DOF replacing the Authorization for Transport of Forest Products - ATPF.

- MMA Normative Instruction No. 1, of September 5, 1996: Deals with the Mandatory Forest Replenishment and the Integrated Forestry Plan.

- MMA Normative Instruction No. 07, of April 27, 1999: Provides for authorization for deforestation in the States of the Legal Amazon.

- MMA Normative Instruction No. 02, of May 10, 2001: Provides for the economic exploitation of forests on rural properties located in the Legal Amazon, including Legal Reserve areas, except for permanent preservation areas established in current legislation, which will be carried out through sustainable forest management practices for multiple uses.

- MMA Normative Instruction No. 06, of December 15, 2006: Provides for forest replenishment and the consumption of forest raw materials, and other measures.

- IBAMA Normative Instruction No. 178, of June 23, 2008: Defines the guidelines and procedures, on the part of IBAMA, for consideration and approval regarding the issuance of authorizations for the suppression of forests and other forms of native vegetation in an area greater than two thousand hectares in rural properties located in the Legal Amazon and one thousand hectares in rural properties located in other regions of the country.

- Regulatory Standard No. 31, of March 3, 2005: Approves the Regulatory Norm for Safety and Health at Work in Agriculture, Livestock, Forestry and Aquaculture

STATE LEGISLATION

- State Law No. 9048, of May 04, 2020: Institutes the State Policy on Climate Change in Pará (PEMC/PA), and other measures.

- State Law No. 7389, of March 31, 2010: Defines activities with a local environmental impact in the State of Pará and other provisions.

- State Law No. 7381, of March 16, 2010: Provides for the recomposition of the vegetation cover of riparian forests in the State of Pará.

- State Law No. 6745, of May 06, 2005: Establishes the Ecological Economic Macrozoning of the State of Pará and other measures.

- State Law No. 6671, of July 27, 2004: Amends Art. 122 of State Law No. 5887, of May 9, 1995.

- State Law No. 6506 of December 2, 2002: Establishes the basic guidelines for carrying out the Ecological Economic Zoning (EEZ) in the State of Pará and other measures.

- State Law No. 6462, of July 04, 2002: Provides for the State Policy on Forests and other forms of vegetation.

- State Law No. 5977, of July 10, 1996: Provides for the protection of wild fauna in the State of Pará.

- State Law No. 5887, of May 09, 1995: Deals with the State Environmental Policy and other measures.

- State Decree No. 941, of August 3, 2020: Institutes the *Amazônia Agora* State Plan (PEAA), creates the Plan's Scientific Committee and the Permanent Plan Monitoring Nucleus, and other measures.

- State Decree No. 254, of August 8, 2019: Establishes the Paraense Forum on Climate Change and Adaptation (FPMAC).

- State Decree No. 518, of September 5, 2012: Establishes the Paraense Forum on Climate Change and other measures.

- State Decree No. 216, of September 22, 2011: Provides for the environmental licensing of agrosilvopastoral activities carried out in altered and/or underutilized areas outside the legal reserve area and permanent preservation area in rural properties in the State of Pará.

- State Decree No. 2436, of August 10, 2010: Regulates actions directly or indirectly linked to agrosilvopastoral activities, carried out within areas of alternative land use, considered to have low environmental impact.

- State Decree No. 2,099, of January 25, 2010: Provides for the maintenance, recomposition, conduction of natural regeneration, compensation and composition of the Legal Reserve area of rural properties in the State of Pará and other provisions.

- State Decree No. 1,697, of June 5, 2009: Establishes the Plan for Prevention, Control and Alternatives to Deforestation in the State of Pará and other measures.

- State Decree No. 1,148, of July 17, 2008: Provides for the Rural Environmental Registry – CAR-PA, the Legal Reserve area and other measures.

- State Decree No. 2,592, of November 27, 2006: Establishes the Registry of Forest Product Explorers and Consumers in the State of Pará – CEPROF-PA and the System for Commercialization and Transport of Forest Products in the state of Pará SISFLORA-PA and its operational documents and other measures.

- State Decree No. 2141, of June 31, 2006: Regulates provisions of Law No. 6462, of July 4, 2002, which provides for the State Policy on Forests and other forms of vegetation.

- State Decree No. 2,141, of March 31, 2006: Regulates provisions of State Law No. 6462 of July 4, 2002, which provides for the State Policy on Forests and Other Forms of Vegetation and other measures, with the aim of encouraging the recovery of altered and/or degraded areas and the recomposition of legal reserves, for energy, timber, fruit, industrial or other purposes, through forestry and agroforestry repopulation with native and exotic species and other provisions.

- State Decree No. 1,523, of July 25, 1996: Approves the Regulation of the State Fund for the Environment - FEMA, created by Law No. 5887, of May 9, 1995.

- Resolution No. 54, of October 24, 2007 (ANNEX 1): Approves the list of endangered flora and fauna species in the State of Pará.

2.5.8 Approvals (G5.7)

Project proponents achieved recognition and approval of the implementation of Agropalma REDD+ Project with stakeholders through meetings, lectures and face-to-face meetings with communities, partners, proponents and authorities mentioned in Section 2.3.

The event to present the project and publicly consult the communities about the project's activities was held between November 21, 2022 and November 24, 2022 and took place through community involvement, facilitated by efficient dissemination via letters, folders and face-to-face direct communication with community leaders and municipal and state entities. In this feedback, participants were able to understand and collaborate with the design and development of the project as described in Section 2.3.7.

In addition to these meetings and participation meetings of the community members and other stakeholders described above, the Project will go through the public consultation event on Verra registration platform for notes of comments, suggestions and clarification of doubts about Agropalma REDD+ Project, expected to

take place in the period from January 23, 2023 to February 21, 2023. The importance of engagement and collaboration of these stakeholders in this process was reinforced by sending formal invitations to those directly and indirectly involved in the forest conservation sector, community associations, non-governmental organizations (NGO's), educational institutions, government agencies, private companies, and the Palm Oil production sector. Such invitation was made via mailing, with information about the project and invitation to participate in the public consultation.

In addition, letters were sent to relevant local institutions in the state of Pará, such as the State Public Prosecutor's Office and other government and federal agencies, containing information about the public consultation, as well as the context of the project and the communication channels used.

Additionally, a special edition of the Viver Bem Journal was created for the project and disclosure of the public consultation, so that information could reach the local communities, reinforcing the invitation to stakeholders to participate and have more information about the project.

The participation of Agropalma workers in the public consultation was also encouraged by sending an invitation to participate via Corporate Communication Notice Board and TV and Internal Communications, tools already used by Agropalma in its business activities.

It is worth mentioning that despite the advances in the National Strategy for REDD+ in Brazil (ENREDD+), the processing of Bill No. 572/2020 and resumption of the Paraense Forum on Climate Change and Adaptation (FPMAC), demonstrated in Section 2.5.6 - National and Local Laws, there are still no official REDD+ policies at national or jurisdictional level. However, the Project proponents are always attentive to new information, always present in discussion forums of the federal and state governments in order to contribute to the formulation of these policies and regulations, being readily available to adjust the Project to the new officially established rules.

2.5.9 Project Ownership (G5.8)

Agropalma is the legitimate owner of the properties where Agropalma REDD+ Project is being implemented and developed, as detailed in **Erro! Fonte de referência não encontrada.** For the establishment of responsibility and rights over the Project, as well as the percentage of carbon credits allocated to each party, a contract was signed by the Project proponents.

2.5.10 Management of Double Counting Risk (G5.9)

Agropalma REDD+ Project generates benefits for the climate, communities and biodiversity. However, only net greenhouse gas (GHG) reductions and removals will be traded after being properly registered on a trading platform.

2.5.11 Emissions Trading Programs and Other Binding Limits

Not applicable.

2.5.12 Other Forms of Environmental Credit

Agropalma REDD+ Project does not intend to generate any other form of environmental credits related to the reductions and removals of GHG emissions claimed within the Verified Carbon Standard (VCS) program.

2.5.13 Participation under Other GHG Programs

Agropalma REDD+ Project did not receive or seek to be registered in any other GHG program, in addition to submitting the Project for validation and verification as per the Verified Carbon Standard (VCS) and Climate, Community and Biodiversity Standard (CCB) standards.

2.5.14 Projects Rejected by Other GHG Programs

Agropalma REDD+ Project has not been submitted for validation/verification of any other GHG program, and is therefore not rejected by any other GHG program.

2.5.15 Double Counting (G5.9)

The Government of the State of Pará has brought the issue of REDD+ to debate since the beginning of discussions on the subject within the framework of international climate conferences. In 2009, the Paraense Forum for Climate Change and Adaptation (FPMCA) was created, and in 2019 it was reactivated through

a Law Decree signed by the governor of the State of Pará[34]. The FPMCA, among its objectives, guides and subsidizes the preparation and implementation of the State Policy on Climate Change Law of Pará (PEMC/PA). One year after the reactivation of the FPMCA, the Law establishing the PEMC/PA[35] was published. Such law provides for the planning and execution of plans, actions and programs related to climate change, through policies, actions, research and technical studies focused on environmental services and Reduction of Emissions from Deforestation and Forest Degradation (REDD+)[36].

Regarding REDD+, the FPMCA proposed the creation of a State REDD+ Strategy, aiming to organize and prioritize actions in the areas of deforestation and forest degradation, conservation and forest management. In this sense, in December 2021, the FPMCA approved the creation of the Technical Chamber of Bioeconomy, to compose the State Council on Climate Change; which, among several strategies, includes the regulation of the REDD+ jurisdictional system in Pará, training on REDD+ and the carbon market, and actions for eligibility for carbon certification[37].

Given this context, in February 2022 the 1st Seminar on Payments for Environmental Services (PSA) and Reduction of Emissions from Deforestation and Degradation (REDD+) was held in Pará, promoted by the Secretariat for the Environment and Sustainability (Semas) and the Institute of Environmental Research of Amazon (IPAM). The central objective of this event was to discuss the REDD+ jurisdictional system in Pará, taking into account the challenges and possible solutions in the areas of REDD+, such as payments for Environmental Services (PSA) and the carbon market in the State of Pará[38]

However, despite the initiatives, so far, the State of Pará does not have a defined REDD+ State Strategy.

Thus, it is the understanding of the proponents that there is no risk of double counting, since the Government of Pará does not have a structured legal program or any type of state regulation for Climate Change and REDD+ and does not carry out voluntary or unregulated market operations.

With specific regard to Agropalma REDD+ Project, the project proponents (Agropalma and Biofilica Ambipar Environmental) will use the Verra registration platform both for registration and issuance and

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[34] FEDERATIVE REPUBLIC OF BRAZIL. Official Gazette No. 33948, of August 9, 2019. Belém-PA. Available at: http://www.ioepa.com.br/pages/2019/2019.08.09.DOE.pdf

[35] GOVERNMENT OF THE STATE OF PARÁ. Law No. 9048, of April 29, 2020. Available at: https://www.semas.pa.gov.br/legislacao/files/pdf/4093.pdf

[36] AGÊNCIA PARÁ. **Paraense Forum for Climate Change and Adaptation debates advances with society**. Available at: https://agenciapara.com.br/noticia/24012/.

[37] SMAS - SECRETARIAT FOR ENVIRONMENT AND SUSTAINABILITY OF THE STATE OF PARÁ. **State climate change forum creates Bioeconomy Technical Chamber**. Available at: https://www.semas.pa.gov.br/2021/12/17/forum-estadual-de-mudancas-climaticas-cria-camara-tecnica-de-bioeconomia/.

[38] AGÊNCIA PARÁ. **Semas and IPAM discuss jurisdictional REDD+ system and carbon market in seminar.** Available at: https://agenciapara.com.br/noticia/35041/..

commercialization of credits/VCU's. There will be a guarantee, through contracts with the buyers, that any and all credits negotiated will go through the registration and issuance process, with immediate accounting, and as soon as the sale is concluded, the credits will be retired or transferred to the buyer's account and, consequently, double counting will be avoided.

3 CLIMATE

3.1 Application of Methodology

3.1.1 Title and Reference of Methodology

Verified Carbon Standard (VCS) Approved Methodology VM0015 – Methodology for Prevented Planned Deforestation, version 1.1.

3.1.2 Applicability of Methodology

For Agropalma REDD+ Project, the methodology approved by VCS, code VM0015, was used and is applicable according to the applicability criteria specified in Table 11, below.

Table 11 - Criteria for applicability of the methodology for Agropalma REDD+ Project

APPLICABILITY CRITERIA	DESCRIPTION OF HOW THE PROJECT MEETS THESE CRITERIA
(a) baseline activities may include planned or unplanned logging, firewood collection, charcoal production, agricultural and grazing activities, since the category is unplanned deforestation as per the latest version of the VCS AFOLU Requirements.	Project baseline activities include unplanned deforestation as a result of agricultural and livestock activities, as per the recent version of the VCS AFOLU Requirements document.
(b) Project activities may be included in one category or a combination thereof as defined in the methodology scope description.	Project activities include forest protection with logging, in accordance with the description of scope "D" of the methodology used (page 12, Table 1 and Figure 2-D in VCS document VM0015).
(c) The Project area may include different types of forest, including but not limited to primary forests, degraded forests, secondary forests, planted	The project area has mature forests that meet the national definition of "forest".

APPLICABILITY CRITERIA	DESCRIPTION OF HOW THE PROJECT MEETS THESE CRITERIA
forests and agroforestry systems, complying with the definition of "forest".	
(d) At the beginning of the Project, the Project area shall only include areas qualified as "forest" for a minimum of 10 years prior to the Project start date.	The project area only includes areas classified as "forest" for a minimum period of 10 years prior to the project start date.
(e) The Project area may include floodplain areas (such as lowland forests, floodplain forests, mangroves) as long as they do not develop into peat. Peat should be defined as organic soils with at least 65% organic matter and minimum thickness of 50 cm. If the Project area includes lowland forests that develop into peat (e.g., peat forests), this methodology is not applicable.	Forest types found in the project area do not include forested wetlands or peatswamp forests.

3.1.3 Project Boundary

3.1.3.1 Step 1 of VM0015 - Definition of limits

3.1.3.1.1 Project spatial limits

Reference Region

According to the VCS methodology VM0015, the Reference Region is the spatial boundary that contains the Project Area, the Leakage Belt, Leakage Management areas and other geographic areas relevant to determine the project baseline (Figure 12). The main criteria used to define the spatial limits of the reference region, and thus demonstrate the conditions of compatibility in the probability of future deforestation, were:

i) Probable area of action and influence of the agents and vectors of deforestation;

ii) Landscape configurations and ecological conditions;

iii) Socio-economic and cultural conditions

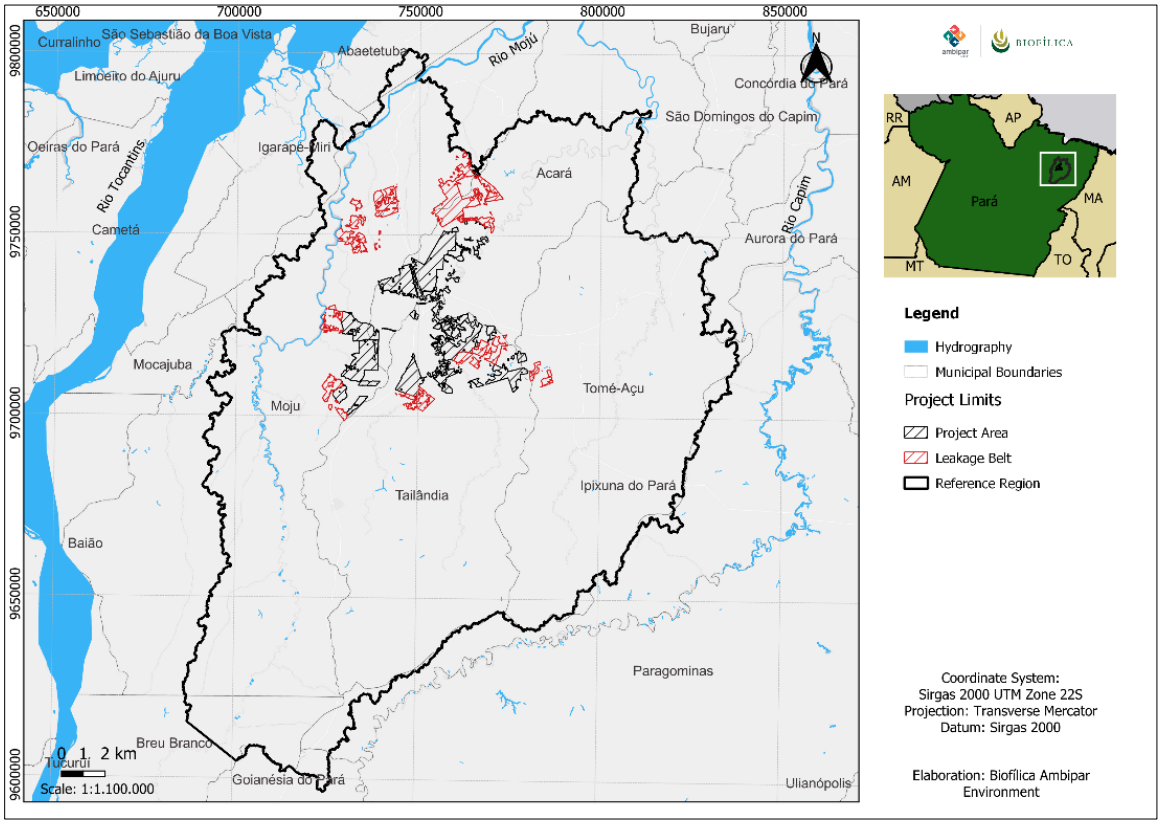

Figure 12 - Boundaries of the Reference Region, Project Area, Leakage Belt and Leakage Management of Agropalma REDD+ Project

Thus, the proposed reference region corresponds to an area of 1,802,252 hectares, equivalent to 35.7 times the Project Area (50,519 hectares). To determine the reference region, a set of hydrographic sub-basins [39] located in the region was considered. Thus, the hydrographic context, proximity to federal highways and unofficial roads (branches), together with the land situation of the areas surrounding the Project Area (private properties) were the main elements used to determine the geographical limit of the Region of Reference. The Reference region has only one stratum to analyze the actions of agents and drivers of deforestation and changes in land use and land cover.

In addition to the context described above, the following criteria established by VM0015 (pages 18 and 19 of the methodology) were analyzed, and are listed below:

- Infrastructure vectors: New projects are expected, such as the expansion of the port of Vila do Conde, the paving of the PA 252 and the construction of the Açailândia (MA) - Barcarena (PA) railroad, whose

[39] Amazon GIS-Based River Basin Framework database available at https://doi.org/10.5194/essd-8-651-2016

construction was authorized and "is part of the group of three railroads requested whose destination is the port of Vila do Conde, in Barcarena, which will have a railroad linking the North-South to Açailândia, another that goes to Santana do Araguaia and another connection going to another part of Maranhão (railway proposed by Vale).

Landscape configuration and ecological conditions: 100% of the Project Area has the same vegetation classes found in the entire reference region; 100% of the project area is between the 5th and 85th percentiles (80%) of the elevation values of the reference region; 95% of the slope of the Project area is between the 5th and 95th percentiles of the slope of the reference region; the project area has average annual rainfall within the same rainfall range as the reference region. The values obtained in the analysis of these criteria are presented in Table 12 and the spatial data used are shared with the audit team.

Table 12 - Spatial attributes of landscape configuration and ecological conditions in the Reference Region and Project Area

Landscape element	Source	Reference Region (5th and 95th percentiles)	Project Area (5th and 95th percentiles)
Dense Ombrophylous Forest	IBGE	Yes	Yes
Elevation (m)	SRTM	17 – 86	19-58
Slope (degrees)		0 – 8.4	0- 7.4
Average annual rainfall (mm)	CHIRPS V.2	2273 – 3183	2419- 3456

- Socio-economic and cultural conditions: the legal status of the land in the project area in the baseline scenario can be observed in several locations in the reference region. The land situation in the Project area (private property) occurs in 91% of the reference region. The current and projected land use classes and land cover types in the project area are the same over the entire reference region. They are: a) Forest and b) Anthropized Vegetation in Balance. The project area is governed by the same laws and regulations applied throughout the reference region.

Project Area

Agropalma REDD+ Project has an area of 50,519 hectares and its delimitation is shown in Figure 12. The limits of the project area were defined considering the existing forest area inside Agropalma Farm owned by Agropalma S.A. The description of tenure, property rights and land documents were dealt with in Section 2.5.

Estimate of forest cover for Agropalma Farm, in the year the REDD+ project started, was based on PRODES/INPE data. Areas planned for the implementation of the Project's infrastructure must be excluded and estimates presented in the certification process.

Leakage Belt

We used the multicriteria mobility approach to delimit the leakage belt, as there is no evidence that more than 80% of historical deforestation in the Reference Region was carried out in regions where deforestation generates profit. We used the deforestation projection map and maps of private properties (farms) located close to the project area to carry out the analysis.

The following criteria that facilitate and restrict the accessibility of deforestation agents were applied:

1) areas with a higher risk of deforestation are more accessible to deforestation agents (higher risk areas indicate greater accessibility to deforestation agents).

2) Rural properties with controlled access and that have environmental characteristics similar to those observed in the project area (these properties have a certain level of access control to the interior of the forest, therefore greater restriction of the deforestation agent).

The selection of farms in this initial analysis took into account the following cartographic bases:

- Deforestation risk map (as a proxy for areas with greater or lesser ease of access and close to other areas already deforested)
- Limits of georeferenced rural properties from the Rural Environmental Registry (CAR)
- Project area boundary: used to limit the selection to the vicinity of the project area

Considering the above criteria, we define the Leakage Belt as shown in Figure 12 The total area of properties selected as the Leakage Belt is 62,055 hectares, with 29,977 hectares of forest**.**

Leak Management Areas

Leakage Management areas are areas without forest where the project intends to develop activities to reduce the risk of deforestation in the Project Area and in the Leakage Belt. These areas are in the process of defining the criteria to be applied.

Forest

The Forest area was identified based on the results of the Project for Monitoring Deforestation in the Legal Amazon by Satellite (PRODES) of the National Institute for Space Research (INPE). The forest area identified by PRODES in the Reference Region was 763,231 hectares on August 2, 2021 (end of the

historical reference period). The forest definition adopted by PRODES is in accordance with the forest definition contained in Appendix I of VM0015 v1.1 (page 124). Figure 13 shows the areas covered by forests in the Reference Region on August 2, 2021 (Forest Cover Benchmark Map).

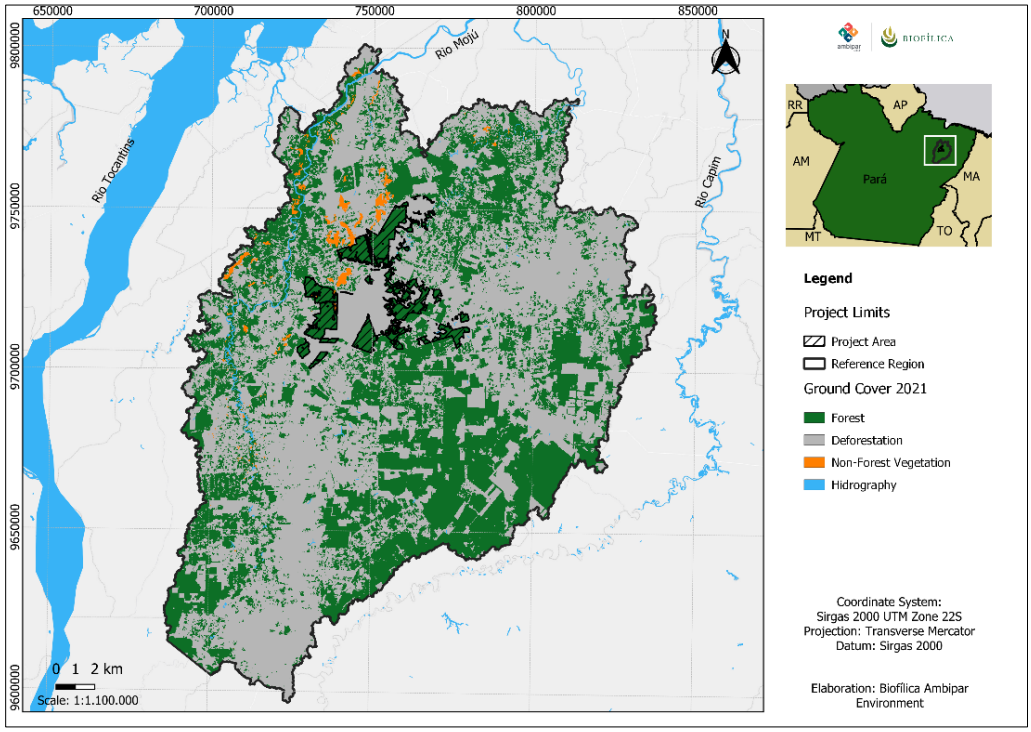

Figure 13 - Forest cover benchmark map in August 2021

3.1.3.1.2 Time limits

Start and end date of the Historical Reference Period: August 01, 2011 to August 02, 2021. These dates were defined mainly considering the reference period of PRODES data, used to generate the land cover maps and meet the requirements of the methodology VM0015.

Start date and end date of the first fixed baseline period: The fixed baseline period is 6 years as updated in VCS Standard version 4.2. In the approved methodology VM0015 version 1.1 the baseline period is still set at 10 years, the Project proponents understand that it will be updated according to the new limit defined by the VCS Standard document version 4.2.

Monitoring Period: The monitoring period of land use change and land use will start from the Project start date, contemplating the requirement of being at least 1 year.

Start date of project activities and crediting period are described in Sections 2.1.14 and 2.1.15.

Step 1.3 of VM0015 - Carbon Pools

The carbon pools analyzed in Agropalma REDD+ Project are shown in Table 13. Methodological details for estimating the carbon pools considered can be found in the document Estimating the Forest Carbon Stock in the project area, made available to the validating/verifying body.

GHG sources, sinks and carbon pools in the baseline scenario.

Table 13 - Carbon pools considered in Agropalma REDD+ Project (Table 3 of methodology VM0015, page 27)

Carbon Pool	Included/Excluded	Justification/Explanation
Above the ground	Arboreal: Included	Changes in the carbon stock of this pool are always significant.
	Non-arboreal: Excluded	Palm trees and vines were excluded from sampling, as they are not significant components of the carbon stock (allowed by methodology VM0015)
Below ground	Included	Significant pool for the forest typology of the Project Area, representing 16.7% of the total carbon stock (>10%)
Dead wood	Included	Significant reservoir for the forest typology of the Project Area, representing 13.7% of the total carbon stock (>10%)
Wood Products	Excluded	Omitted for conservatism, pool present only in scenario with Project
Litter	Excluded	Excluded in accordance with "VCS AFOLU Requirements, v3.2"
Soil organic carbon	Excluded	Excluded when land cover is grassland in baseline scenario as per "VCS AFOLU Requirements, v3.2"

Table 14 - GHG sources included or excluded within the boundaries of the REDD+ Agropalma project area (Table 4 of methodology VM0015, page 28)

Sources		Gas	Included/Excluded	Justification/Explanation
Baseline	Biomass burning	CO_2	Excluded	Accounted for as changes in carbon stocks
		CH_4	Excluded	Not significant
		N_2O	Excluded	Considered insignificant according to "VCS AFOLU Requirements, v3.2"
		CO_2	Excluded	Not a significant source

Sources		Gas	Included/Excluded	Justification/Explanation
	Emissions from farmed animals	CH_4	Excluded	Not applicable to the Project The Project does not have livestock activities, so it is conservative to exclude these emissions since they are present in the baseline scenario
		N_2O	Excluded	Not applicable to the Project The Project does not have livestock activities, so it is conservative to exclude these emissions since they are present in the baseline scenario

3.1.4 Baseline Scenario

3.1.4.1 Step 2 of VM0015 - Analysis of historical changes in land use and cover

3.1.4.1.1 Gathering the appropriate information

For the mapping of land use and land cover classes, data from the PRODES program, made available by the National Institute for Space Research, were used (PRODES, 2005). The PRODES program uses images from the Landsat series of satellites and others to map annual clear-cut deforestation and monitor the forest remnant. PRODES data in raster format provided by Terra Brasilis system[40] were analyzed in the following thematic classes: **forest, non-forest vegetation, hydrography** and **anthropic vegetation** (deforestation). The images cover the period 2012 to 2021 and correspond to orbits/points 223-61; 223-62; 223-63; 224-61; 224-62 The maps produced by PRODES have a methodology and estimate of accuracy for mapping classes recognized by the national[41] and international[42] scientific community.

Table 15 - List of satellite images used by PRODES System to monitor deforestation in the project's Reference Region over the historical period

Vector (Satellite or airplane)	Sensor	Resolution		Coverage	Acquisition date	Scene identifier	
		Spatial (m)	Spectral	(km2)	(DD/MM/YY)	Path/ Latitude	Row/ Longitude
Landsat	TM	30	0.45 – 2.35 µm	34,225	08/09/2011	223	61

[40] http://terrabrasilis.dpi.inpe.br/download/dataset/legal-amz-prodes/raster/PDigital2000_2021_AMZ_raster_v20211118.zip

[41] MAURANO, L. E. P.; ESCADA, M. I. S.; RENNO, C. D. Padrões espaciais de desmatamento e a estimativa da exatidão dos mapas do PRODES para Amazônia Legal Brasileira. Ciência Florestal, Santa Maria, v. 29, n. 4, pp. 1763-1775

[42] KINTISCH, Eli. Improved monitoring of rainforests helps pierce haze of deforestation. Science (2007)

Landsat	TM	31	0.45 – 2.35 µm	34,226	02/08/2012	223	61
Landsat	TM	32	0.45 – 2.35 µm	34,227	27/07/2013	223	61
Landsat	TM	33	0.45 – 2.35 µm	34,228	02/10/2014	223	61
Landsat	TM	34	0.45 – 2.35 µm	34,229	02/08/2015	223	61
Landsat	TM	35	0.45 – 2.35 µm	34,230	19/09/2015	223	61
Landsat	TM	36	0.45 – 2.35 µm	34,231	10/02/2016	223	61
Landsat	TM	37	0.45 – 2.35 µm	34,232	04/08/2016	223	61
Landsat	TM	38	0.45 – 2.35 µm	34,233	06/07/2017	223	61
Landsat	TM	39	0.45 – 2.35 µm	34,234	10/08/2018	223	61
Landsat	TM	40	0.45 – 2.35 µm	34,235	10/08/2019	223	61
Landsat	TM	41	0.45 – 2.35 µm	34,236	30/09/2019	223	61
Landsat	TM	42	0.45 – 2.35 µm	34,237	08/08/2020	223	61
Landsat	TM	43	0.45 – 2.35 µm	34,238	08/02/2021	223	61
Landsat	TM	44	0.45 – 2.35 µm	34,239	07/25/2011	223	62
Landsat	TM	45	0.45 – 2.35 µm	34,240	08/02/2012	223	62
Landsat	TM	46	0.45 – 2.35 µm	34,241	07/27/2013	223	62
Landsat	TM	47	0.45 – 2.35 µm	34,242	09/16/2014	223	62
Landsat	TM	48	0.45 – 2.35 µm	34,243	08/02/2015	223	62
Landsat	TM	49	0.45 – 2.35 µm	34,244	09/03/2015	223	62
Landsat	TM	50	0.45 – 2.35 µm	34,245	02/26/2016	223	62
Landsat	TM	51	0.45 – 2.35 µm	34,246	07/19/2016	223	62
Landsat	TM	52	0.45 – 2.35 µm	34,247	07/06/2017	223	62
Landsat	TM	53	0.45 – 2.35 µm	34,248	08/10/2018	223	62
Landsat	TM	54	0.45 – 2.35 µm	34,249	08/10/2018	223	62
Landsat	TM	55	0.45 – 2.35 µm	34,250	08/09/2019	223	62
Landsat	TM	56	0.45 – 2.35 µm	34,251	08/08/2020	223	62
Landsat	TM	57	0.45 – 2.35 µm	34,252	09/07/2020	223	62
Landsat	TM	58	0.45 – 2.35 µm	34,253	09/16/2020	223	62
Landsat	TM	59	0.45 – 2.35 µm	34,254	08/02/2021	223	62
Landsat	TM	60	0.45 – 2.35 µm	34,255	06/04/2011	223	63
Landsat	TM	61	0.45 – 2.35 µm	34,256	07/11/2013	223	63
Landsat	TM	62	0.45 – 2.35 µm	34,257	06/12/2014	223	63
Landsat	TM	63	0.45 – 2.35 µm	34,258	02/10/2016	223	63
Landsat	TM	64	0.45 – 2.35 µm	34,259	07/06/2017	223	63
Landsat	TM	65	0.45 – 2.35 µm	34,260	08/13/2019	223	63
Landsat	TM	66	0.45 – 2.35 µm	34,261	08/15/2020	223	63
Landsat	TM	67	0.45 – 2.35 µm	34,262	07/29/2011	224	61
Landsat	TM	68	0.45 – 2.35 µm	34,263	08/02/2012	224	61
Landsat	TM	69	0.45 – 2.35 µm	34,264	09/04/2013	224	61
Landsat	TM	70	0.45 – 2.35 µm	34,265	08/22/2014	224	61
Landsat	TM	71	0.45 – 2.35 µm	34,266	08/11/2016	224	61
Landsat	TM	72	0.45 – 2.35 µm	34,267	08/14/2017	224	61
Landsat	TM	73	0.45 – 2.35 µm	34,268	07/16/2018	224	61
Landsat	TM	74	0.45 – 2.35 µm	34,269	09/05/2019	224	61
Landsat	TM	75	0.45 – 2.35 µm	34,270	08/06/2020	224	61
Landsat	TM	76	0.45 – 2.35 µm	34,271	07/24/2021	224	61
Landsat	TM	77	0.45 – 2.35 µm	34,272	07/29/2011	224	62
Landsat	TM	78	0.45 – 2.35 µm	34,273	08/02/2012	224	62
Landsat	TM	79	0.45 – 2.35 µm	34,274	07/18/2013	224	62
Landsat	TM	80	0.45 – 2.35 µm	34,275	08/22/2014	224	62
Landsat	TM	81	0.45 – 2.35 µm	34,276	09/10/2015	224	62
Landsat	TM	82	0.45 – 2.35 µm	34,277	09/26/2015	224	62
Landsat	TM	83	0.45 – 2.35 µm	34,278	11/29/2015	224	62
Landsat	TM	84	0.45 – 2.35 µm	34,279	07/26/2016	224	62
Landsat	TM	85	0.45 – 2.35 µm	34,280	08/27/2016	224	62
Landsat	TM	86	0.45 – 2.35 µm	34,281	07/29/2017	224	62
Landsat	TM	87	0.45 – 2.35 µm	34,282	07/16/2018	224	62
Landsat	TM	88	0.45 – 2.35 µm	34,283	08/20/2019	224	62
Landsat	TM	89	0.45 – 2.35 µm	34,284	08/06/2020	224	62
Landsat	TM	90	0.45 – 2.35 µm	34,285	07/24/2021	224	62

PlanetScope Base Map	Multiespectral	4.77	RGB Basemaps - Several Sensors[43]	October 2021 image mosaic	10/01/2021	-	-

3.1.4.1.2 Definition of land use and land cover classes

The land cover classes present in the reference region on the project start date (PRODES raster data) are: Forest; Non-Forest Vegetation; Hydrography and Anthropized Vegetation in Balance (

). The description of each class and code (ND) and its existing area before the start of the project (2021) is presented below:

- Forest (ND = 0 with 763,231 ha): forest remnant area belonging to the Dense Ombrophylous Forest phytophysiognomies.
- Anthropized Vegetation in Balance (ND = 1 with 1,018,108 ha): areas of deforested forests converted to other land uses (mosaic of different types of vegetation that includes pastures, swiddens, plantations and secondary vegetation).
- Non-Forest Vegetation (ND = 2 with 16,279 ha): areas made up of natural vegetation with different physiognomy of forest, regionally known as Campinarana, Savannah or Cerrado.
- Hydrography (ND = 3 with 4,633 ha): water bodies (rivers, lakes, streams, among others).

Table 16 - Classes of existing land use and land cover in the Reference Region (table 6 of VM0015)

Class Identification		Carbon Stock Trend	Present in[1]	Baseline Activity[2]			Description
ID_{cl}	Name			LG	FW	CP	
0	Forest	Descending	RR, PA, LB.	Yes	Yes	Yes	Remaining forest.
1	Anthropized Vegetation in Balance	Constant	RR, LB, LM	No	No	No	Forest areas deforested by clear cutting and with a type of vegetation different from the Ombrophylous Forest.
2	Non-Forest Vegetation	Constant	RR, (LB, LM?)	No	No	No	Natural vegetation cover with non-forest phytophysiognomy.

[43] Information on Planet website: Accessed on December 1, 2022: https://developers.planet.com/docs/data/visual-basemaps/#overview

3	Hydrography	-	RR	No	No	No	Bodies of water.

[1]RR: Reference Region: PA: Project Area: LB: Leakage Belt; LM: *Leak* Management Areas.

[2]LG: Logging; FW = Fuel-wood collection; CP = Charcoal Production.

3.1.4.1.3 Definition of land use and land cover change categories

In the spatial modeling of future deforestation, changes (Table 17) in areas with Forest (Class 0) to areas with Anthropic Vegetation in Balance (Class 1) within the project area and in the leakage belt were considered.(Table 18).

Table 17 - Matrix of potential changes in land use and land cover (table 7a of VM0015)

		Initial Class				
	ID	ID_{cl}	0	1	2	3
		Name	**Forest**	**Anthropized Vegetation in Balance**	**Non-Forest Vegetation**	**Hydrography**
Final Class	0	**Forest**	forest in balance	-	-	-
	1	**Anthropized Vegetation in Balance**	Deforestation	Anthropized Vegetation in Balance	-	-
	2	**Non-Forest Vegetation**	-	-	Non-Forest Vegetation in balance	-
	3	**Hydrography**	-	-	-	Hydrography

Table 18 - Definition of land use and change categories (table 7.b of VM0015)

IDcl	Name	Carbon stock trend	Present in	Activity in the baseline case			Name	Carbon stock trend	Present in	Activity in the project case		
				LG	FW	CP				LG	FW	CP
0/1	Deforestation	Descending	PA, LB, RR	Yes	Yes	Yes	Deforestation	Constant	LB. RR	No	No	No

3.1.4.1.4 Analysis of land use history and land use change

Data provided by PRODES were used to analyze the history of land use changes. The main activities carried out by PRODES to map deforestation in the Brazilian Amazon are detailed below:

- **Pre-processing:** the main image pre-processing procedures performed by PRODES (Câmara et al., 2006)[44] consist of the steps of selecting images with less cloud cover, with acquisition date closest to the dry season in the Amazon and with adequate radiometric quality; georeferencing of images with a spatial resolution of 30 meters with topographic maps at a scale of 1:100,000 and images in NASA MrSID orthorectified format. The present baseline study evaluated the geometric quality of images and the results showed RMS less than 01 pixel.
- **Interpretation and Classification:** the satellite image classification method used by PRODES follows four steps: i) a spectral mixture model is generated by identifying vegetation, soil and shade components in the images. This technique is known as linear spectral mixing model (LSMM), which aims to estimate the percentage of vegetation, soil and shade components for each cell (pixel) of the image; ii) application of the segmentation technique, which identifies spatially adjacent regions (segments) with similar spectral characteristics in the satellite image; iii) automatic classification of segments individually to identify forest, non-forest vegetation, hydrography and deforestation (anthropic vegetation) classes; iv) visual Interpretation process directly on the computer screen using the geographic information system
- **Assessment of Mapping Accuracy:** the assessment of mapping available by PRODES 1 was carried out by comparing each class of the most recent land use and cover map (2021) with a set of points randomly distributed over the reference region. The reference data used in this step comes from the visual interpretation of a mosaic of high spatial resolution images from PlanetScope (forming a "basemap" with a reference date of approximately October 2021). Using the reference points and the 2021 land use and land cover map, it was possible to evaluate the performance of mapping through the analysis of the error matrix (Table 19). The overall accuracy of PRODES mapping in the Reference Region was 97%, with user and producer accuracy equal to 99% and 95% for forest and 100% and 99% for deforestation, respectively, above the 90% published by INPE for the accuracy of data for the Brazilian Legal Amazon, of 93% (Maurano et al., 2019).

Table 19 - PRODES 2021 data evaluation error matrix

		Planetscope Reference					
PRODES Classified		Forest	Deforestation	Water	Non-Forest	Total	User Accuracy
	Forest	99	1	0	0	100	99%

[44] CÂMARA, G.; VALERIANO, D. M.; SOARES, J. V. Metodologia para o Cálculo da Taxa Anual de Desmatamento na Amazônia Legal. Instituto Nacional de Pesquisas Espaciais, São José dos Campos, 2006.

	Deforestation	0	100	0	0	100	100%
	Water	3	0	47	0	50	94%
	Non-Forest	2	0	1	47	50	94%
	Total	104	101	48	47	300	
	Producer Accuracy	95%	99%	98%	100%		

3.1.4.1.5 Results of analysis of the history of changes in land use and land cover

From PRODES data, we estimate that the deforestation that occurred between August 1, 2011 and August 2, 2021 (Table 20), in the reference region, was 72,108 hectares, or 8.5% of the forest cover on August 1, 2011.

Table 20 - Land use change matrix in the reference region between 2011 and 2021 (Table 7.a of methodology VM0015)

ID_{cl}		Name	Initial LU/LC Class (2011)				Total (ha)
			Forest	Anthropized Vegetation in Balance	Non-Forest Vegetation	Hydrography	
			I2	I4	I3	I1	
Final LU/LC class (2021)	F2	Forest	763.231	0	0	0	763.231
	F4	Anthropized Vegetation in Balance	72.108	946.000	0	0	1.018.108
	F3	Non-Forest Vegetation	0	0	16.279	0	16.279
	F1	Hydrography	0	0	0	4.633	4.633
Total (ha)			835.236	946.003	16.280	4.630	1.802.149

During the years 2011 and 2021, an average deforestation rate of 7,210 hectares per year (0.85% per year) was observed. The graph of Figure 14 shows the temporal variation in deforestation on an annual basis for the reference region, the state of Pará and the Legal Amazon during the period 2011 - 2021. The spatial distribution of deforestation at the end of the historical period (August 02, 2021) is shown in Figure 14.

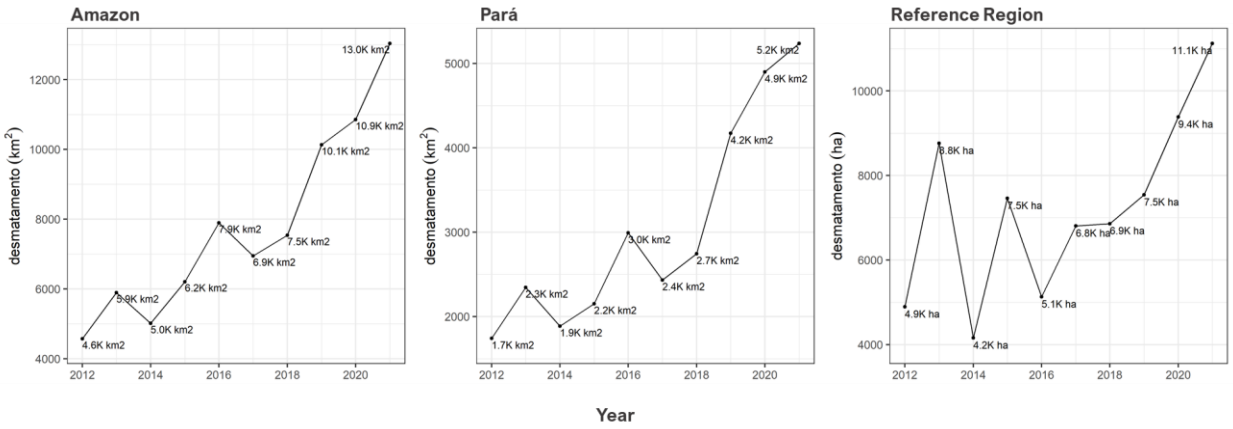

Figure 14 - Evolution of deforestation in the Reference Region, in (the State of) Pará and in the Legal Amazon.

A dramatic increase in deforestation over the entire historical period in the Brazilian Legal Amazon can be observed in the reference historical period, a pattern that is repeated in Pará and in the Reference Region of the Project from 2016 onwards. The increase in deforestation in the region reflects the ineffectiveness of the public power in preventing unplanned deforestation throughout the Brazilian Amazon in the period, a problem that intensified after the political and economic instabilities of 2016[45]. In the Project Reference region, deforestation appears to have been stationary, but with large fluctuations around 6000 ha/year between 2012 and 2015, starting a clear upward trend since then.

3.1.4.2 Step 3 of VM0015 – Analysis of agents, controllers and underlying causes of deforestation and its probable future development

Infrastructure and agricultural production represent major threats to the present and future of the forest conservation areas of Agropalma Farm, considering its history of spatial distribution. The spatial distribution of deforestation occurs due to the construction of infrastructure in the region, with emphasis on the PA-150 highway, expansion of the port of Vila do Conde, paving of the PA-252, construction of Açailândia (MA) - Barcarena railroad (PA) connecting the North-South to Açailândia, another railroad that goes to Santana do Araguaia and in the future, another connection going to another part of Maranhão (railway proposed by Vale). With regard to the pressure for deforestation on Agropalma Farm, the same happens through invasions in the forest areas and in the reference area by small, medium and large rural landowners.

[45] LEÃO PEREIRA, Eder Johnson de Area; SILVEIRA FERREIRA, Paulo Jorge; DE SANTAA RIBEIRO, Luiz Carlos; SABADINI CARVALHO, Terciane; DE BARROS PEREIRA, Hernane Borges. Policy in Brazil (2016–2019) threaten conservation of the Amazon rainforest. Environmental Science & Policy, vol. 100, p. 8–12, Oct. 2019. DOI 10.1016/j.envsci.2019.06.001. Available at: https://linkinghub.elsevier.com/retrieve/pii/S1462901119303818

3.1.4.2.1 Identification of deforestation agents

a) Deforestation agents in the reference region: the main groups of deforestation agents are small, medium and large rural producers.

b) Relative importance of the amount of historical deforestation attributed to each agent or group: the identified small, medium and large local farmers are responsible for 100% of the unplanned deforestation observed in the reference region.

c) Brief description: the felling and burning of the forest is carried out periodically to expand the crop production area due to the reduction in the level of fertilization of land. Medium and large producers use more productive techniques and are able to maintain the level of soil fertilization with the application of chemical products.

Livestock production in the region has low productivity and cattle raising is done extensively, and part of the milk production is consumed by families. On farms with a large number of animals, production is carried out considering practices that increase productivity and scale of production.

Some residents of communities seek their own or community forest areas with those registered in the communities of Arauaí, Boa Esperança, Gonçalves, Nazaré-Auí-Açu and Nova Esperança, where fruits such as bacuri, uxí, piquiá, as well as seeds and bark of species such as Veronica, Barbatimão and Casca de caju area collected.

There are cases of access to the legal reserve areas of oil palm farms and companies as seen in the Boa Esperança community, whose collection was carried out at Agropalma farm.

The main agents of deforestation are rural producers who own areas in agrarian reform settlements, squatters and land grabbers who are in areas not recognized by agrarian reform yet or officially registered with INCRA and ITERPA.

These agents carry out unplanned deforestation, with the following characteristics:
- Small rural producers, o carry out fractional deforestation of forest areas on their properties to plant subsistence crops and sell the surplus to the local market; o have low level of education or high income vulnerability o seek forest areas to collect extractive products such as fruits, bark and oils. o have low access to public services and guarantees of rights o have a low level of social organization

- Medium and large rural producers who seek new areas to expand the planting of monocultures and expand pasture areas for extensive cattle raising. o have a higher level of education o have a high level of income o have low access to public services and greater legal bargaining power o have a higher level of social organization.

d) Brief assessment of the most probable development of population of groups of deforestation agents in the Reference Region, Project Area and Leakage Belt

The context evidenced in the reference region, which should follow the same trend in the Project area and in the leakage belt (in the baseline scenario), demonstrates that there are growth trends of agents identified as family farmers, medium and large local landowners.

Factors such as population development of groups of deforestation agents in the Reference Region, Project Area and Leakage Belt include:

- Population growth in the communities facilitated by the infrastructure of highways such as PA-150, expansion of the port of Vila do Conde, paving of PA 252 and construction of the Açailândia (MA) - Barcarena (PA) railroad connecting North-South, until Açailândia, another that goes to Santana do Araguaia and another connection going to another part of Maranhão (railway proposed by Vale) will be a great railway and multimodal hub in the country, with a great export capacity not only of ore, but agriculture as well and with attraction of other ventures enabling population mobility.

- Increase in the demand for land by small producers to increase the production of crops such as corn, acai berries, palm oil, black pepper and cassava, is largely due to deforestation carried out by family farmers who have scarce resources, where burning is a necessary evil, and because it is more practical to cut down and burn, to grow cassava.

- Increased demand for land by large producers to increase production of crops such as oil palm, soybeans and corn. The search for an increase in areas for the production of these crops will continue to happen as demand for these increases in the international and national market, encouraging producers to put pressure on small producers to sell areas with or without forest areas.

e) Statistics of historical deforestation attributed to each agent in the reference region:

The discussion about who are the agents of deforestation in the Amazon is made by several authors such as Calandino et al., (2012)[46], who evaluated the deforestation dynamics of 15% of the federal settlements in the State of Pará during five years, and the results show greater deforestation inside the settlements than in the surrounding areas; however, the pace of deforestation growth in the settlements is lower. The authors point out some factors that contribute to this growing trend of deforestation in the settlements, including economic vulnerability, delay in the release of rural financing, land uncertainties, the size of lots and logging in settlements.

The study by Amorim et al., (2020)[47] shows that the lack of planning to develop the colonization process and structure settlements in the Amazon ended up inducing agricultural practices that led to deforestation. The authors point out that 50% of the forest area of settlements was suppressed by agricultural activities.

[46] Calandino, D., Wehrmann, M., Koblitz, R., 2012. Contribuição dos assentamentos rurais no desmatamento da Amazônia: um olhar sobre o Estado do Pará. Desenvolv. E Meio Ambiente 26.

[47] Amorim, I.A., Mello, A.H. de, Homma, A.K.O., Pontes, A.N., 2020. DINÂMICA DO DESMATAMENTO EM ÁREA DE ASSENTAMENTO DE REFORMA AGRÁRIA NO SUDESTE PARAENSE. Caminhos Geogr. 21, 21–35. https://doi.org/10.14393/RCG217851483

In summary, Amorim et al. (2020) point out that “the absence or weakness of inspection and monitoring, inadequate technical assistance and rural extension without continuity and the economic vulnerability of the settlers”, were the factors identified as motivating deforestation.

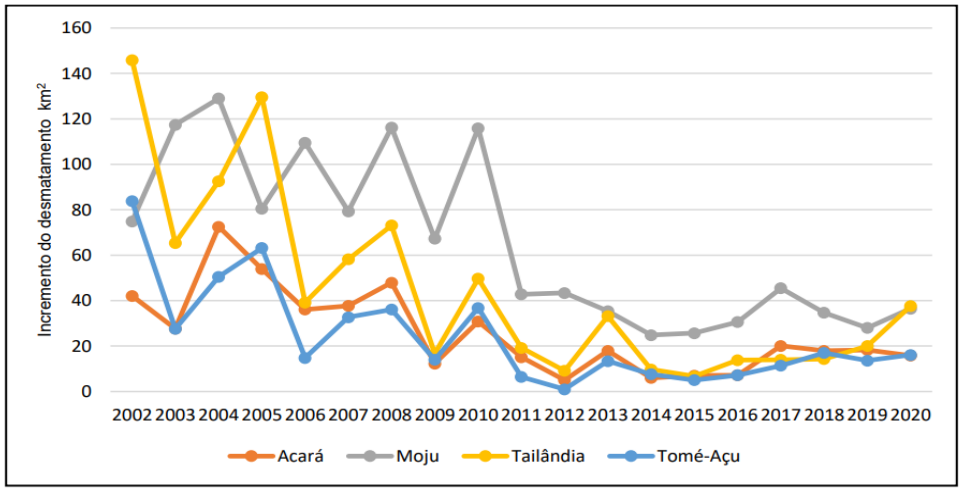

Figure 15 - Deforestation dynamics in the last 12 years in the municipalities of Acará, Moju, Tailândia and Tomé-Açú neighboring the Agropalma Farm.

Thus, from the contextualization of information on the dynamics of deforestation (Figure 15, above) it is possible to understand the numbers and areas of agricultural establishments by total area group (Table 21, below).

Table 21 - Number and area of agricultural establishments by total area group

CHARACTERISTIC	ACARÁ		MOJU		TAILÂNDIA		TOMÉ-AÇÚ	
	A	B	A	B	A	B	A	B
0.1 to < 1 ha	7.50	0.11	2.13	0.02	5.22	0.01	1.55	0.01
1 to < 5 ha	18.43	1.73	17.18	0.71	3.20	0.04	15.61	0.46
5 to < 20 ha	29.30	12.18	28.74	5.06	12.24	0.55	28.69	3.57
20 to < 50 ha	32.54	36.02	31.37	14.34	38.55	5.18	39.11	12.90
50 to < 100 ha	9.29	23.10	12.36	12.43	20.45	5.56	8.20	6.51
100 to < 500 ha	2.26	14.44	5.92	16.00	13.95	11.89	4.86	11.59
500 ha and +	0.20	3.14	1.25	51.44	6.17	42.35	2.01	47.09

Source: IBGE/2017 AGRICULTURAL CENSUS
A =% establishments; B=% of total area.

In the municipalities surveyed, cassava is the most cultivated temporary crop, with emphasis on the municipality of Acará; however, the planted area reduced from 2015 to 2020, this reduction was also observed in the municipalities of Tailândia and Tomé-Açu. Corn production grew by almost 150.0% in Tailândia, from 7.5 thousand ha in 2015 to 18 thousand ha in 2020, while in Acará the area reduced by almost 100.0%, from 300 ha in 2015 to 50 ha, in 2020.

The rice harvested area increased in the municipalities of Tailândia and Tomé-Açu. The bean area reduced in the municipalities, and the soybean harvested area grew 300.0% in Tailândia, from 4.3 thousand ha in 2015 to 17.5 thousand ha in 2020. The tendency is for the area harvested with soybeans to increase in the coming years.

The results in Table 22 show that oil palm has a moderate correlation with deforestation in the municipalities of Acará, Tailândia and Tomé-açu, where increases in the area planted with oil palm are associated with increases in the increment of deforestation in these municipalities.

The harvested area of acai berries presents a moderate positive correlation with the increase in deforestation in the municipalities of Acará, Moju and Tailândia, and is strongly correlated with the variable of increase in deforestation in Tomé-Açu, which is explained by the performance of CAMTA cooperative that stimulates the consortium of acai berries with other crops in the agroforestry system.

Cocoa has a positive and moderate correlation between its harvested area and deforestation in the municipalities of Acará, Tailândia and Tomé-Açu; however, in Moju this correlation is weak. The black pepper harvested area has a moderate correlation with increased deforestation in the municipalities of Moju, Tailândia and Tomé-Açu, such correlation being weak in Acará.

The cassava harvested area has a strong and negative correlation with the increase in deforestation in Acará and a moderate and negative correlation in Tomé-Açu, which indicates that an increase in the cassava harvested area is associated with a decrease in the increment of deforestation in these municipalities. Corn has a moderate and positive correlation between harvested area and increased deforestation in Moju and Tailândia, where increases in harvested area of this crop are associated with increases in deforestation. The correlation between the area harvested with soybeans and the increase in deforestation appears in the municipality of Tailândia with weak intensity and positive direction.

Table 22 - Correlation of increase in deforestation with the harvested area of some crops and Cattle Herd (ERB) in the municipalities of Acará, Moju, Tailândia and Tomé-Açu, in the period from 2012 to 2020.

ACTIVITY	ACARÁ	MOJU	TAILÂNDIA	TOMÉ-AÇÚ
PALM OIL	0.551	0.285	0.508	0.742
ACAI BERRIES	0.614	0.531	0.644	0.958

ACTIVITY	ACARÁ	MOJU	TAILÂNDIA	TOMÉ-AÇÚ
COCOA	0.59	0.197	0.408	0.442
BLACK PEPPER	0.248	0.501	0.59	0.623
CASSAVA	-0.729	0.191	0.491	-0.595
CORN	-0.312	0.682	0.522	-
SOYBEANS	-	-	0.491	-
ERB	0.408	0.34	0.645	-0.056

Source: INPE/IBGE[48]

The correlation between the number of cattle herds and increase in deforestation is positive and of moderate intensity in Tailândia, and of low intensity in Acará and Moju. In Tomé-Açu the correlation is negative and not significant for the value close to zero.

According to the literature, the amount (hectares) of deforestation is positively related, according to Ferreira and Coelho (2015)[49], to agricultural prices and they concluded that deforestation is strongly related to variations in agricultural prices and little influenced by public policy. However, the authors point out that the policies developed between 1999 and 2011 were more focused on controlling deforestation, and claim that the embargo on the sale of products from deforested areas seemed to be more effective, in that period, for reducing deforestation. Deforestation is positively correlated with the number of cattle herds and with the expansion of soybeans cultivation for Rivero, Almeida, Ávila and Oliveira (2009) who analyzed the relationship between the main land uses in the 782 municipalities of the Amazon region and deforestation.

For Fearnside (2020)[50], increase in deforestation is promoted by the reduction of control over the agents of deforestation in recent years, with emphasis on the current federal government; the search for gains with increases in commodity prices, deforestation as a way to expand agricultural production, in which deforestation is carried out to produce pastures and then soybeans, increase in land prices, infrastructure projects, population growth and familiar dynamics

3.1.4.2.2 Identification of deforestation controllers

a) Variables that explain the amount (hectares) of deforestation

[48] INSTITUTO BRASILEIRO DE GEOGRAFIA ESTATÍSTICA (IBGE) - Censos Demográficos, 2000. Rio de Janeiro, 2015. Disponível em: IBGE. . 2022.

[49] FERREIRA, Marcelo Dias Paes; COELHO, Alexandre Bragança. Desmatamento Recente nos Estados da Amazônia Legal: uma análise da contribuição dos preços agrícolas e das políticas governamentais. Revista de Economia e Sociologia Rural, v. 53, p. 91-108, 2015.

[50] FEARNSIDE, Philip Martin Deforestation of the Brazilian Amazon. In: H. Shugart (ed.) Oxford Research Encyclopedia of Environmental Science. Oxford University Press, New York, EUA

I) Population growth in most communities, except for Nazaré-Auí-Açu;

II) Increased demand for land by small producers to increase the production of crops such as corn, acai berries, cocoa, palm oil, black pepper and cassava;

III) Increased demand for land by large producers to increase production of crops such as oil palm, soybeans and corn.

b) Cultural aspects and population growth:

i) Brief Description: communities are expected to maintain the population dynamics that began in the 1970's with the large development projects in the Legal Amazon. How such migration was facilitated by the infrastructure of highways such as PA-150, which enabled the integration of municipalities with large government projects with the trans-Amazon highway, connecting the Belém-Brasília highway to the north and southeast of the state (PRADO, 2006)[51] .

ii) Impact on the behavior of agents: the population increase of family farming families can lead to deforestation for advancement of agriculture, based on the practice of slash and burn, in forest reserve areas, as well as intensify illegal logging to supply demands from sawmills and charcoal plants. At the same time, New projects are expected, such as the expansion of the port of Vila do Conde, the paving of the PA 252 and the construction of the Açailândia (MA) - Barcarena (PA) railroad, whose construction was authorized and "is part of the group of three railroads requested whose destination is the port of Vila do Conde, in Barcarena, which will have a railroad linking the North-South to Açailândia, another that goes to Santana do Araguaia and another connection going to another part of Maranhão (railway proposed by Vale).increase the pressure of deforestation in the region caused by the expansion of infrastructure.

iii) Development forecast: as long as alternative production techniques are not adopted by family farmers in the region, the tendency to implement subsistence agriculture based on the conventional way of cultivation is imminent. This mode of production, which wears out the soil and forces small producers to expand their areas, associated with other determining factors such as population growth, resource scarcity, geographic isolation, rural exodus, land speculation, migrant settlement, soy expansion and livestock, and constant demand for wood with commercial value, accelerate and encourage deforestation in forest reserves conserved in the region where the Agropalma Farm is located. In view of this situation related to the logistical infrastructure and what it allows for population mobility, it is expected that there will be an impact on the behavior of migration to the region of these municipalities, increasing the number of people

[51] Prado, F.R., 2006. O Mito da cidade provisória: natureza, migração e conflito social em Tailândia (1977-2000).

in these communities in search for job opportunities in companies that provide civil construction services, paving and others that work in the infrastructure sector.

iv) Measures to be implemented: the actions planned to be implemented during the project management plan will have as their main objective the promotion of socio-economic development in the countryside, offering alternatives for families to diversify and increase their productions sustainably. By offering technical assistance and organizational support, the project aims to reduce the need for families to clear new areas of forest, develop responsible agricultural practices and reduce the predatory exploitation of natural resources, in addition to providing improvements in infrastructure, such as maintenance of roads, along with initiatives to encourage people to settle in the countryside, preventing land close to forest reserves from being occupied by agents that cause environmental degradation.

- **Increased demand for land by small producers to increase the production of crops such as corn, acai berries, cocoa, palm oil, black pepper and cassava:**

a) Brief Description: largely due to deforestation carried out by family farmers which have scarce resources, in which burning is a necessary evil, and because it is more practical to cut down and burn to grow cassava. It should be noted that the family farmer does not clear a significant area of land, if the farmer places more than 2 or 3 ha, he cannot produce, as he does not have the manpower to carry out the required activities. According to the focus group research, difficulty of keeping an area open for two or three years is related to the cultural heritage of past generations and technical difficulties in producing and maintaining the area.

b) Impact on the behavior of agents: the current environmental legislation in Brazil and the relaxation in the inspection of deforestation, associated with the quality of soil in the region and local practices of agricultural use, can encourage these rural producers to expand their areas and grow in terms of production of corn, acai berries, cocoa, palm oil, black pepper and cassava, suppressing forest reserve areas.

c) Development forecast: With this, the underlying causes, linked to environmental policy, soil quality in the region and installation of drainage infrastructure, such as the Açailândia (MA) - Barcarena (PA) railroad connecting the North-South railroad, can boost the agent in the opening of new areas for agriculture and livestock, succumbing to areas of forest reserves, where the search for noble species, with high market value, puts pressure on protected, private and community areas with remaining forests that still exist. At the same time, due to the high price of cooking gas, illegal logging has also been leveraged by the growing demand from charcoal plants to produce charcoal, providing an alternative source of energy for vulnerable families in rural areas. Added to this context, the local conditions of physical infrastructure and the low capacity of public agents to carry out inspection and control, favor the illegal action of these agents of deforestation.

d) Measures to be implemented: the actions planned to be implemented during the project management plan will have as their main objective the promotion of socio-economic development in field so that rural producers can technically and quantitatively improve their productions, with no need for expansion of the agricultural frontier. By offering technical assistance and rural extension, the project aims to reduce the advance of corn, acai berries, cocoa, palm oil, black pepper and cassava agriculture over the forest and to develop responsible and efficient agricultural practices, in addition to promoting the articulation with relevant public bodies to maintain an effective and restrictive environmental policy.

- **Increased demand for land by large producers to increase production of crops such as oil palm, soybeans and corn.**

a) Brief Description: the recent environmental policy of the Brazilian federal government has leveraged deforestation in the Amazon region, mainly for the expansion of soy cultivation in areas of conservation units and traditional communities. There was a relaxation in the enforcement of environmental laws that restricted uses and guaranteed greater safety and protection, both to the environment and to the traditional populations of the region. It is estimated that the sense of impunity for environmental crimes has grown in recent years. The search for an increase in areas for the production of these crops will continue to happen as demand for these increases in the international and national market, encouraging producers to put pressure on small producers to sell areas with or without forest areas.

b) Impact on the behavior of agents: profitability associated with the exploitation of noble wood in lumber and sawmills and the growing demand for charcoal in the project's reference region; associated the conditions of regression in environmental policies with access of the federal government to the maintenance of illegality and the inefficiency on the part of public agencies in combating illegal deforestation; promote the advancement of environmental degradation in the region.

c) Development forecast: deforestation linked to the exploitation of illegal wood in the reference region, both for sawmills and timber companies and for charcoal plants, tends to increase to the extent that it is still possible to remove wood with market value in areas of forest remnants, as well as there is market demand. In addition to that, the lack of governmental commitment in the inspection and strengthening of environmental questions, tends to move a scenery of continuity of degradation of forest remnants.

d) Measures to be implemented: the actions planned to be implemented during the project management plan will have as their main objective the promotion of socio-economic development in the countryside, offering alternatives for the aforementioned agents to diversify and develop activities of a sustainable nature. By offering technical assistance and organizational support, the project aims to encourage sustainable agricultural practices, reducing the predatory exploitation of natural resources, in addition to encouraging and strengthening associations of rural producers. Concomitantly, the project aims to monitor

changes in forest cover and articulate effective and restrictive environmental policies with the competent public bodies.

3.1.4.2.3 Controlling variables that explain the location of deforestation

Six spatial variables were analyzed to identify the vectors that may represent the greatest influence on the location of deforestation in the reference region.

The relative importance of deforestation vectors was estimated using the Weight of Evidence[52] method, implemented in the Dinamica EGO[53] software. In the reference region of Agropalma REDD+ Project, the results of analysis of weights of evidence (WoE) indicated values ranging from -2.46 to +1.08, where positive and negative values represent, respectively, greater or lesser influence of the vector on occurrence of deforestation in each pixel of the map.

The spatial variables that represent the deforestation pattern in the model calibration period were: i) Presence of Settlements; ii) Minimum distance to river; iii); Minimum distance to city or town; iv) Minimum distance to the road; v) Elevation; vi) Slope. The results of the WoE analysis are presented in Figure 16, where the highest and lowest values indicate areas with higher or lower probability of deforestation, respectively.

The description of the variables analyzed to explain the occurrence of deforestation in the historical reference period is presented below:

a) Presence of settlement: this variable takes the value 1 whenever the pixel is within settlements, 0 otherwise;

b) Minimum distance to rivers: rivers are almost always a means of transporting wood extracted from forests due to logging activities that normally precede deforestation.

c) Minimum distance to cities: areas closer to cities, towns and villages have greater accessibility, therefore, they may be related to the risk of deforestation.

d) Distance to roads and branches: forests close to this type of road are more accessible and thus become more susceptible to deforestation.

e) Elevation and slope: Lower and steeper areas have a lower level of accessibility and may impact the risk of deforestation in the region.

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[52] BONHAM-CARTER, G. Geographic information systens for geoscientists: modeling with GIS. New York: Pergamon, 1994. pp. 398

[53] https://www.csr.ufmg.br/dinamica/dokuwiki/doku.php?id=determine_weights_of_evidence_ranges

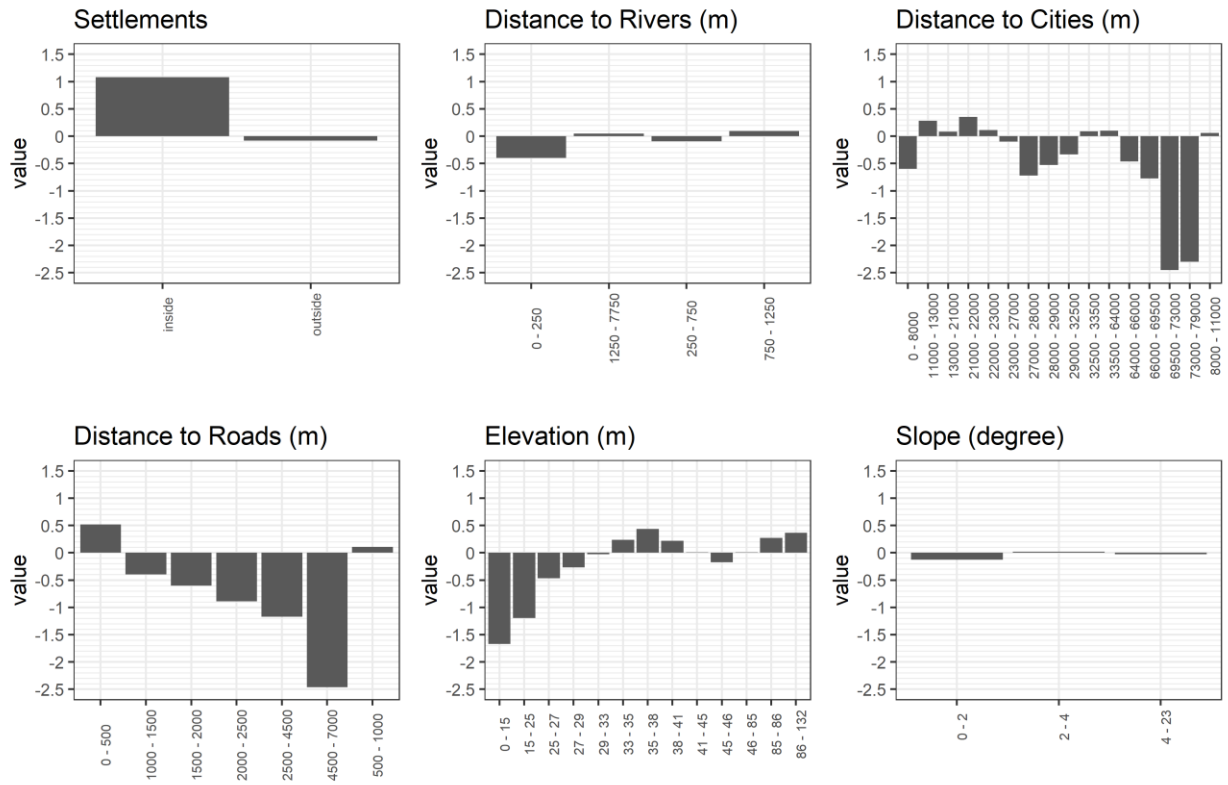

Figure 16 - Spatial vectors analyzed and their respective values of influence on deforestation (Weights of evidence).

The graph on Figure 16 shows that the risk of deforestation is higher in settlements than public and private areas, that the risk is lower near rivers and lower regions, and that the risk of deforestation is higher between ~1km and ~3Km from cities and villages, and up to ~4km from roads.

3.1.4.2.4 Identification of underlying causes of deforestation

a) Brief description: Among the factors underlying deforestation are: i) population growth that increases demand for food and makes producers expand the areas of cultivation, advancing on the existing forest areas in the municipalities. ii) Low level of education of the population of such municipalities, which limits the use of new production techniques beyond those culturally passed on over time. iii) Low family income of residents in the municipalities and a high number of people receiving *Auxílio Brasil*, a social benefit from the federal government. iv) Increase in consumption of beef and soy in the national and international market is another factor that explains, in part, deforestation and has increased due to the growing volume of exported live cattle, frozen meat and soy consumed by countries importers, with repercussions on the increase of prices in the internal market.

b) Impact on the decision of the group of agents to deforest: There is a combination of factors that lead to periodic increases in deforestation, such as: population growth that increases demand for food and makes producers expand the areas of cultivation, advancing on the existing forest areas in the communities, as observed in the communities of Forquilha, Nova Esperança and Turi-Açu, in addition to using areas of *capoeira* that had undergone shifting cultivation for more than four years. Low level of education, in the communities at least 40.0% of people have complete or incomplete primary education or are illiterate, which limits the use of new production techniques beyond those culturally passed on over time, low family income is another determining factor in deforestation by small producers, since 50% to 70% of families in communities earn up to one minimum wage per month or receive *Auxílio Brasil*, a social benefit from the federal government, the low level of income makes producers expand production to create value from the sale of surpluses produced. Increase in consumption of beef and soy in the national and international market is another factor that explains, in part, deforestation and has increased due to the growing volume of exported live cattle, frozen meat and soy consumed by importing countries, reflected in the increase of prices in the internal market. In summary, there is a lack of public policies that can induce the development of communities in order to raise the level of income, schooling, agricultural production such as technical assistance and rural extension, and commercialization based on the inclusion of small producers in value chains of agricultural products.

c) Probable future development: For population growth in communities, it is expected that the population dynamics started in the 1970's with the large development projects in the Legal Amazon will be maintained. How such migration was facilitated by the infrastructure of highways such as PA-150, which enabled the integration of municipalities with large government projects with the trans-Amazon highway, connecting the Belém-Brasília highway to the north and southeast of the state (PRADO, 2006). The expectations of new projects such as the expansion of the port of Vila do Conde, paving the PA 252 and the construction of the Açailândia (MA) - Barcarena (PA) railroad, whose construction was authorized and "is part of the group of three railroads requested that its destination is the port of Vila do Conde, in Barcarena, which will have a railroad linking the North-South to Açailândia, another that goes to Santana do Araguaia and another connection going to another part of Maranhão (railway proposed by Vale). In view of this situation related to the logistical infrastructure and what it allows for population mobility, it is expected that there will be an impact on the behavior of migration to the region of these municipalities, increasing the number of people in these communities in search for job opportunities in companies that provide civil construction services, paving and others that work in the infrastructure sector. As for increase in the demand for land by small producers to increase the production of crops such as corn, acai berries, palm oil, black pepper and cassava, is largely due to deforestation carried out by family farmers who have scarce resources, where burning is a necessary evil, and because it is more practical to cut down and burn, to grow cassava. This behavior of family farmers in new areas to expand the production of monocultures such as acai berries,

cassava and cocoa is largely due to the lack of technological knowledge on how to use the land more efficiently and without degrading the environment, perpetuating the need for the practice of slashing and burning to produce. iii) Increased demand for land by large producers to increase production of crops such as oil palm, soybeans and corn. The search for an increase in areas for the production of these crops will continue to happen as demand for these increases in the international and national market, encouraging producers to put pressure on small producers to sell areas with or without forest areas.

d) Measures to be implemented: Given the conditions of income, schooling, lack of adequate infrastructure in the communities, and the fact that producers are not part of food value chains, and considering the traditional production system of small producers, some actions must be implemented as a way to expand family income, maintenance in rural areas based on practices linked to low-carbon agriculture, including: i) carrying out a project that allows the transfer of scientific knowledge and technologies so that the production of small producers has a diversity of cultures, better performance and profitability. ii) structure the production chain of the main crops in the municipalities and include small producers in individual or associative practices that develop low-carbon rural production, retain families in the countryside, reduce deforestation and encourage restoration of degraded areas. iii) use the agroforestry system as a way of structuring land use. iv) develop a project to reduce environmental liabilities based on land and environmental regularization of properties. v) encourage social organization in communities. vi) develop environmental education projects in community schools. vii) enable technical assistance and rural extension to small producers.

3.1.4.2.5 Analysis of the chain of events leading to deforestation

The chain of events can be thus established according to the information in the previous items:

i) The initial step was the Amazon development process promoted by the federal government in its different development plans for the region since the 1960's, which had as their central axis the logistical infrastructure and integration of the region with other regions of Brazil and that would allow exploitation of mineral and forest resources, creating income for the country.

ii) In this context, in the Northeast region of Pará, a project was carried out to integrate this region into the state capital and the municipality of Marabá, the main integration hub between the state of Pará and the access roads to the Mid-West and other regions of the country. Indeed, there has been an intensification of the migration process to the region, and the densification of settlements along PA150 highway and the opening of secondary roads used to exploit timber and mineral resources and the creation of new settlements and conflicts between squatters, land grabbers and landowners in this region.

iii) As a way of organizing access to land and reducing conflicts, agrarian reform settlements were created and plots of land were distributed to thousands of families; however, the practice of deforestation to expand the production of subsistence crops was established as a result of the lack of planning by the bodies responsible for agrarian reform and lack of knowledge of more efficient production practices, which increased deforestation in these areas. In addition to deforestation carried out by land grabbers and settlers established in the region.

iv) Given the absence of the state to provide infrastructure for education, health, transportation, employment opportunities and the lack of rural technical assistance to producers, the level of aggregate income in these communities has been reducing and making life in the countryside more difficult, especially for communities that were located far from central highways such as PA150 and in others whose access was compromised by lack of road maintenance such as PA 252. Indeed, there has been an increase in the number of families living with an income of less than the minimum wage and an increase in the number of those receiving social benefits from the federal government. The number of retirees in these communities is significant. v) Faced with the difficulties encountered by families to survive, as employment opportunities in companies require levels of education higher than those found in communities, small producers continue to produce in the slash and burn system for monocultures, as a way of guaranteeing the consumption of food products and resell of surpluses. vi) The largest producers continue the process of increasing the production area for cattle, oil palm and soybeans, among other products. Such increase is made from the acquisition of land from neighbors or the leasing made in the areas of small producers who end up selling the land to the large producer.

3.1.4.2.6 Conclusion

The conclusion of this study is supported by primary data on factors linked to deforestation in communities and summarized by the Project (PEABIRU, 2022)[54], in which population growth is expected in most communities where small rural producers are the majority and carry out production in the monoculture system of oil palm, acai berries, cassava, cocoa, corn and black pepper. In this system, small rural producers will continue to expand the deforested area of their rural properties to carry out production, since they do not have access to technical assistance and rural extension, the level of education is low, making it difficult to transfer knowledge and sustainable production practices that can guarantee them income and product marketing channels.

[54] PEABIRU. 2022. PROJETO REDD+ AGROPALMA: DIAGNÓSTICO SOCIAL E AMBIENTAL. Relatório final. 174p.

Medium and large producers will continue the process of expanding their production areas as demand increases for products from the oil palm, soybeans, corn and cattle chains and domestic and international prices are attractive to producers. Indeed, the demand for new areas should increase in the coming years and small producers will suffer economic pressure to lease and/or sell their land. However, as most producers do not have definitive title to the land, there is a source of conflicts of interest and legal disputes, which cause insecurity in the environment with land invasions and deforestation.

The evidence on the agents, vectors, causes of deforestation and the chain of events that lead to deforestation, considering all the information collected and analyzed, lead to the conclusion that these variables are related to the increase of deforestation in the municipalities. This growing trajectory of deforestation in the communities is due, to a large extent, to the implementation of logistics infrastructure projects, which will reduce the costs of production, distribution and transport to other countries that consume soybeans, corn and cattle, making the products more competitive in international trade.

The low effectiveness of governments to solve land and environmental regularization problems potentiates the effects on deforestation, and the little efficiency or absence of actions in education, health, sanitation, technical assistance and rural extension reinforce the context.

3.1.4.3 Step 4 of VM0015 - Projection of Future Deforestation

3.1.4.3.1 Projection of the Amount of Deforestation

The Reference Region was not stratified, since the characteristics of the agents, vectors and causes of deforestation are the same throughout its extension.

3.1.4.3.2 Selection of baseline methodology

The methodology VM0015 suggests three methods of projecting the amount of future deforestation: (a) the historical average of deforestation; (b) deforestation as a function of time and c) modeling of the deforestation rate. We opted for approach "b" (function of time) of sub-step 4.1.1 of methodology VM0015 to project the deforestation baseline. In the adopted approach, the baseline annual deforestation in year t for the reference region was calculated by extrapolating the historical trend of deforestation increment in the reference region. The deforestation rate projections were calculated by a piecewise linear regression

mode[55]l, using the "segmented"[56] package in the R programming environment[57].This approach was chosen to take into account the "break" of the observed deforestation trend as of 2018 (Figure 17).

3.1.4.3.3 Quantitative projection of future deforestation

As mentioned in the previous item, we used method "b" (deforestation as a function of time) to estimate the future deforestation that will be allocated annually in the baseline of the Reference Region. We fit a piecewise linear regression model to capture the stationarity breakdown of the annual deforestation increment after 2018. The implementation in R automatically detects the period of stationarity break. The adjusted parameters were: break year: 2018, gradient 3.08 (p<0.01):, gradient increment: 1461 (p=0.02) which indicates a significant increase in the trend from 2018 onwards. The adjusted R2 was 96%, indicating a good fit of the model to the data. In addition, the model has an excellent fit for the last three years of the historical period (Figure 17). The annual deforestation increment projections can be seen in Table 23.

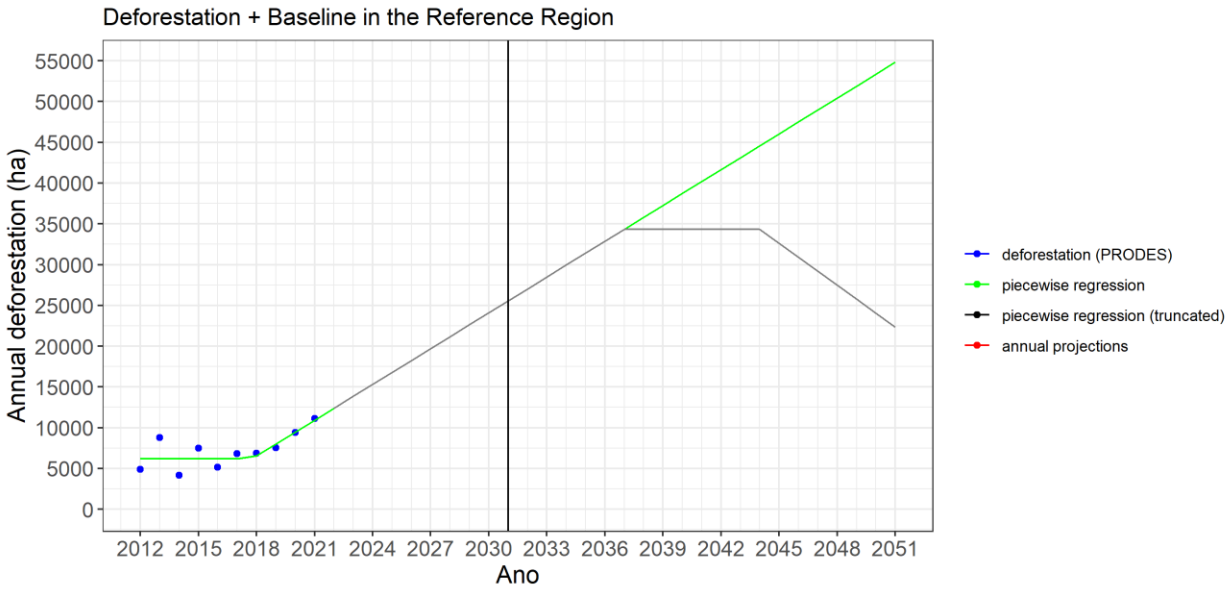

Figure 17 - Historical and projected deforestation in the reference region

We apply the procedure suggested by VM0015 to avoid non-conservative projections. For this, we developed a method to estimate the following parameters:

[55] McZgee, Victor E., and Willard T. Carleton. "Piecewise regression." *Journal of the American Statistical Association* 65.331 (1970): 1109-1124.
[56] Muggeo, V. M. (2008). Segmented: an R package to fit regression models with broken-line relationships. *R news*, *8*(1), 20-25.
[57] R Core Team. 2018. "R: The R Project for Statistical Computing". 2018. https://www.r-project.org/.

$Aoptimal = \sum_{\{t=1\}}^{\{toptimal\}} ABSLRR_t$

$Aaverage = \sum_{\{t>toptimal\}}^{\{taverage\}} ABSLRR_t$

Where:

$ABSLRR_t$: Annual baseline area in the reference region in year t;

$toptimal$: year by which conversion from forest to non-forest will be "optimal";

$taverage$: year by which the conversion from forest to non-forest will be "medium";

$Aoptimal$: forest area where conversion to non-forest is "optimal";

$Aaverage$: forest area where conversion to non-forest is "medium".

To find the values of $toptimal$, $taverage$, $Aoptimal$ and $Aaverage$ we use the following procedure:

i) We create maps of land use changes that occurred during the historical period

ii) We fitted a raster logistic regression of land use and cover change on variables that constrain/encourage the use of cleared land: land category, elevation, and slope, and used the model to estimate the "probability" of deforestation for each 1ha pixel covering the reference region. *The results of this model are in Table 23*.

iii) We use the minimum and maximum values (actually 0.001 and 0.099 percentiles to remove outliers). We divide this interval into 3 sub-intervals of equal amplitude.

iv) Areas with scores within each sub-interval were considered areas where the conversion is "optimal", "medium" and "sub-optimal".

v) *The value of* $toptimal$ was the first value where the remaining forest area is smaller than the forest area where the conversion conditions are "optimal", obtained by the above procedure (forest< $Aoptimal$).

vi) The value of $taverage$ was equal to the first value where the remaining forest area is smaller than the forest area where the conversion conditions are "medium", obtained by the above procedure (forest< $Aaverage$).

Table 23 - Logistic regression to determine viability scores for forest conversion in the reference region.

	Estimate	Std.	z	Pr(>|z|)
(Intercept)	-2.19E+00	1.59E-02	-137.48	2.00E-16
Gleysol Order	-9.17E-01	1.81E-02	-50.62	2.00E-16

	Estimate	Std.	z	Pr(>|z|)
Oxisol Order	8.98E-02	1.58E-02	5.699	1.21E-08
Plinthsoil order	-7.52E-01	1.61E-02	-46.732	2.00E-16
No order	-2.19E+00	5.42E-02	-40.428	2.00E-16
elevation	5.58E-03	4.54E-05	123.054	2.00E-16
slope	3.50E-02	4.23E-04	82.743	2.00E-16

Table 23 shows the forest area thresholds for the different levels of conditions for conversion found by the method above. According to the results, c.a. 405 thousand hectares (22%) of forest can still be deforested in the Reference Region under "optimal" conditions. Another 656 thousand (36%) can be deforested under "sub-optimal" conditions. The estimated value of $toptimal$ is 16 years, so the model can be used to generate projections for the entire 10-year crediting period (Figure 17).

Table 24 - Forest area and conversion conditions estimated from a logistic regression of deforestation and soil type, elevation and slope

Condition for conversion	Total Forest Area	Period
optimal	405.108	0-16
medium	656.752	17-23
sub-optimal	761.489	>23

Projected deforestation for the 10-year period (2022-2031) in the reference region was calculated by Equation 1of methodology VM0015:

Equation 1

$$ABSLRR_{i,t} = ARR_{i,t-1} * RBSLRR_{i,t}$$

Where:

$ABSLRR_{i,t}$: annual area of baseline deforestation in stratum i, year t, in the Reference Region (ha/year);

$ARR_{i,t-1}$: area with forest cover in stratum i, year t-1, in the reference region (ha);

$RBSLRR_{i,t}$: deforestation rate applicable to stratum I within the Reference Region in year t (%);

t: 1, 2, 3 ... 30 years of the proposed crediting period (dimensionless);

i=1, stratum of the Reference Region (dimensionless).

The projected total for the 10-year period (2022-2031) in the Reference Region was 210,132 ha.

Table 25 - Projected annual deforestation rate for the first 10 years of the project

Project Year	Deforestation rate
2022	1.69%
2023	1.96%
2024	2.25%
2025	2.55%
2026	2.87%
2027	3.22%
2028	3.60%
2029	4.01%
2030	4.47%
2031	4.99%

3.1.4.3.4 Projection of annual areas of baseline deforestation in the Project Area and Leakage Belt

Areas of projected annual deforestation were spatially distributed across the entire Reference Region using the procedures described in the next section. Baseline deforestation in the Project Area and Leakage Belt corresponds to baseline deforestation allocated in these regions. The projected deforestation values for the period from 2022 to 2031 in the Reference Region (Table 26), Project Area (Table 27) and Leakage Belt (Table 28) are presented. The projected total deforestation for the Project Area in the crediting period was **13,951 ha**, with an annual average of 1,395 ha.

Table 26 - Deforestation projected for the Reference Region (Table 9a of methodology VM0015)

Project Year t	*Stratum I of the reference region* 1 $ABSLRR_{i,t}$ ha	Total	
		Annual $ABSLRR_t$ ha	Accumulated ABSLRR ha
2022	12.943	12.943	12.943
2023	14.736	14.736	27.679
2024	16.530	16.530	44.209

Project Year t	*Stratum I of the reference region* 1 $ABSLRR_{i,t}$ ha	Total	
		Annual $ABSLRR_t$ ha	Accumulated ABSLRR ha
2025	18.323	18.323	62.532
2026	20.116	20.116	82.648
2027	21.910	21.910	104.558
2028	23.703	23.703	128.261
2029	25.497	25.497	153.758
2030	27.290	27.290	181.048
2031	29.084	29.084	210.132

Table 27 - Deforestation projected for the Reference Region (Table 9a of methodology VM0015)

Project Year t	*Stratum I of the reference region in the Project area* 1 $ABSLPA_{i,t}$ ha	Total	
		Annual $ABSLPA_t$ ha	Accumulated ABSLPA ha
2022	747	747	747
2023	833	833	1.580
2024	882	882	2.462
2025	1.147	1.147	3.609
2026	1.170	1.170	4.779
2027	1.546	1.546	6.325
2028	1.460	1.460	7.785
2029	2.054	2.054	9.839
2030	2.045	2.045	11.884
2031	2.067	2.067	13.951

Table 28 - Deforestation projected for the Reference Region (Table 9a of methodology VM0015)

Project Year t	*Stratum I of the reference region in the Leakage Belt* 1 $ABSLLK_{i,t}$ ha	Total	
		Annual $ABSLLK_t$ ha	Accumulated ABSLLK ha
2022	243	243	243
2023	461	461	704
2024	372	372	1.076
2025	672	672	1.748
2026	264	264	2.012
2027	666	666	2.678
2028	840	840	3.518
2029	707	707	4.225
2030	681	681	4.906
2031	930	930	5.836

3.1.4.3.5 Projection of the Location of Future Deforestation

Dinamica EGO software was used to project the location of future deforestation. This software is indicated by methodology VM0015 as appropriate for baseline modeling of REDD+ projects to avoid unplanned deforestation (AUD). The use of Dinamica EGO is justified for the following reasons: a) it is a model available in scientific publications[58]; b) it has a transparent process for input and output of data and processed parameters with an easy-to-understand graphical interface; c) incorporates the use of appropriate data to explain the location of deforestation; d) has an appropriate tool for evaluating uncertainties[59].

The main steps performed in this stage were:

1. Organization of georeferenced maps of land use and land cover, and georeferenced maps with explanatory factors of deforestation;

[58] SOARES-FILHO, B. et al. Modeling conservation in the Amazon Basin. Nature 440, pp.520-523, 2006

[59] Hagen, Alex. 2003. "Fuzzy set approach to assessing similarity of categorical maps". International Journal of Geographical Information Science 17 (3): 235–49. https://doi.org/10.1080/13658810210157822.

2. Model calibration by determining the weights of evidence (WoE shown in Figure 4) and analyzing the correlation between variables;
3. Assessment of model accuracy (Figure of Merit - FOM);
4. Development of baseline deforestation scenarios.

Preparation of factor maps

To carry out this step, an empirical approach was used to create factor maps (spatial variables that explain the location of deforestation). Studies on deforestation in the Amazon show that distance maps of spatial attributes (roads, locations, etc.) and ecological aspects of the landscape (relief, soils and vegetation, etc.) are highly correlated with the location of new deforestation.

To prepare the risk map and calibrate the model for projecting future deforestation, Dinamica EGO software requires that the input spatial variables are independent before using them. Six independent spatial variables were used to produce the deforestation risk map (Table 29), previously described (item 3.1.4.2.3). In Dinamica EGO, spatial data were processed with a pixel size of 100 x 100 meters (01 hectare), GeoTiff format (Datum SIRGAS 2000, UTM Zone 22S).

Table 29 - List of maps, variables and factor maps (Table 10 VM0015)

Factor maps		Source	Represented variable		Meaning of categories or pixel values		Maps used to create		Algorithm or equation used
ID	File name		Unit	Description	Range	Meaning	ID	File name[60]	
1	settlements	INCRA[61]	-	Describes whether a pixel is inside or outside settlements	0-1	1 = Settlements; 0 = Other categories (private areas, etc)	1	Assentamento Brasil.shp	Rasterization (R/packages: earth, qgisprocess)
2	dist_drenagem	ANA[62]	Meters	Continuous data		Distance to the nearest river.	2	vw_drenagem.gpkg	Euclidean distance (R/packages: earth,

[60] Consult raster files (.tiff) in the folder "...\baseline\1_variaveis".
[61] http://terrabrasilis.dpi.inpe.br/download/dataset/legal-amz-prodes/raster/PDigital2000_2021_AMZ_raster_v20211118.zip
[62] https://www.amazoniasocioambiental.org/pt-br/download/estradas/

									qgisprocess)
3	dst_cidade	IBGE[63]	Meters	Continuous data		Distance from locations (cities, towns, villages, communities).	3	localidades AMZ.shp	Euclidean distance (R/packages: earth, qgisprocess)
4	dst_estradas	DNIT[64]/IMAZONGEO	Meters	Continuous data		Distance to the nearest road	4	estradas_finais_16032020.shp; Estradas_Federais_SNV_202201B.shp Rodovias Estaduais_vw_cide_rod_2021.gpkg	Euclidean distance (ArcGIS 10.1

[63]https://geoftp.ibge.gov.br/organizacao_do_territorio/estrutura_territorial/localidades/Shapefile_SHP/BR_Localidades_2010_v1.shp
[64]https://geoftp.ibge.gov.br/cartas_e_mapas/bases_cartograficas_continuas/bc250/versao2021/shapefile/bc250_shapefile_2021_11_18.zip

5	elevation	SRTM[65]	Meters	Continuous data		Land elevation	5	elevação.tiff	-
6	slope	SRTM	Categories	Land classes		Land slope	2	elevação.tiff	-

[65] http://www.dpi.inpe.br/Ambdata/download.php

- **Preparation of the deforestation risk map**

Deforestation risk maps show the regions with the highest (risk close to or equal to 1) or lowest conditions for deforestation to occur (risk close to or equal to 0). In this baseline study, the risk map was produced using the weight of evidence method (Bonham-Carter, 1994)available in Dinamica EGO. This method calculates the probability of there being a transition from forest to deforested area at each pixel in the reference region, based on the sum of all weights of evidence that overlap at a given pixel, and dependent on the combinations of all static and dynamic maps[66].

The result of applying the weights of evidence method in Dinamica EGO is a deforestation risk map that identifies areas with the highest (1.0) and lowest (0.0) probability of deforestation occurring (Figure 18). The spatial variables shown in Table 28, together with the deforestation risk map, are the starting point for producing future deforestation baseline scenarios.

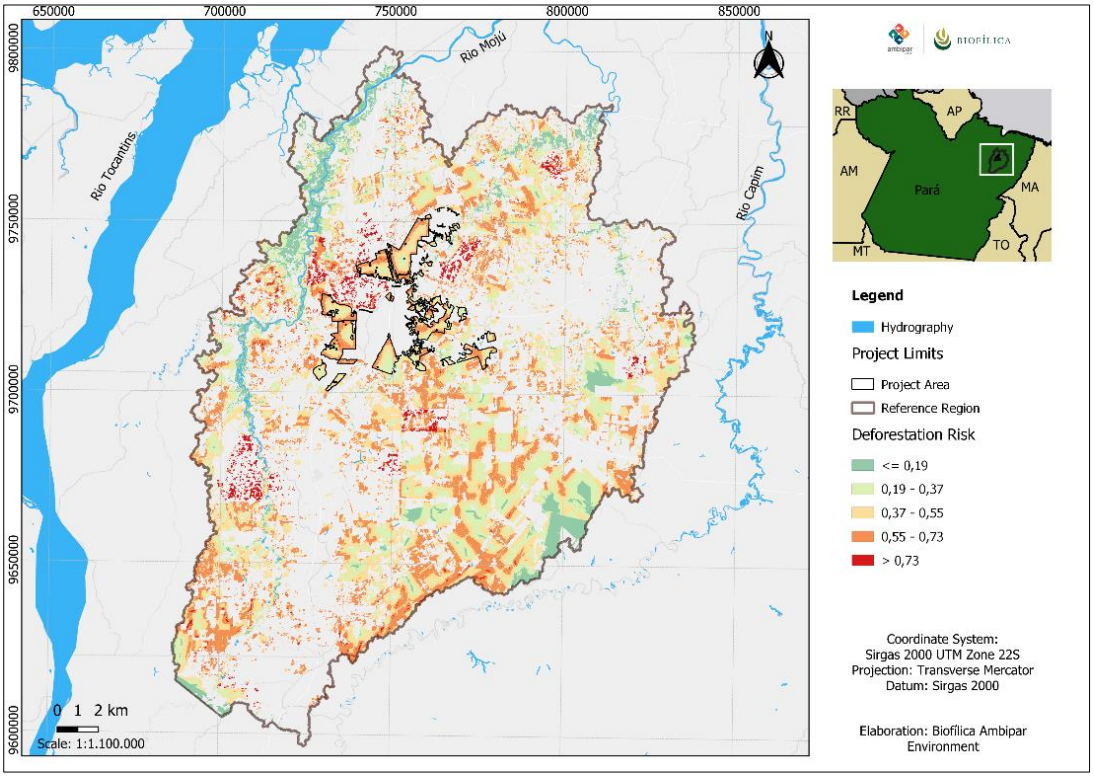

Figure 18 - Deforestation risk map in the Reference Region

[66] SOARES-FILHO, B. et al. Modeling conservation in the Amazon Basin. Nature 440, pp.520-523, 2006.

- **Selection of the most accurate deforestation risk map (Calibration and Validation of the model)**

To assess the quality of the model produced, option "a" available in methodology VM0015 version 1.1 was used: *calibration and confirmation using two historical sub-periods.* Deforestation data that occurred between 2012 and 2016 and the variables listed were used to calibrate the model, while the deforestation map mapped by PRODES in 2021 was used for the confirmation process. In this process, a 2021 deforestation map was simulated from data observed between 2011 and 2016.

FOM (Figure of Merit) technique was used to assess the accuracy of the simulated map in 2021. The FOM result is the ratio of the intersection of the observed changes (changes between the reference map at time 1 and time 2) and the simulated changes (changes between the reference map at time 1 and the reference map at time 2) to the union of the observed change and the predicted variation, as defined in equation 9 of methodology VM0015.

Methodology VM0015 indicates that the minimum threshold for the best fit measured by the FOM should be defined by the net change observed in the reference region for the model calibration period. The observed net change shall be calculated as the total area of modeled change in the reference region during the calibration period (percentage of total area of the reference region), and the FOM value shall be at least equivalent to this value. If the FOM value is below this threshold, the project proponent must demonstrate that at least three models have been tested (three deforestation risk maps), and the one with the best FOM should be used.

The net change observed in the Reference Region was 1.62%, and the FOM value obtained by applying equation 9 of VM0015 was 38%. Thus, the FOM of the risk map produced is greater than the required threshold (Step 4.2.4 of VM0015). Thus, the deforestation risk map developed in the calibration step (Figure 18) offers good performance for spatially projecting changes in land use until 2031 in the Reference Region of the Agropalma REDD+ Project.

- **Spatial projection of future deforestation**

The selection of pixels with the highest risk of deforestation was performed automatically by Dinamica EGO for a period of 10 years, starting in 2022. The results are presented in Figure 19, with deforestation in the Reference Region predicted for the first 10 years of the Project. In the developed baseline scenario, the Project Area would have deforested 13,951 ha between 2022 and 2031.

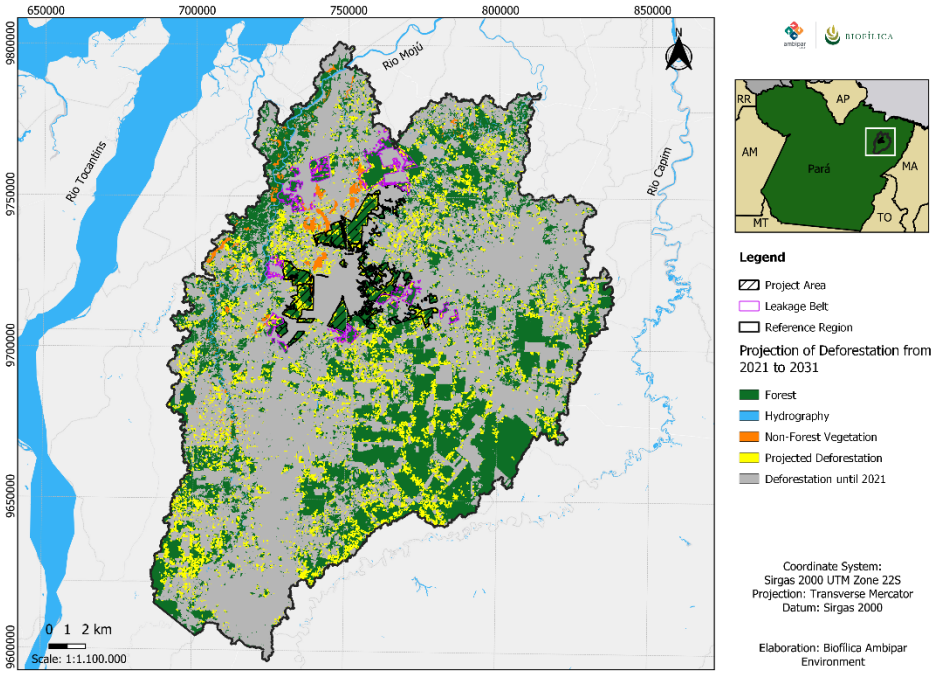

Figure 19 - Deforestation projected in 10 years in the Reference Region

3.1.5 Additionality

To demonstrate the project's additionality, the guidelines and the "step-by-step" approach established in the specific tool referenced in methodology "VT0001 - version 3.0" were followed, which includes demonstration and assessment of additionality in Agriculture, Forestry and Other Uses of Land projects (AFOLU) in VCS project activities, “Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and other Land Use (AFOLU) Project Activities (VT0001, version 3.0)”, of February 1, 2012.

The applicability conditions of this tool are met, because:

• AFOLU activities are the same or similar to the proposed activities of the Project, within their respective limits, registered or not as a VCS AFOLU Project, and do not lead to brach of any applicable law even if this law is not applied; and

• VM0015 baseline methodology provides a step-by-step approach to justify the determination of the most plausible baseline scenario (see “Part 2 – Methodology Steps for ex ante estimate of GHG emissions reductions” of VM0015).

The tool establishes four steps for demonstrating additionality that will be followed below:
STEP 1: Identification of alternative land use scenarios to the AFOLU project activity

STEP 2: Investment analysis to determine that the proposed project activity is not the most economically or financially attractive of the identified land use scenarios
STEP 3: Barriers analysis
STEP 4: Common practice analysis

STEP 1. Identification of land use scenarios alternative to those proposed by the VCS AFOLU Project activity

Sub-step 1a. – Identify alternative land use scenarios credible to the proposed VCS AFOLU Project activities

The scenarios described in this item were based on data collected by the socio-economic study carried out in 2022 and by the field consultation carried out in 2021, which relied on the use of secondary data (literature review in databases of public institutions) and primary data, resulting from the Socio-Economic Diagnosis (DSE) with the communities surrounding Agropalma.

Among the alternative realistic and credible land use scenarios that would occur within the Project boundaries in the absence of the AFOLU Project activity registered in the VCS, the following were considered:

1) ***Scenario of continuation of land use prior to the Project (baseline scenario with deforestation):***

Historically, there is the following sequence of events in the region:

i) Initial stage is related to large development projects in the Amazon by the I and II National Development Plan (PND) whose main interest was the integration of the regions of the country, raising the productive structures of these regions using incentive policies from the federal government that suffered the influence of large multinational corporations that operated in the mining-metallurgical sector and in the processing of animal and vegetable products, installed in the Amazon. In this sense, government spending on infrastructure prioritized the construction of highways, railways and ports, power generation and the implementation of the Greater Carajás Project. Indeed, there is migration of people from other states and municipalities in the state that envisioned the possibility of employment, income in logging activities and in the supply chain that served this activity. Such displacement was favored by the infrastructure of highways, such as BR-010, PA-150, PA-155 and PA-483, which enabled the integration of municipalities with large government projects with the transamazon highway, connecting with Belém-Brasília highway to the North and Southeast areas of the state. With the implementation of these highways, there was a migration of people from other states who served as labor for the opening of PA-150 highways (PRADO, 2006).

ii) Subsequently, with the construction of PA-150 Highway, in the 1970's, which crosses the state of Pará in the North-South direction, it contributed to foment conflicts between landowners (who sought tax incentives from the Superintendence for the Development of Amazon (SUDAM), land grabbers (people who took over

the land for speculative purposes) and squatters (rural workers and small landowners who settled on the land and accompanied the opening of the road) (IBGE, 2015)[67].

iii) Considering the conflicts over land ownership, Settlement projects began, in which thousands of families were settled; however, without the support of government agencies, there was economic vulnerability, as well as the absence of technical assistance and rural extension, lack of credit, land uncertainties (CALANDINO; WEHRMANN; KOBLITZ, 2012), i.e., total lack of planning to structure the settlements and with that the settlers established agricultural practices such as slashing and burning, which resulted in low productivity and little surplus for commercialization, which ended up generating low economic value, weakening families and increasing socio-environmental problems in these areas.

iv) In the sequence, over the years, what we have is the worsening of social problems with a high number of families in the condition of poverty or extreme poverty, in which part of them started to receive social benefits from the federal government. Part of the residents of rural areas migrated to the urban areas of municipalities and others due to the lack of social projects by municipalities and due to economic fragility, suffered economic pressure from large producers to sell their land, and with that the vicious circle of deforestation carried out by the small producer to support his family.

In a temporal context, the phenomenon of deforestation in the municipalities of Acará, Moju and Tomé-Açu began with Portuguese explorations interested in wood species and agricultural products, initially using rivers as roads. With the opening of the roads, there was an intensification of deforestation, mainly due to the fact that Tailândia and Tomé-Açu are logging centers that extracted and processed large amounts of wood extracted from the forests of neighboring municipalities and municipalities on the island of Marajó. The dynamics of deforestation in Tailândia began with land conflicts and advanced with the opening of PA-150 connecting Pará to other states and the port of Vila do Conde. Given this dynamic, it is expected that this vicious cycle will continue if the relationship between small rural producers and land use is not changed.

Probable future scenarios for vegetation can be predicted from a joint analysis of the initial biodiversity conditions both in the Project Area and the surrounding region.

Also, these initial conditions can be correlated with future projections of deforestation for the without-project scenario, taking into account the fact that the advance of deforestation is directly related to impacts on biodiversity.

In the regional context, the Project Area is inserted as a private area in the midst of a mosaic of forest areas, which has been suffering major threats to the maintenance of biodiversity over the last decades. These areas

[67] INSTITUTO BRASILEIRO DE GEOGRAFIA ESTATÍSTICA (IBGE) - Censos Demográficos, 2000. Rio de Janeiro, 2015. Disponível em: IBGE. Acesso em: fev. 2022.

have a history of degradation related to theft of wood, invasions, hunting, land grabbing, among other activities, so that despite the protection determined by law, the security and surveillance of these areas are extremely fragile, allowing such illegal activities.

Enforcement of compliance with environmental legislation is not very effective in Brazil. The high cost related to the cost of inspection activities, the reduced number of employees in environmental protection and control bodies, and the size of the territory demand a large number of people, institutions and tools capable of monitoring any change in forest cover. Therefore, command and control instruments (norms, rules and legislation) are often not complied with in Brazilian territory, especially in the Amazon, causing several negative socio-economic and environmental impacts.

Among the future impacts to biodiversity in the without-project scenario, loss of restricted species, loss of habitat, loss of connectivity, and loss of ecosystem services can be listed. In addition to these impacts, studies and monitoring of biodiversity can also be included, which would no longer be carried out without incentive of the project.

Forest fragmentation caused by deforestation tends to cause a drastic reduction in species richness, whose density and distribution is lower in small fragments, mainly affecting more specialist taxa LAURANCE and VASCONCELOS, 2009)[68], many of which are threatened, endemic or have restricted distribution.

According to Silva et al. (2005), connectivity between fragments provides the constitution of a large resilient conservation system, with potential to mitigate future global changes, make significant improvements in the living standards of local populations and provide ecosystem services to the population. In the same way, forest fragmentation leads to opposite effects, mainly evidenced by edge effects that alter the dynamics of the fragments, strongly affecting the microclimate of the forest, tree mortality, carbon storage, fauna, among other ecological aspects (LAURANCE, 2011)[69].

According to DeFries et al. (2005)[70], the deforestation that occurs around protected areas directly affects the quality of these areas and the ability to maintain their biological wealth. This fact occurs mainly due to the isolation process caused by the lack of protection in the surroundings of these areas.

Finally, based on the analysis of regional biodiversity studies, it is possible to verify that in the future scenario without the project, vegetation tends to be worse than that presented at the beginning of the

[68] Laurance, W.F., Vasconcelos, H.L., 2009. CONSEQÜÊNCIAS ECOLÓGICAS DA FRAGMENTAÇÃO FLORESTAL NA AMAZÔNIA. Oecologia Aust. 13, 434–451.
[69] Referencia faltando
[70] DeFries, R., Hansen, A., Newton, A.C., Hansen, M.C., 2005. Increasing Isolation of Protected Areas in Tropical Forests over the past Twenty Years. Ecol. Appl. 15, 19–26.

project, since the deforestation scenario tends to remain unchanged in the future, and studies show that the biodiversity scenario tends to worsen due to the effects of forest fragmentation.

Therefore, with the continuation of this dynamic, for the next 10 years (2022-2031), a loss of 210,132 hectares is projected in this scenario for the reference region, of which 13,951 hectares are expected to be deforested in the Project area. In the scenario described, such dynamic tends to remain until large part of the forest cover is altered, generating an inestimable impact on local biodiversity, and further deepening social and economic problems. Thus, this scenario can be classified as the common practice scenario in the region, or business as usual scenario.

2) Scenario with conservation activities in PPA and LR with surplus, carried out by Agropalma, without registration of VCS AFOLU project.

This scenario represents compliance with all relevant regulations, norms, standards and legislation regarding Permanent Preservation Areas (PAA) and Legal Reserve (LR) with conservation activities to protect these areas and their surplus carried out by Agropalma, not registered as a VCS AFOLU project.

This model of exploitation in natural forests in the Tropics, especially in the Amazon, is based on the application of intensive exploitation techniques for the cultivation of palm, relying on production in all surplus native vegetation that, by law, allows it to be deforested and can collaborate with the socio-economic development of the region and the economic development of Agropalma. In the case of production of Palm in the state of Pará, much of the literature highlights the negative impacts caused on its planting in areas of native vegetation, such as deforestation, increased emissions of greenhouse gases, loss of biodiversity and loss and decrease of ecosystem services provided in the area, pollution due to the emission of toxic components via industrial waste (BICALHO et al., 2016[71]; KUSS et al., 2015[72]; MUNASINGHE et al., 2019[73]; VILLELA et al., 2014[74]).

[71] Bicalho, T., Bessou, C., Pacca, S.A., 2016. Land use change within EU sustainability criteria for biofuels: The case of oil palm expansion in the Brazilian Amazon. Renew. Energy 89, 588–597. https://doi.org/10.1016/j.renene.2015.12.017

[72] Kuss, V.V., Kuss, A.V., Rosa, R.G. da, Aranda, D.A.G., Cruz, Y.R., 2015. Potential of biodiesel production from palm oil at Brazilian Amazon. Renew. Sustain. Energy Rev. 50, 1013–1020. https://doi.org/10.1016/j.rser.2015.05.055

[73] Munasinghe, M., Jayasinghe, P., Deraniyagala, Y., Matlaba, V.J., Santos, J.F. dos, Maneschy, M.C., Mota, J.A., 2019. Value–Supply Chain Analysis (VSCA) of crude palm oil production in Brazil, focusing on economic, environmental and social sustainability. Sustain. Prod. Consum. 17, 161–175. https://doi.org/10.1016/j.spc.2018.10.001

[74] Villela, A.A., Jaccoud, D.B., Rosa, L.P., Freitas, M.V., 2014. Status and prospects of oil palm in the Brazilian Amazon. Biomass Bioenergy 67, 270–278. https://doi.org/10.1016/j.biombioe.2014.05.005

The exploitation of the surplus vegetation of the legal reserve by Agropalma would be possible, according to Law 12.651/2012, however the company has no intention to do so, because it believes that forest areas have many riches, mainly related to the stock of hardwood and the high biological diversity, including being habitat to endangered species.

Still, we can point to the low enforcement, application, and capacity of public agencies to supervise environmental laws, which makes it even more difficult to keep these areas conserved, increasing the possibility of land invasions, extraction of natural resources, illegal timber trading, and hunting of wild animals.

The production of palm by Grupo Agropalma follows the most relevant international certification standards of the *Roundtable on Sustainable Palm Oil* (RSPO). RSPO certification is internationally recognized not only by the palm, palm oil and palm kernel industries, but also by numerous researchers in the field (RSPO, 2016[75]; BICALHO et al., 2016; MUNASINGHE et al., 2019).

In this sense, although the production of certified palm assists with the costs for the conservation of the standing forest and the maintenance of carbon stocks, through sustainable forest management, the forest reserves are subject to the occurrence of illegal deforestation caused by external agents, mainly because they are unmanaged areas and no activities are developed, reducing the physical presence and increasing fragility.

Furthermore, the expansion of the agricultural frontier through the conversion of remnants of conserved forests for the implementation of subsistence farming, commodity cultivation of large landowners, and cattle raising in extensive pastures becomes more attractive and financially advantageous, since the governance of deforestation control is inefficient and the cost of implementation and maintenance of these activities is substantially lower. In addition to the demand for agricultural properties, infrastructure and logistics developments in the region of Fazenda Agropalma also contribute to the valuation of land in deforested areas, leading to real estate speculation.

In this sense, despite the employment of guidelines and practices aimed at the conservation of Agropalma's forests, the constant market uncertainties and the pulsating pressure for areas, which enable the irregular invasion of forest fragments, make forest reserves and surpluses in the Amazon on private properties vulnerable to illegal deforestation.

Thus, the conservation of the vegetation surplus, as well as the APP and RL areas in the region of the Agropalma Farm, need additional investments and complementary activities, in order to soften the panorama

[75] RSPO Roundtable on Sustainable Palm Oil, 2016. Impact Report 2016. www.rspo.org/publications/download/df716d24dd1ee80 (Accessed 22.12.22).

described above. Therefore, the economic viability of conservation is reduced without the addition of additional revenue resulting from the commercialization of credits registered in the VCS.

3) Scenario with REDD+ Project, conservation activities and sale of carbon credits:

With the objective of developing several synchronized actions that induce a change in the local context, avoiding the rural exodus as the concern to maintain and ensure the permanence of families in the field, besides the strengthening of value chains, the stimulus to sustainable practices, reduction of invasion attempts in the forest areas of the Agropalma Farm, as well as biodiversity conservation actions allied with the perspective of a sustainable development, are implemented actions in the development of the REDD+ Agropalma Project, such as

I) strengthening of patrimonial surveillance in Agropalma Farm, by remote and continuous monitoring, allied to terrestrial surveillance, in order to avoid invasions, deforestation and any kind of degradation in forest areas;

II) to develop and strengthen productive value chains of the main cultures of the region, mainly the dendê palm, encouraging the social and productive organization, means of valorization of the products and access to the market and, as a way of encouraging the autonomy and the socio-economic development of the involved parties;

III) to promote to the familiar farmers and small rural producers agricultural practices that direct the sustainable production, allowing to retain the families in the field, to reduce deforestation and to guarantee income and food security;

IV) to structure a biodiversity conservation program, promoting environmental education actions, incentive to alternative activities to hunting and predatory fishing and environmental awareness campaigns, besides the continuous monitoring of the biodiversity of the Agropalma Farm;

V) strengthening local governance, with the empowerment of local leaders, building or strengthening formal and informal collective structures of social organization, encouraging the search for basic rights and the engagement of stakeholders to discuss and solve environmental, structural, social and land demands of collective interest.

Given this scenario, and considering that activities that promote changes in local conditions and ensure forest conservation compromise and burden Agropalma, additional revenue from the commercialization of verified credits for specific investments in containment and monitoring initiatives in the region of the Agropalma farm becomes vital, by fostering asset surveillance, strengthening local governance, strengthening sustainable agricultural practices, developing and strengthening value chains, and a biodiversity conservation program, all of which are actions mentioned above that will promote sustainable socioeconomic development and reduce emissions from deforestation and forest degradation.

Therefore, the addition of additional revenue from the commercialization of verified and registered credits would provide net positive impacts to the preservation of forest cover and the maintenance of carbon stocks, as well as co-benefits to biodiversity and communities in the Project region. In addition, it would enable the economic viability of the sustainable management model of activities in forest conservation areas, including APP areas, RL and surplus native vegetation.

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

Of the proposed scenarios, scenarios (ii) and (iii) are in compliance with all applicable legal and regulatory requirements and only the practices contained in scenario (i) are not in accordance with the legislation and mandatory regulations.

Illegal or unauthorized deforestation is systematic and widespread in the Legal Amazon. According to the Annual Deforestation Relatory for Brazil (AZEVEDO et al., 2022) [76], released by MapBiomas Project, in the Amazon biome, only 4% of the areas deforested in 2020 had Vegetation Suppression Authorization (ASV, in Portuguese) given by the responsible government agencies. In addition, the document also exposes the difficulty of the competent environmental agencies in supervising and punishing illegal suppressions in states of the Legal Amazon. In the period of 2018 and 2021 alone, IBAMA embargoed and/or fined only 8% of the areas with irregular deforestation in the state of Pará. These numbers reinforce the government's limitation to ensure compliance with laws and regulations that were created to prevent deforestation.

Strengthening the exposed panorama, a study carried out by the Amazon Institute of People and the Environment (IMAZON, 2013)[77] showed that for the years 2011 to 2012, 78% of logging was unauthorized and that the majority of these 78% (67%) was located in private, vacant or disputed areas. This data corroborates previous studies by the same organization that identified the categories of “private, unused and unclaimed” land as the main stages of illegal and unauthorized deforestation.

In this context, considering the municipalities that comprise the Agropalma Farm (Moju, Thailand, Tomé-Açú and Acará), as well as the current environmental regulations (Law 12651/2012 - Law for Protection of Native Vegetation - Normative Instruction No. 02, of July 6, 2015), which deals with the suppression of native vegetation on rural properties or the cutting of trees in urban areas, it is understood that any activity that requires the suppression of native vegetation is subject to the issuance of an ASV by the government agency, either state or federal. Since 2018, authorizations granted by states must be issued or registered in the

[76] Azevedo, T., Rosa, M.R., Shimbo, J.Z., de Oliveira, M.G., Valdiones, A.P., Lama, C.D., Teixeira, L.M.S., Rosa, M., Vélez, E., Meiguins, A., Castro, G., Falcão, D., Rodrigues, T., 2022. RAD 2021 RELATÓRIO ANUAL DO DESMATAMENTO NO BRASIL 126p.
[77] IMAZON. (2013). Imazon: desmatamento ilegal cresce 151% no Pará. Amazônia , p. 1- 3.

National System for the Control of Origin of Forest Products (SINAFLOR) which is managed by IBAMA. However, Pará is not fully integrated into the system yet, and verification of the existence of authorization is carried out on the state basis.

In this sense, in consultation with the MapBiomas study (AZEVEDO et al., 2022), considering the list of settlements with the largest deforested area in 2021 is the Moju I E II Settlement, in the city of Moju (PA) with 193 numbers of deforestation alerts and 3,122 KM² of deforested area, highlighting Pará as the state that had the largest deforested area detected in 2021, with loss of 402,492 ha, representing 24.3% of the total deforested in the country.

There is the formation of two cycles of deforestation, the first until 2012 and the other from the following years onwards, in which the rates reflect, in part, the depletion of deforested areas and the need for new areas to insert new crops in the municipalities. In the case of the municipalities of Acará, Moju and Tomé-Açu, deforested areas were consolidated many years ago. These numbers, obtained through the Amazon monitoring system carried out by INPE, demonstrate the historical trend of growth in forest clearing, not only for the aforementioned municipality, but also for the entire Project region, even without presenting any licensing record for such activities.

Sub-step 1c. – Selection of the baseline scenario

Described in Section 3.1.4, specified in item 3.1.4.1.

STEP 2. Investment Analysis

Under development.

STEP 3. Barrier Analysis

VCS “VT0001 – Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities - requires investment analysis (Step 2) or Barrier Analysis (Step 3). In this case, we opted for the Investment Analysis, already described in Step 2.

STEP 4. Common Practice Analysis

As for the annual deforestation increments in the municipalities, the adjustments show a downward trend in the increment rates until 2012, and in the following years the deforestation increments resumed growth, however, at levels lower than the average of the previous period. This behavior shows the formation of two deforestation cycles, the first until 2012 and the other from the following years onwards, in which the rates

reflect, in part, the depletion of deforested areas and the need for new areas to insert new crops in the municipalities. In the case of the municipalities of Acará, Moju and Tomé-Açu, deforested areas were consolidated many years ago.

According to the focal group survey carried out in the municipalities (PEABIRU, 2022), it was possible to obtain information on the trajectory of deforestation, in which the perception that deforestation has reduced in the municipalities is almost unanimous; however, it continues in a fragmented way by small family farmers that deforest up to two hectares every year.

Among the agents of deforestation, the following stand out:

I) small rural producers residing in settlement communities and carrying out small deforestation that does not exceed two hectares per year for planting corn, rice, beans and cassava fields;

II) medium and large producers that take advantage of the economic difficulties of small producers to establish relationships of economic subordination with small producers (economic pressure), from the lease in which small deforestations are carried out until selling the area or carrying out direct forest suppression to expand the production of cassava, palm oil, soybeans and corn, the harvesting area of these last two has expanded significantly with the arrival of producers from the South, Southeast and Mid-West who came to the municipality of Tailândia due to low prices of land, lower production costs and the competitive advantage of carrying out production close to the port of Vila do Conde, in Barcarena, and for having roads that make transport to the port feasible. Small producers who resist economic pressure end up cornered and isolated, which makes it difficult to sell production.

It should be noted that deforestation occurs in planted forest areas, mainly in Tomé-Açu and the destination is the sawmills located in the region, which have adjusted to environmental regulations and started to develop the activity in a sustainable way.

The discussion about who are the agents of deforestation in the Amazon is made by several authors such as Calandino, Wehrmann and Koblitz (2012) [78], who evaluated the deforestation dynamics of 15% of the federal settlements in the State of Pará during five years, and the results show greater deforestation inside the settlements than in the surrounding areas; however, the pace of deforestation growth in the settlements is lower. The authors point out some factors that contribute to this growing trend of deforestation in the settlements, including economic vulnerability, delay in the release of rural financing, land uncertainties, the size of lots and logging in settlements.

[78] Calandino, D., Wehrmann, M., Koblitz, R., 2012. Contribuição dos assentamentos rurais no desmatamento da Amazônia: um olhar sobre o Estado do Pará. Desenvolv. E Meio Ambiente 26.

The study by Amorim, Mello, Homma and Pontes (2020) [79] shows that the lack of planning to develop the colonization process and structure settlements in the Amazon ended up inducing agricultural practices that led to deforestation. The authors point out that 50% of the forest area of settlements was suppressed by agricultural activities.

Thus, considering the secondary data on the evolution of increase in deforestation in the harvested area of palm oil, acai berries, cassava, cocoa, corn and black pepper, in the intensity and direction of the linear correlation between the crops and the increase deforestation for the 2012-2020 period, in-depth interviews with representatives of trade unions and municipal secretariats, and in the results of the research of focus groups carried out in each municipality and in the review of the literature on the subject, which lead to the conclusion that deforestation should continue in the coming years with an increasing trend as shown in item 3.1.4.1.

There are two pressure groups that trigger deforestation: population growth in municipalities and increase in demand for land to increase the production of crops such as soybeans, corn, acai berries, cocoa, black pepper and cassava. In which the first will maintain the growing trajectory in the coming years due to the logistics infrastructure projects, and the second due to the lower costs of production, distribution and transport to other countries that consume soybeans, making the product more competitive in international trade. The low effectiveness of governments in solving land and environmental regularization problems potentiates the effects on deforestation, and the low efficiency or lack of education, health and sanitation actions reinforces the context.

As agents of deforestation, there are small rural producers who live in the communities of settlements and carry out small deforestations that do not exceed two hectares per year for planting fields of corn, rice, beans and cassava, with a low level of productivity resulting from the process of production made with low technological level and absence of technical assistance and access to credit.

Medium and large producers that take advantage of the economic difficulties of small producers to establish relationships of economic subordination and outsource deforestation by leasing land from small producers (economic pressure). Therefore, the existence of Agropalma REDD+ Project represents an opportunity to conserve the Amazon Forest and its associated ecosystem services, combining the promotion of socio-economic development with environmental conservation in the municipalities of Tomé-Açú, Acará, Moju and Tailândia.

[79] Amorim, I.A., Mello, A.H. de, Homma, A.K.O., Pontes, A.N., 2020. DINÂMICA DO DESMATAMENTO EM ÁREA DE ASSENTAMENTO DE REFORMA AGRÁRIA NO SUDESTE PARAENSE. Caminhos Geogr. 21, 21–35. https://doi.org/10.14393/RCG217851483

3.1.6 Methodology Deviations

No methodology deviation was applied in Agropalma REDD+ Project.

3.2 Quantification of GHG Emission Reductions and Removals

3.2.1 Baseline Emissions

Step 5 of VM0015 – Definition of the Land Use and Land Cover Change Component in the Baseline

3.2.1.1 Calculation of baseline activity data by forestry class (Step 5.1 VM0015)

Result of basic projections of the Project indicates deforestation of approximately 13,951 hectares for the Project Area between 2022 and 2031 (Table 30) and 5,836 for the Leakage Belt (Table 31Table 31).

Table 30 - Annual areas deforested by icl forest class within the Project Area in the baseline case (baseline activity data by forest class) (Table 11b of Methodology VM0015)

Area deforested per forest class *icl* within the project area		Total baseline deforestation in the project area	
ID_{icl}>	icl1	$ABSLPA_t$	ABSLPA
Name>	Forest	annual	cumulative
Project $year_t$	ha	ha	ha
2022	747	747	747
2023	833	833	1.580
2024	882	882	2.462
2025	1.147	1.147	3.609
2026	1.170	1.170	4.779
2027	1.546	1.546	6.325
2028	1.460	1.460	7.785
2029	2.054	2.054	9.839
2030	2.045	2.045	11.884
2031	2.067	2.067	13.951

Table 31 - Annual areas deforested by icl forest class within the Leakage Belt area in the baseline case (baseline activity data by forest class) (Table 11c of Methodology VM0015).

Area deforested per forest class *icl* within the leakage belt area		Total baseline deforestation in the leakage belt area	
ID_{icl}>	icl1	$ABSLLK_t$	ABSLLK
Name>	Forest	annual	cumulative
Project $year_t$	ha	ha	ha
2022	243	243	243
2023	461	461	704
2024	372	372	1.076
2025	672	672	1.748
2026	264	264	2.012
2027	666	666	2.678
2028	840	840	3.518
2029	707	707	4.225
2030	681	681	4.906
2031	930	930	5.836

3.2.1.2 Calculation of baseline activity data by post-deforestation class (Step 5.2 VM0015)

Method 1 available in methodology VM0015 was used to define the class that will replace the forest cover in the baseline of the Project (anthropic vegetation in balance). Table 32 shows the area of zone 1, which comprises the Project Area, Leakage Belt and Leakage Management Areas, and the corresponding areas of each post-deforestation land use/land use change class.

Table 32 - Area of the Reference Region that covers potential post-deforestation LU/LC class (Table 12 of Methodology VM0015)

Zone		Name		Total of all other LU/LC classes present in the zone		Total area of each Zone	
		Zone 1					
		ID_{fcl}	1				
		Area	% of Zone	Area	% of Zone	Area	% of Zone
IDz	Name	ha	%	ha	%	ha	%
1	Zone 1	80.496	100	19.787	24.58%	80.496	100
Total area of each class *fcl*		80.496	100	19.787	24.58%	80.496	100

The area projected to be deforested is reported in Table 33 (for the Project Area) and Table 34 (for the Leakage Belt).

Table 33 - Annual areas deforested in each zone within the Project Area in case of baseline. (Table 13b of Methodology VM0015)

Area established after deforestation per zone within the project area		Total baseline deforestation in the project area	
IDz>	1		
Name>	Zone 1	$ABSLPA_t$	ABSLPA
Project year$_t$	ha	ha	ha
2022	747	747	747
2023	833	833	1.580
2024	882	882	2.462
2025	1.147	1.147	3.609
2026	1.170	1.170	4.779
2027	1.546	1.546	6.325
2028	1.460	1.460	7.785
2029	2.054	2.054	9.839
2030	2.045	2.045	11.884
2031	2.067	2.067	13.951

Table 34 - Annual areas deforested in each zone within the Leakage Belt in the baseline box (Table 13c of Methodology VM0015)

Area established after deforestation per zone within the leakage belt		Total baseline deforestation in the leakage belt	
IDz>	1		
Name>	Zone 1	$ABSLLK_t$	ABSLLK
Project year$_t$	ha	ha	ha
2022	243	243	243
2023	461	461	704
2024	372	372	1.076
2025	672	672	1.748
2026	264	264	2.012
2027	666	666	2.678
2028	840	840	3.518
2029	707	707	4.225
2030	681	681	4.906
2031	930	930	5.836

3.2.1.3 Calculation of baseline activity by land use category and land cover change (Step 5.3 VM0015)

Not applicable as method 2 was not performed.

Step 6 of VM0015: Estimated changes in baseline carbon stock and non-CO_2 emissions

3.2.1.4 Estimated changes in baseline carbon stock and non-CO_2 emissions (Step 6.1 VM0015)

The carbon stock estimate for the forest class was obtained through the forest inventory carried out by Biodendro's technical team, in 2021, in partnership with Biofílica Ambipar Environmental Investments. The main results found in this study will be described below, and more information can be obtained in the Report "Forest Carbon Stock Agropalma REDD+ Project", made by the company Biodendro.

Below is a summary of the estimates of carbon stocks in the Project Area.

Estimated average carbon stocks for each class of land use and land cover (Step 6.1.1 VM0015)

Sampling

The estimate of biomass stocks of the Agropalma farm was carried out through field survey and forest inventory carried out between January and February 2022. The forest inventory was carried out through the cluster sampling process, with each cluster being composed of four plots with an individual area of 2,000 m². Plots were subdivided into four sub-units to measure trees of different sizes. Regarding the size of the trees, 4 DBH classes (5-15cm; 15-30cm; 30-50 cm and >50 cm) were stipulated for the inventory. In all of them, 35 clusters were installed, making up 140 plots of 2,000 m² and a sampling area of 280,000m² or 28 hectares. These plots were used to measure live trees and standing dead trees.

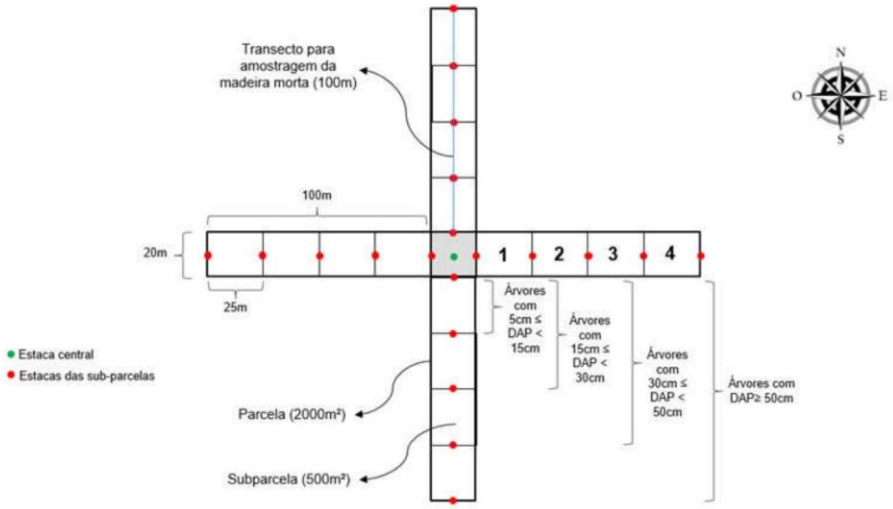

Figure 20 - Schematic drawing of a conglomerate used in the forest carbon inventory. Source: Report "Forest Carbon Stock Agropalma Redd+ Project"

The cluster of plots were randomly distributed throughout the sampled area ("Project Area"). Considering prior knowledge of the existence of areas considered as exploited and in areas not exploited in the "Project Area", the distribution of plots was carried out in order to have a good representation of these two strata. Another factor considered was the probability of deforestation or degradation of the areas, with the plots preferably allocated in places where the risks of incidence of these actions were considered greater, according to the risk analysis of forest degradation or deforestation previously carried out by the Biofilica Ambipar Environment team. Figure 20 shows the plot location map.

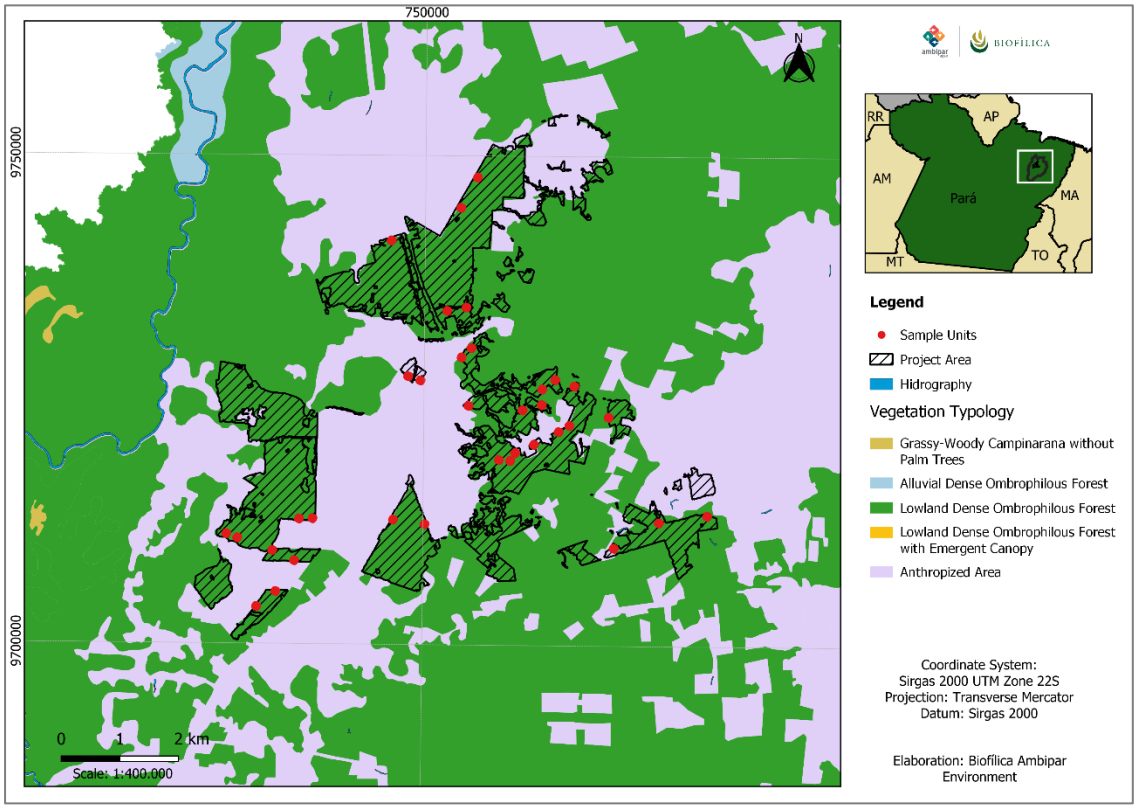

Figure 21 - Location map of inventoried clusters.

The plots were subdivided into 4 sub-units (sub-plots) of 500 m² (20 x 25 m), named sub-plots 1, 2, 3 and 4. This subdivision was adopted to better represent the larger trees that, due to their lower density of individuals per area, require a larger plot size than trees with smaller DBH. Thus, the DBH classes used as inclusion criteria in the sub-plots were the following: a) Sub-plot 1: all trees with DBH ≥ 5cm; b) Sub-plot 2: all trees with DBH ≥ 15cm; c) Sub-plot 3: all trees with DBH ≥ 30 cm; d) Sub-plot 4: all trees with DBH ≥ 50cm.

In this way, the different diametric classes had different useful plot area, as reported below:

- Class 1 - trees with DBH ≥ 5 cm and < 15 cm – 500 m2 (measurement only in sub-plot 1)
- Class 2 - trees with DBH ≥ 15 cm and < 30 cm – 1,000 m2 (measurement in sub-plots 1 and 2)
- Class 3 - trees with DBH ≥ 30 cm and < 50 cm – 1,500 m2 (measurement in sub-plots 1, 2 and 3)
- Class 4 - trees with DBH ≥ 50 cm– 2,000 m2 (measurement in all sub-plots)

Estimates of forest inventory parameters

The carbon stock estimates obtained from the sampling process in clusters and the statistics of parameters related to carbon quantification were calculated according to forest inventory procedures presented in Pélico Netto and Brena (1997)[80] The equations below were used to estimate the mean and standard error for each component of the inventoried biomass (live trees, standing dead trees and dead trees on the ground).

The estimate of the population mean per sub-unit is given by:

$$\bar{x} = \frac{\sum_{i=1}^{n}\sum_{j=1}^{M} X_{i,j}}{n \times M}$$

Where:

M = number of cluster sub-units;

n = number of sampled clusters;

Xi,j = variable of interest.

The estimate of the average of sub-units per cluster is given by:

$$\bar{x}_i = \sum_{j=1}^{M} \frac{X_{i,j}}{M}$$

The estimate of population variance per sub-unit is given by:

$$s_x^2 = \frac{1}{nM-1}\sum_{i=1}^{n}\sum_{j=1}^{M}\left(X_{i,j} - \bar{x}\right)^2$$

In cluster sampling, the total varianceS_x^2 is divided into two components of variation: within (S_x^2) and between clusters (S_x^2):

$$S_x^2 = S_e^2 + S_d^2$$

Estimates of S_x^2 are obtained by analysis of variance, which has the following mathematical expectations:

$$E(MS_{between}) = MS_e^2 + S_d^2$$

$$E(MS_{within}) = S_d^2$$

Where $MS_{within} = \frac{1}{nM-1}\sum_{i=1}^{n}\sum_{j=1}^{M}\left(X_{i,j} - \bar{x_i}\right)^2 = s_d^2$, and $MS_{between} = \frac{\sum_{i=1}^{n} M(\bar{x_i} - \bar{x})^2}{n-1}$

Then S_x^2 is estimated given by:

[80] PÉLLICO NETTO, S; BRENA, D.A. Inventário Florestal. v.1, Curitiba, PR, 1997. 316p.

$$s_e^2 = \frac{MS_{between} - MS_{within}}{M}$$

And finally the total variance is estimated by:

$$S_x^2 = S_e^2 + S_d^2 = \frac{(MS_{between} + (M-1) \times MS_{within})}{M}$$

The variance of the overall mean is estimated by:

$$s_{\bar{x}} = \sqrt{\frac{s_x^2}{n \times M}[1 + r(M-1)]}$$

Where r is the intra-cluster correlation coefficient:

$$r = \frac{s_e^2}{s_e^2 + s_d^2}$$

Finally, the sampling error is given by:

$$e = t \times s_x$$

Where t is the value of the student's t distribution with n-1 degrees of freedom.

Estimates of average carbon stocks per hectare

The average total carbon stock per hectare (= carbon density) in a land-use and land-cover (LU/LC) class was estimated by the following equation:

$$Ctot_{cl} = Cab_{cl} + Cbb_{cl} + Cdw_{cl}$$

Where:

$Ctot_{c,l}$ = Average carbon stock per hectare in all carbon pools accounted for in class LU/LC cl, in $tCO_2eq\ ha^{-1}$;

$Cab_{c,l}$ = Average carbon stock per hectare in the aboveground biomass carbon pool of class LU/LC cl, in $tCO_2eq\ ha^{-1}$;

$Cbb_{c,l}$ = Average carbon stock per hectare in the belowground biomass carbon pool of class LU/LC cl, in $tCO_2eq\ ha^{-1}$;

$Cdw_{c,l}$ = Average carbon stock per hectare in the LU/LC cl class dead wood carbon pool, in $tCO_2qe\ ha^{-1}$.

Measurements

Estimate of carbon stocks in living biomass carbon pools

The estimate of dry biomass of the trees included in the sample was made means of allometry using the prediction equation developed by Nogueira et al. (2008)[81]. This equation used was adjusted adopting the DBH as input variable in a simple model that calculates the dry biomass above ground (in Kg).

The equation proposed by Nogueira et al. (2008) for forests in Southern Amazonia and used for the determination of aboveground dry biomass of the whole tree, is as follows:

$$ln(Peso\ seco) = -1{,}716 + 2{,}413\ ln(DAP)$$

Where:

Dry weight = Weight of the tree's dry biomass above ground, in Kg. DBH = Tree trunk diameter measured at breast height, in cm.

The individual tree biomass prediction equation presented by Nogueira et al. (2008) was adjusted considering a sample set of 262 trees, using samples with DBH ranging from 5 to 124 cm. The adjusted coefficient of determination of the equation (adjusted R2) was 0.964 and the standard error of the absolute estimate was 0.306. The application of the equation for predicting dry biomass of the sampled trees showed good accuracy in the prediction of prediction, with bias of -1% for the prediction of the biomass of sampled trees and -0.05% for the normalized dry biomass per hectare.

To make up the plot total, considering the different sampling areas applied to the different DBH classes, the tree biomass data in the sub-plots were transformed to the hectare area unit, according to Table 35.

Table 35 - Plot size per DBH class

DBH Class Number	DBH range	Plot Area (PA) (m²)
1	5cm ≤ DBH < 15cm	500
2	15cm ≤ DBH < 30cm	1.000
3	30cm ≤ DBH < 50cm	1.500
4	DBH >50cm	2.000

[81] NOGUEIRA, E.M., P.M. FEARNSIDE, B.W. NELSON, R.I. BARBOSA & E.W.H. KEIZER. Estimates of forest biomass in the Brazilian Amazon: New allometric equations and adjustments to biomass from wood-volume inventories. Forest Ecology and Management (published online 17-SEP-2008) doi:10.1016/j.foreco.2008.07.022

Standardization of the size of sampling areas by DBH class was carried out by transforming data into the hectare area unit. After this transformation, the total biomass value of the plot per hectare was obtained by adding the biomass of the different DBH classes, using the following equation:

$$BAb_{pl} = \sum_{cd=1}^{CD} \left(BAb_{cd} \times \frac{10000}{AP} \right)$$

Where:

BAb_{pl} Total aboveground biomass of trees in the plot, in kg.ha-1;

BAb_{cd} Aboveground biomass of diameter class cd, 1,2,3, 4, in kg.ha-1;

Cd: DBH classes 1, 2, 3 and 4, dimensionless; Plot expansion factor, dimensionless; Plot area, in m²

PA: Plot Area, in m²

The aboveground biomass carbon stock is calculated by:

$$TCab_{tr} = TBab_{tr} \times CF$$

Where $TCab_{tr}$ is the carbon stock in the aboveground biomass of the *tr* tree; $TCab_{tr}$ is the aerial biomass of the *tr* tree and CF is the carbon fraction, adopted as 0.47 (IPCC, 2006)[82];

The aboveground biomass carbon stock was calculated by plot and by area, adding the aboveground carbon stock of all trees within each plot and multiplying by a plot expansion factor proportional to the area of the measured plot for each DBH class (Table 35).

Carbon stock in the biomass of living trees below ground

Estimate of the carbon stock of the belowground living biomass was obtained using the root/shoot ratio and the aboveground carbon stock:

$$Cbb_{cl} = TCab_{tr} \times R \times CF$$

Where Cbb_{cl} is the carbon stock in the belowground biomass of the *tr* tree; Cbb_{cl} is the aerial biomass of the *tr* tree; R is the root-shoot ratio, equal to 0.24 and CF is the carbon fraction, adopted as 0.47 (IPCC, 2006)

The calculation of carbon stock in the belowground living biomass was made by plot and by area, adding the belowground carbon stock of all trees within each plot and multiplying by a plot expansion factor proportional to the plot area measured for each DBH class (Table 35).

[82] IPCC. (2006). Agriculture, Forestry and Other Land Use. In: Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, *Vol. 4*. IGES, Japan.

Carbon stock in the biomass of standing dead trees

The same plots and procedures used for sampling living trees were used for standing dead trees. For this component, additional information was used to characterize the sampled individuals, dividing the samples into four shape categories, described below and exemplified in the illustrations in Figure 22.

Category 1 - Tree with branches, with architecture similar to a living tree, except for the absence of leaves

Category 2 - Tree without thin branches, but with persistent small and large branches;

Category 3 - Tree with large branches only;

Category 4 - Trees with trunk only, without the crown or branches.

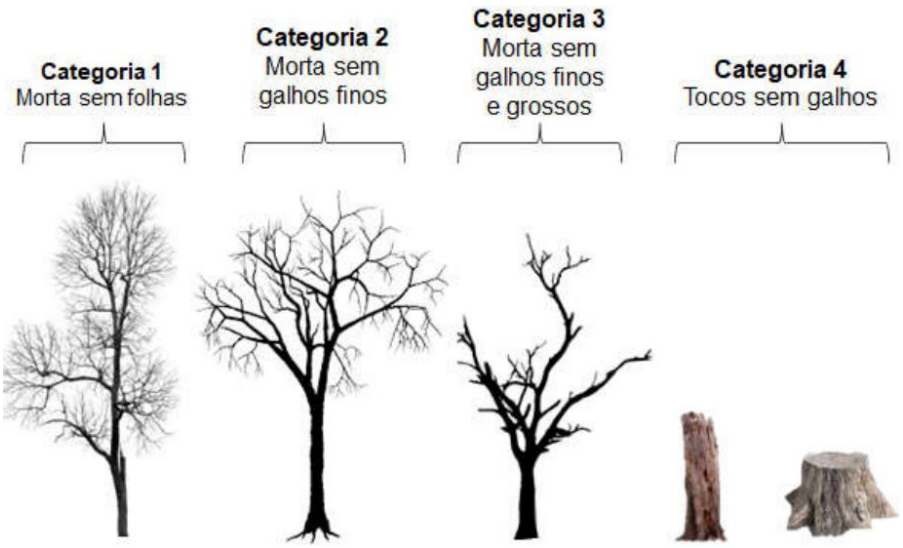

Figure 22 - Illustration to exemplify the categories of standing dead trees

For Category 1 wood from standing dead trees, the necromass (kg) of each dead tree was estimated using the allometric method applied to living trees and subtracting the leaf biomass (about 3% of the aboveground biomass).

For classes 2, 3 and 4, only the tree trunk necromass was estimated. Volume was calculated using DBH and height measurements and the top diameter estimate. It was then estimated as the volume of a truncated cone:

$$volume\ (m^3) = \frac{1}{3} \times \pi \times H \times (r_1^2 + r_2^2 + r_1 \times r_2)$$

Where:

H = height of the tree, in meters;

r_1 = radius of the base of the tree, in meters;

r_2 = radius of the top of the tree, in meters

The volume of wood from dead trees was converted to mass, multiplying by the average wood density of 642 kg/m³. (Nogueira et al., 2007[83]). From the determination of carbon stock and CO2eq., the same procedures applied to living trees were used.

Carbon stock in the biomass of dead trees on the ground

The carbon stock per hectare in the wood carbon pool of dead trees on the forest floor, of each LU/LC class is calculated as follows:

$$Cldw_{cl} = \frac{\sum_{pl=1}^{PL}\left(\sum_{dc=1}^{DC} Volume_{dc} \times D_{dc} \times CF_{dc} \times \frac{44}{12}\right)_{pl}}{PL_{cl}}$$

Where:

Cdwc,l = Average carbon stock per hectare in the LU/LC cl class dead wood carbon pool, in tCO2qe ha-1;

$Volume_{dc}$ = Volume of dead wood on the floor in the density class dc, in m³;

CF_{dc} = Carbon fraction of density class dc, dimensionless;

44/12 = Conversion ratio of C to CO2qe;

pl = 1,2,3,.., PL_{cl} Total number of parcels in class LU/LC, dimensionless;

PL_{cl} = Total number of plots in class cl, dimensionless;

D_{dc} = Average density of dead wood of a given dc class, in t/m³

DC = total number of density classes (3), dimensionless;

dc = 1, 2, 3 wood density classes, dimensionless.

Total carbon stocks

Considering the different components of living trees above and below ground, dead trees on the ground and standing trees, the Agropalma Farm forests contain 46.7 million tons of CO2eq, with 31.65 million tons in the aerial part of living trees, representing the largest compartment in stock (69%). Still, the underground part of

[83] Nogueira, E.M.; Fearnside, P.M.; Nelson, B.W.; França, M.B. Wood density in forests of Brazil's 'arc of deforestation': Implications for biomass and flux of carbon from land-use change in Amazonia. Forest Ecology and Management 248, p. 119–135, 2007

living trees represents 17% of the total stock, with 7.6 million tons of CO2eq, 6.2 million tons of CO2eq in dead wood on the ground and 1.2 million tons of CO2eq in dead wood in standing trees , accounting for 14% of the total stock.

The relative sampling error of the estimated average total carbon stock per hectare in the project area was 8.3%, well below the 10% established in methodology VM0015.

For calculations of the values of Carbon equivalent (COe, sometimes also called CO_2e) presented in Table 36, the reduced emissions were calculated by multiplying the estimated stock of the inventory by 3.6667, since mass of CO_2 = 44 and mass of C = 12; 44/12 = 3.6667. Values were calculated in Carbon equivalent to comply with Table 15 of methodology VM0015.

Table 36 - Carbon stock per hectare for the initial icl class existing in the Project area and leakage belt (table 15a of VM0015)

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 $tCO_2e\ ha^{-1}$**
507.3	47.20	121.8	11.30	99.8	13.9	728.9	60.4

Where:

Cab*icl* : Average equivalent carbon stock per hectare for the aboveground biomass pool for the initial forest class;

Cbb*icl* : Average equivalent carbon stock per hectare for the belowground biomass pool for the initial forest class;

Cdw*icl* : Average equivalent carbon stock per hectare for the dead biomass pool for the initial forest class;

Ctot*icl* : Average equivalent carbon stock per hectare for total biomass pool for the initial forest class

Projected post-deforestation classes for the Project area and leakage belt in the baseline scenario and existing non-forest classes in the leakage management areas

The VM0015 methodology allows the use of average total carbon stock estimates from local studies. We therefore used the value of 95.15 tCO2e ha -as the average carbon stock value of anthropogenic vegetation in the equilibrium class, the class that was projected to exist in the Project Area in the baseline scenario and the Leakage Belt. This carbon stock estimate was obtained from the paper by (Englund et al. (2017)[84], whose objective was to evaluate existing carbon maps with coverage in Brazil and present a new above-ground carbon (COMP) map with higher spatial resolution detail, national coverage and reflecting current land use and land cover change (LULC).

The study by Englund et al. (2017) compared existing biomass estimates (Saatchi et al. 2007[85]; Saatchi et al., 2011[86]; Baccini et al., 2012[87]; Nogueira et al. 2015[88]) and UNFCCC communications for Brazil (called in the paper "O10" and "O16"), and obtained, from new analyses, maps of carbon stocks for the Amazon that are more accurate and, with a higher level of detail (50mx50m pixels).

The value of 95.15 tCO2e ha-1 used here is actually a weighted average of the averages of the post-deforestation classes found in the article, weighted by the areas of each class in the Reference Region (Table 37).

Table 37 – Carbon stocks classes for post-deforestation at Reference Region

Stock post deforestation in each class (ton/hectare)						
Classes	**Área***	**%**	**Biomass**	**Carbon**	**CO2e**	**CO2e/ha****
Secondary Vegetation	1.421	20%	117.945	53.075	194.610	136,95
Pasture	3.251	47%	139.129	62.608	229.562	70,62
Agriculture	2.308	33%	145.416	65.437	239.936	103,95
Total	**6.980**	**100%**	**402.490**	**181.121**	**664.109**	**95,15**

* Areas with classes post deforestation use inside the Reference Region (REF)

** Mean by classes post deforestation (Englund et al. 2017).

[84] Englund et al. A new high-resolution nationwide aboveground carbon map for Brazil. Geo: Geography and Environment, 2017; 4 (2), e00045. 12p.

[85] Saatchi S S, Houghton R A, Santos Alvala Dos R C, Soares J V and Yu Y 2007 Distribution of aboveground live biomass in the Amazon basin Global Change Biology 13 816–37

[86] Saatchi S S, Harris N L, Brown S, Lefsky M, Mitchard E T A, Salas W, Zutta B R, Buermann W, Lewis S L, Hagen S, Petrova S, White L, Silman M and Morel A 2011 Benchmark map of forest carbon stocks in tropical regions across three continents Proceedings of the National Academy of Sciences 108 9899–904.

[87] Baccini A, Goetz S J, Walker W S, Laporte N T, Sun M, SullaMenashe D, Hackler J, Beck P S A, Dubayah R, Friedl M A, Samanta S and Houghton R A 2012 Estimated carbon dioxide emissions from tropical deforestation improved by carbon-density maps Nature Climate Change 2 182–5

[88] Nogueira E M, Fearnside P M, Nelson B W, Barbosa R I and Hermanus Keizer E W 2008 Estimates of forest biomass in the Brazilian Amazon: new allometric equations and adjustments to biomass from wood-volume inventories Forest Ecology and Management 256 1853–67

Calculation of carbon stock change factors (Step 6.1.1 VM0015)

In the baseline scenario, the Project considers the change in carbon stock of forest cover replaced by pasture areas, small-scale agricultural plantations or plantations (temporary or permanent). AFOLU requirements require that the breakdown of carbon stock into soil carbon, belowground biomass, dead wood and harvested wood products, in the case of the baseline, be considered. To calculate such carbon stock reduction, version VM0015 1.1 applies a standard linear function to explain the carbon stock reduction in the initial forest classes (icl) and the carbon stock increase in post-deforestation use classes. Table 38 and Table 39 summarize how the carbon stock change factor was calculated.

Table 38 - Carbon stock change factors for initial icl forest classes (Method 1) (Table 20a of Methodology VM0015).

Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$	$\Delta Cdw_{icl,t}$	$\Delta Ctot_{cl,t}$
0	t*	507.3	12.2	10.0	529.5
1	t*+1	0	12.2	10.0	22.2
2	t*+2	0	12.2	10.0	22.2
3	t*+3	0	12.2	10.0	22.2
4	t*+4	0	12.2	10.0	22.2
5	t*+5	0	12.2	10.0	22.2
6	t*+6	0	12.2	10.0	22.2
7	t*+7	0	12.2	10.0	22.2
8	t*+8	0	12.2	10.0	22.2
9	t*+9	0	12.2	10.0	22.2
10	t*+10				
11	t*+11				
12	t*+12				
13	t*+13				
14	t*+14				
15	t*+15				
16	t*+16				
17	t*+17				
18	t*+18				
19	t*+19				
20-T	t*+20...				

Table 39 - Carbon stock change factors for final fcl classes or z zones (Method 1) (Table 20b of Methodology VM0015).

Year after deforestation		$\Delta Ctot_{fcl,t}$
0	t*	0.0
1	t*+1	9.5
2	t*+2	9.5
3	t*+3	9.5
4	t*+4	9.5
5	t*+5	9.5
6	t*+6	9.5
7	t*+7	9.5
8	t*+8	9.5
9	t*+9	9.5
10	t*+10	9.5
11	t*+11	0
12	t*+12	0
13	t*+13	0
14	t*+14	0
15	t*+15	0
16	t*+16	0
17	t*+17	0
18	t*+18	0
19	t*+19	0
20-T	t*+20...	

Calculation of changes in baseline carbon stock and non-CO_2 emissions (Step 6.1.3 VM0015)

Method 1 (activity data available for classes) was used to calculate the baseline total carbon stock change in the Project Area (Table 33) and Leakage Belt (Table 34) in the year following equation 10 on page 72 of VM0015 version 1.1, as shown:

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

Where:

ΔCBSLPAt: Total change in baseline carbon stock in the Project Area in year t (tCO_{2-e});

ABSLPAicl, t: Area of initial class of icl forest deforested at time t within the Project Area in case of baseline (ha);

ABSLPAicl, t-1: Area of initial icl forest class deforested at time t-19 within the Project Area in case of baseline (ha);

ABSLPAicl, t = t-19: Initial class area of icl forest cleared at time t-19 within the Project Area in case of baseline (ha);

ΔCpicl, t = t *: The average change factor of the carbon stock to the carbon pool fixes the initial icl forest class applicable at time t (according to Table 20.a) (tCO2-e.ha-1);

ΔCpicl, t = t * + 19: The average change factor of the carbon stock to the carbon pool fixes the initial icl forest class applicable at the time t = t * + 19 (20th year after deforestation, (according to Table 20.a VM0015) (tCO2-e. ha-1);

ABSLPAz, t: Area of zone z “deforested” at time t within the Project Area in the baseline case (ha);

ABSLPAz, t-1: Area of zone z “deforested” at time t- 1 in the Project Area in the baseline case (ha);

ABSLPAz, t-19: Area of z-zone “deforested” at time t-19 in the Project Area in the baseline case (ha);

ΔCpz, t = t * : Average change factor in the carbon stock for the carbon pool z applicable at time t = t * (according to Table 20.b VM0015) (tCO2-e.ha-1);

ΔCpz, t = t + 1: Average carbon stock change factor for the applicable carbon pool at time t = t * + 1 ((= second year after deforestation, as per Table 20.b VM0015) (tCO2-e.ha-1);

ΔCpz, t = t * + 19: Average carbon stock change factor for the applicable carbon pool at time t = t * + 19 ((= 20year after deforestation, as per Table 20.b VM0015) (tCO2-e.ha -1).

Table 40 - Baseline of carbon stock change in the Project Area (Table 21b of Methodology 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
2022	395.507	395.507	395.507	2022	0	0	0	395.507	395.507
2023	457.594	457.594	853.100	2023	7.107	7.107	7.107	450.486	845.993
2024	501.997	501.997	1.355.097	2024	15.033	15.033	22.140	486.963	1.332.956
2025	661.849	661.849	2.016.945	2025	23.425	23.425	45.565	638.424	1.971.380
2026	699.444	699.444	2.716.389	2026	34.338	34.338	79.904	665.105	2.636.485
2027	924.448	924.448	3.640.837	2027	45.470	45.470	125.374	878.978	3.515.463
2028	913.174	913.174	4.554.010	2028	60.180	60.180	185.554	852.994	4.368.457
2029	1.260.026	1.260.026	5.814.037	2029	74.071	74.071	259.625	1.185.955	5.554.412
2030	1.300.778	1.300.778	7.114.815	2030	93.614	93.614	353.239	1.207.164	6.761.576
2031	1.357.743	1.357.743	8.472.558	2031	113.072	113.072	466.311	1.244.672	8.006.247

Table 41 - Baseline of carbon stock change in the Leakage Belt area (Table 21c of Methodology 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
2022	128.659	128.659	128.659	2022	0	0	0	128.659	128.659
2023	249.466	249.466	378.125	2023	2.312	2.312	2.312	247.154	375.813
2024	212.560	212.560	590.684	2024	6.698	6.698	9.010	205.861	581.674
2025	379.641	379.641	970.326	2025	10.238	10.238	19.248	369.404	951.078
2026	178.513	178.513	1.148.839	2026	16.632	16.632	35.880	161.882	1.112.959
2027	397.206	397.206	1.546.045	2027	19.143	19.143	55.023	378.063	1.491.022
2028	504.091	504.091	2.050.136	2028	25.480	25.480	80.503	478.611	1.969.633

2029	452.287	452.287	2.502.423	2029	33.472	33.472	113.975	418.815	2.388.448
2030	454.188	454.188	2.956.611	2030	40.199	40.199	154.175	413.989	2.802.437
2031	601.115	601.115	3.557.726	2031	46.679	46.679	200.853	554.436	3.356.873

Non-CO2 emission from the forest fires baseline (Step 6.2 VM0015)

Non-CO2 emissions were not considered and accounted for in Agropalma REDD+ Project, due to the low risk in the Project Area.

3.2.2 Project Emissions

Step 7 of VM0015 - Ex ante estimate of actual changes in carbon stocks and non-CO2 emissions in the Project area

Non-CO2 emissions were not considered and accounted for in Agropalma REDD+ Project.

Ex ante estimate of actual changes in carbon stock (Step 7.1 VM0015)

Ex ante estimate of actual changes in carbon stock due to planned activities (Step 7.1.1 VM0015)

Agropalma REDD+ Project Area does not have any planned activities, that is, no activities are carried out in the project area such as timber and non-timber forest management, and there is no intention of having any activities planned in the future. In this sense, planned wood extraction, charcoal production and firewood collection were not considered and accounted for in Agropalma REDD+ Project, since these activities are not carried out in the Project Area.

Optional accounting of increase in carbon stocks

The ex ante estimate of the carbon stock increase by regeneration after management activities was not considered as conservative measure.

Ex ante estimation of carbon stock changes due to unavoidable unplanned deforestation in the Project Area (Step 7.1.2 VM0015)

No unavoidable and significant unplanned deforestation is expected in the Project scenario due to the implementation of effective monitoring of forest cover, strengthening of the governance framework, activities envisaged by the Project and greater alignment with communities. With this, the project is expected to reach high levels of effectiveness during its 30-year lifespan.

However, some unplanned deforestation may occur in the Project Area, depending on the effectiveness of the proposed activities, which cannot be measured ex ante. The ex post measurements made for the Monitoring Report will be important to determine actual emission reductions.

To allow for ex ante projections, a conservative assumption was made about the effectiveness of the proposed activities to define the Effectiveness Index (EI). The estimated value of EI is used to multiply the baseline projections by the factor (1 - EI) and the result was considered to be the ex ante estimated emissions from unplanned deforestation in the case of the Project. To calculate the actual ex ante change in carbon stock due to unavoidable unplanned deforestation, equation 16 of methodology VM0015 version 1.1, presented below, was used.

$$\Delta CUDdPAt = \Delta CBSLt * (1 - EI)$$

Where:

ΔCUDdPAt: Total ex ante change in actual carbon stock due to unplanned and unavoidable deforestation in year t in the Project Area (tCO2-e);

ΔCBSLt: Total variation in the baseline carbon stock in the year, in the Project Area (tCO2- e);

EI: Ex ante Index of Estimated Effectiveness;

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

Based on the history of deforestation that occurred in the area prior to the start of the project, the Effectiveness Index (EI) of the project activities was conservatively assumed to be 90% in the first five years of implementation, and that this value will gradually increase with their efficiency over the years.

Estimated ex ante net changes of the actual carbon stock in the project area (Step 7.1.3 VM0015)

Changes in the carbon stock related to the effectiveness of the Project are presented in Table 42. We point out that changes in inventories related to planned activities were not considered as explained above.

Table 42 - Ex ante estimates of net carbon reduction in the Project Area in the Project scenario (Table 27 of 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 unavoided unplanned deforestation		Total carbon stock change in the project case	
	annual $\Delta CPAdPA_t$ tCO_2e	cumulative $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	cumulative $\Delta CPAiPA$ tCO_2e	annual $\Delta CUDdPA_t$ tCO_2e	cumulative $\Delta CUDdPA$ tCO_2e	annual $\Delta CPSPA_t$ tCO_2e	cumulative $\Delta CPSPA$ tCO_2e
2022	0.0	0.0	0.0	0.0	39.550.7	39.550.7	39.550.7	39.550.7
2023	0.0	0.0	0.0	0.0	45.048.6	84.599.3	45.048.6	84.599.3
2024	0.0	0.0	0.0	0.0	48.696.3	133.295.6	48.696.3	133.295.6
2025	0.0	0.0	0.0	0.0	63.842.4	197.138.0	63.842.4	197.138.0
2026	0.0	0.0	0.0	0.0	66.510.5	263.648.5	66.510.5	263.648.5
2027	0.0	0.0	0.0	0.0	70.318.2	333.966.7	70.318.2	333.966.7

Project Year t	Total carbon stock decrease due to planned activities		Total carbon stock increase due to planned activities		Total carbon stock decrease due to unavoided unplanned deforestation		Total carbon stock change in the project case	
	annual $\Delta CPAdPA_t$ tCO_2e	cumulative $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	cumulative $\Delta CPAiPA$ tCO_2e	annual $\Delta CUDdPA_t$ tCO_2e	cumulative $\Delta CUDdPA$ tCO_2e	annual $\Delta CPSPA_t$ tCO_2e	cumulative $\Delta CPSPA$ tCO_2e
2028	0.0	0.0	0.0	0.0	68.239.5	402.206.2	68.239.5	402.206.2
2029	0.0	0.0	0.0	0.0	83.016.9	485.223.1	83.016.9	485.223.1
2030	0.0	0.0	0.0	0.0	84.501.5	569.724.6	84.501.5	569.724.6
2031	0.0	0.0	0.0	0.0	74.680.3	644.404.9	74.680.3	644.404.9

Ex ante estimation of non-CO2 emissions due to forest fires (Step 7.2 VM0015)

Non-CO2 emissions from fire were not accounted for in the baseline scenario.

Total ex ante emissions for the project area (Step 7.3 VM0015)

Table 43 presents the expected net changes and non-CO2 emissions in the Project Area. If these emissions occur during the development of Project activities, they will be monitored and reported to verify if there will be an increase in projected emissions in the Project scenario.

Table 43 - Total ex ante estimate of net changes in carbon stock and non-CO2 emissions in the Project Area (Table 29 of VM0015)

Project Year t	Total ex ante carbon stock decrease due to planned activities		Total ex ante carbon stock increase due to planned activities		Total ex ante carbon stock decrease due to unavoided unplanned deforestation		Total ex ante net carbon stock change		Total ex ante estimated actual non-CO_2 emissions from forest fires in the project area	
	annual $\Delta CPAdPA_t$ tCO_2e	cumulative $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	cumulative $\Delta CPAiPA$ tCO_2e	annual $\Delta CUDdPA_t$ tCO_2e	cumulative $\Delta CUDdPA$ tCO_2e	annual $\Delta CPSPA_t$ tCO_2e	cumulative $\Delta CPSPA$ tCO_2e	annual $EBBPSPA_t$ tCO_2e	cumulative $EBBPSPA$ tCO_2e
2022	0.0	0.0	0.0	0.0	39.550.7	39.550.7	39.550.7	39.550.7	0.0	0.0
2023	0.0	0.0	0.0	0.0	45.048.6	84.599.3	45.048.6	84.599.3	0.0	0.0
2024	0.0	0.0	0.0	0.0	48.696.3	133.295.6	48.696.3	133.295.6	0.0	0.0
2025	0.0	0.0	0.0	0.0	63.842.4	197.138.0	63.842.4	197.138.0	0.0	0.0
2026	0.0	0.0	0.0	0.0	66.510.5	263.648.5	66.510.5	263.648.5	0.0	0.0
2027	0.0	0.0	0.0	0.0	70.318.2	333.966.7	70.318.2	333.966.7	0.0	0.0
2028	0.0	0.0	0.0	0.0	68.239.5	402.206.2	68.239.5	402.206.2	0.0	0.0
2029	0.0	0.0	0.0	0.0	83.016.9	485.223.1	83.016.9	485.223.1	0.0	0.0
2030	0.0	0.0	0.0	0.0	84.501.5	569.724.6	84.501.5	569.724.6	0.0	0.0
2031	0.0	0.0	0.0	0.0	74.680.3	644.404.9	74.680.3	644.404.9	0.0	0.0

3.2.3 Leakage

Step 8 of VM0015 - Ex ante estimate of leakage

Ex ante estimate of carbon stock reduction and increase in GHG emissions due to leakage prevention measures (Step 8.1 VM0015)

Leak prevention measures will take place within the boundaries of the leakage management areas. As described in section 2.1.11, two activities proposed by the Project will contribute to leakage management measures: "Promotion of sustainable agricultural practices" and "Development and strengthening of value chains". Thus, intensive agricultural management activities, intensive pasture management, forage production or any other activities that reduce carbon stocks and increase GHG emissions compared to the baseline scenario are not foreseen.

The follow-up of activities developed that act as leakage management will be monitored and reported in all Project verification events.

Changes in the carbon stock due to activities implemented in the leakage management areas (Step 8.1.1 VM0015)

Table 30c of VM0015 is not applicable, as no reduction is expected due to the implementation of activities. If significant changes occur in the carbon stock, these activities will be monitored, accounted for and reported.

Ex ante estimate of methane (CH4) and nitrous oxide (N20) emissions from livestock intensification (Step 8.1.2 VM0015)

As mentioned above, the development of activities that create a significant increase in CH4 and N2O emissions from grazing animals are not foreseen within the Project activities. Therefore, tables 31 and 32 of VM0015 are not applicable.

Total ex ante estimate of carbon stock changes and increase in GHG emissions due to leakage prevention measures (Step 8.1.3 VM0015)

Table 33 of VM0015 does not apply (justifications presented above).

Ex ante estimate of reduction in carbon stocks and increase in GHG emissions due to leakage due to activity displacement (Step 8.2 VM0015)

Activities that will cause deforestation within the Project Area in the baseline case may be shifted outside the project boundaries due to the implementation of the AUD project activity. Decrease in carbon stocks within the leakage band during the project scenario greater than those predicted ex ante would indicate displacement of deforestation activities due to the project.

Ex ante activity displacement leakage was calculated based on the anticipated combined effectiveness of the proposed leakage prevention measures and Project activities. As explained above, the Project will seek to prevent deforestation by encouraging alternative economic practices and efficient land planning through the "Promotion of sustainable agricultural practices", "Development and strengthening of value chains", as well as environmental awareness actions and campaigns and active community participation through a "Biodiversity Conservation Program".

The activity "Promotion of sustainable agricultural practices" will seek to identify improvements and other opportunities to be developed in order to strengthen production models and sustainable agricultural practices in the Project Zone. Through the valorization of the standing forest and the adoption of sustainable practices, it is expected to influence new territorial dynamics, discouraging activities that are drivers of deforestation in the region, such as charcoal production, illegal timber trade or extensive cattle ranching carried out through predatory and disorderly occupation of forest areas. Furthermore, the activity "Development and strengthening of value chains" complements the actions proposed by the aforementioned activity, encouraging means of valorization of local agricultural products and non-timber forest products, access to commercialization channels, and efficient territorial planning. Thus, it is expected that the scope of the results reaches the largest possible number of stakeholders through the communication channels available by the project.

Although the Project aimed to reach 100% of agents at baseline, it was conservatively considered a “Leakage Displacement Factor”. To calculate the ex ante change in the actual carbon stock due to unavoidable unplanned deforestation, an equation similar to equation 16 of the methodology VM0015 version 1.1, presented in Step 7.1.2, was used; however, with an adjustment, multiplying the estimated baseline carbon stock changes for the Project Area by a "Displacement Leakage Factor" (DLF) representing the percentage of deforestation that is expected to be displaced outside the project boundaries, starting with a rate of 10% and decreasing over the lifetime of the project. The equation is shown below:

$$\Delta CADLKt = \Delta CBSLPAt * DLF$$

Where:

ΔCADLKt: Total decrease in carbon stock due to displaced deforestation in year t (tCO2e);

ΔCBSLPAt: Total change in baseline carbon stock in the Project Area in year t (tCO_2);

DLF: Displacement Leakage Factor (%).

Thus, a displacement factor of 10% was adopted during the first five years. Then, the reduction of the leakage displacement factor is gradual, already considering the influence of the project in this context. Thus, the leakage displacement factor tends to approach zero during the 30 years of project implementation. The ex

ante estimate of leakage due to activity displacement for the first fixed baseline period is found in Table 44 and the total ex ante leakage is shown in Table 45.

Table 44 - Estimated ex ante leakage due to activity displacement (Table 34 of Methodology VM0015 version 1.1)

Project Year t	Total ex ante estimated decrease in carbon stocks due to displaced deforestation		Total ex ante estimated increase in GHG emissions due to displaced forest fires	
	annual $\Delta CADLK_t$ tCO_2e	cumulative $\Delta CADLK$ tCO_2e	annual $EADLK_t$ tCO_2e	cumulative $EADLK$ tCO_2e
2022	39.550.7	39.550.7	0.0	0.0
2023	45.048.6	84.599.3	0.0	0.0
2024	48.696.3	133.295.6	0.0	0.0
2025	63.842.4	197.138.0	0.0	0.0
2026	66.510.5	263.648.5	0.0	0.0
2027	70.318.2	333.966.7	0.0	0.0
2028	68.239.5	402.206.2	0.0	0.0
2029	83.016.9	485.223.1	0.0	0.0
2030	84.501.5	569.724.6	0.0	0.0
2031	74.680.3	644.404.9	0.0	0.0

Ex ante estimate of total leakage (Step 8.3 of VM0015)

Table 45 - Total ex ante estimate leakage (Table 35 of Methodology VM0015 version 1).

Project Year t	Total ex ante GHG emissions from increased grazing activities		Total ex ante increase in GHG emissions due to displaced forest fires		Total ex ante decrease in carbon stocks due to displaced deforestation		Carbon stock decrease due to leakage prevention measures		Total net carbon stock change due to leakage		Total net increase in emissions due to leakage	
	annual $EgLK_t$ tCO_2e	cumulative $EgLK$ tCO_2e	annual $EADLK_t$ tCO_2e	cumulative $EADLK$ tCO_2e	annual $\Delta CADLK_t$ tCO_2e	cumulative $\Delta CADLK$ tCO_2e	annual $\Delta CLPMLK_t$ tCO_2e	cumulative $\Delta CLPMLK$ tCO_2e	annual ΔCLK_t tCO_2e	cumulative ΔCLK tCO_2e	annual ELK_t tCO_2e	cumulative ELK tCO_2e
2022	0.0	0.0	0.0	0.0	39.551	39.551	0.0	0.0	39.551	39.551	0.0	0.0
2023	0.0	0.0	0.0	0.0	45.049	84.599	0.0	0.0	45.049	84.599	0.0	0.0
2024	0.0	0.0	0.0	0.0	48.696	133.296	0.0	0.0	48.696	133.296	0.0	0.0
2025	0.0	0.0	0.0	0.0	63.842	197.138	0.0	0.0	63.842	197.138	0.0	0.0
2026	0.0	0.0	0.0	0.0	66.511	263.649	0.0	0.0	66.511	263.649	0.0	0.0
2027	0.0	0.0	0.0	0.0	70.318	333.967	0.0	0.0	70.318	333.967	0.0	0.0

Project Year *t*	Total ex ante GHG emissions from increased grazing activities		Total ex ante increase in GHG emissions due to displaced forest fires		Total ex ante decrease in carbon stocks due to displaced deforestation		Carbon stock decrease due to leakage prevention measures		Total net carbon stock change due to leakage		Total net increase in emissions due to leakage	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$EgLK_t$ tCO_2e	$EgLK$ tCO_2e	$EADLK_t$ tCO_2e	$EADLK$ tCO_2e	$\Delta CADLK_t$ tCO_2e	$\Delta CADLK$ tCO_2e	$\Delta CLPMLK_t$ tCO_2e	$\Delta CLPMLK$ tCO_2e	ΔCLK_t tCO_2e	ΔCLK tCO_2e	ELK_t tCO_2e	ELK tCO_2e
2028	0.0	0.0	0.0	0.0	68.239	402.206	0.0	0.0	68.239	402.206	0.0	0.0
2029	0.0	0.0	0.0	0.0	83.017	485.223	0.0	0.0	83.017	485.223	0.0	0.0
2030	0.0	0.0	0.0	0.0	84.501	569.725	0.0	0.0	84.501	569.725	0.0	0.0
2031	0.0	0.0	0.0	0.0	74.680	644.405	0.0	0.0	74.680	644.405	0.0	0.0

3.2.4 Net Reductions and Removals of GHG Emissions

Step 9 of VM0015 - Total ex ante reduction of net anthropogenic GHG emissions

Significance assessment (Step 9.1 VM0015)

Using the most recent document “EB-CDM approved “Tool for testing significance of GHG emissions in A/R CDM Project activities”, it was possible to verify that aboveground biomass will contribute to 69% of the expected emissions in the baseline scenario, at belowground biomass with 17% and dead wood with 14%.

Therefore, they all represent significant sources of emissions (above 5%).

Calculation of ex ante estimates of total net GHG emission reductions (Step 9.2 VM0015)

The equation below was used as suggested by methodology VM0015 version 1.1 to estimate ex ante net decrease in Project emissions. Result is shown in Table 46(Table 36 of Methodology version VM0015 1.1).

$$\Delta REDDt = (\Delta CBSLPAt + EBBBSLPAt) - (\Delta CPSPAt + EBBPSPAt) - (\Delta CLKt + ELKt)$$

Where:

∆REDDt: Reduction of ex post anthropogenic GHG emissions attributed to the AUD activity of the project in year t (tCO2e);

∆CBSLPAt: Sum of changes in baseline carbon stock in the Project Area in year t (tCO2e);

EBBBSLPAt: Sum of changes in baseline caused by the burning of biomass in the Project Area in year t (tCO2e);

ΔCPSPAt: Sum of ex post changes in carbon stock in the Project Area in year t (tCO2e);

EBBPSPAt: Sum of ex post emissions caused by the burning of biomass in the Project Area in year t (tCO2e);

ΔCLKt: Sum of ex post changes in carbon stock due to leakage in year t (tCO2e);

ELKt: Sum of ex post emissions due to leakage in year t (tCO2e);

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

Ex ante calculation of Verified Carbon Units (VCU's) (Step 9.3 VM0015)

Equation 20 of Methodology VM0015 was used to estimate the number of VCU's. The Risk Factor parameter was estimated using the VCS AFOLU Non-Permanence Risk Tool, resulting in10%. The result is shown in Table 46(below (Table 36 of Methodology VM0015 version 1.1).

$$\Delta VCUt = \Delta REDDt - VBCt$$

$$VBCt = (\Delta CBSLPAt - \Delta CPSPAt) * RFt$$

Where:

VCUt: Number of Verified Carbon Units that can be traded in year t (tCO2e);

ΔREDDt: Reduction of ex post anthropogenic GHG emissions attributed to the AUD activity of the project in year t (tCO2e);

VBCt: Number of buffer credits deposited in the VCS buffer in year t (t CO2-e);

ΔCBSLPAt: Sum of changes in baseline carbon stock in the Project Area in year t (tCO2e);

ΔCPSPAt: Sum of expost changes in carbon stock in the Project Area in year t (tCO2e);

RFt: Risk factor used to calculate the VCS credit buffer (%);

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

Table 46 - Ex ante estimatie of net anthropogenic GHG emission reductions (ΔREDDt) and Verified Carbon Units (VCUt) (Methodology Table 36 VM0015)

Project Year t	Baseline carbon stock changes		Baseline GHG emissions		Ex ante project carbon stock changes		Ex ante project GHG emissions		Ex ante leakage carbon stock changes		Ex ante leakage GHG emissions		Ex ante net anthropogenic GHG emission reductions		Ex ante VCUs tradable		Ex ante buffer credits	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\Delta CBSLPA_t$	ΔCBSLPA	$\Delta EBBBSLPA_t$	ΔEBBBSLPA	$\Delta CPSPA_t$	ΔCPSPA	$EBBPSPA_t$	EBBPSPA	ΔCLK_t	ΔCLK	ELK_t	ELK	$\Delta REDD_t$	ΔREDD	VCU_t	VCU	VCB_t	VCB
	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e	tCO_2e
2022	395.507	395.507	0	0	39.551	39.551	0	0	39.551	39.551	0	0	316.405	316.405	280.810	280.810	35.596	35.596
2023	450.486	845.993	0	0	45.049	84.599	0	0	45.049	84.599	0	0	360.389	676.794	319.845	600.655	40.544	76.139
2024	486.963	1.332.956	0	0	48.696	133.296	0	0	48.696	133.296	0	0	389.571	1.066.365	345.744	946.399	43.827	119.966
2025	638.424	1.971.380	0	0	63.842	197.138	0	0	63.842	197.138	0	0	510.739	1.577.104	453.281	1.399.680	57.458	177.424
2026	665.105	2.636.485	0	0	66.511	263.649	0	0	66.511	263.649	0	0	532.084	2.109.188	472.225	1.871.905	59.859	237.284
2027	878.978	3.515.463	0	0	70.318	333.967	0	0	70.318	333.967	0	0	738.341	2.847.529	657.475	2.529.380	80.866	318.150
2028	852.994	4.368.457	0	0	68.239	402.206	0	0	68.239	402.206	0	0	716.515	3.564.044	638.039	3.167.419	78.475	396.625
2029	1.185.955	5.554.412	0	0	83.017	485.223	0	0	83.017	485.223	0	0	1.019.922	4.583.966	909.628	4.077.047	110.294	506.919
2030	1.207.164	6.761.576	0	0	84.501	569.725	0	0	84.501	569.725	0	0	1.038.161	5.622.127	925.895	5.002.941	112.266	619.185
2031	1.244.672	8.006.247	0	0	74.680	644.405	0	0	74.680	644.405	0	0	1.095.311	6.717.438	978.312	5.981.253	116.999	736.184
												Total	6.717.438		5.981.253		736.184	
												Average	671.744		598.125		73.618	

3.3 Monitoring

3.3.1 Data and Parameters Available at Validation

Data / Parameter	**$Ctot_{cl}$**
Data unit	t CO_2-and ha_{-1}
Description	Average stock of $CO_{2\text{-}e}$ per hectare in all forest class carbon pools used in the baseline scenario
Source of data	Calculated by allometric equations, conversion factors from the literature and data measured in the field
Value applied	748.2
Justification of choice of data or description of measurement methods and procedures applied	Estimates of aboveground, belowground and dead wood carbon stock were obtained using forest inventory data and allometric equations[89] developed in areas similar to the Project Area and adopting standard values from the literature or recommended by VCS VM0015
Purpose of data	• Determination of the baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	See document: Forest Carbon Stock Agropalma REDD+ Project v1.4

Data / Parameter	**Cab_{cl}**
Data unit	t CO_2-and ha_{-1}
Description	Average stock per hectare of $CO_{2\text{-}e}$ biomass in the aboveground pool
Source of data	Calculated by allometric equations, conversion factors from the literature and data measured in the field

[89] Nogueira, E.M.; Fearnside, P.M.; Nelson, B.W. Barbosa, R.I.; Keizer, E.W.H. Estimates of forest biomass in the Brazilian Amazon: New allometric equations and adjustments to biomass from wood-volume inventories. Forest Ecology and Management, v. 256, n. 11, p. 1853-1867, 2008.

Value applied	507.3
Justification of choice of data or description of measurement methods and procedures applied	Estimates of aboveground carbon stock were obtained using forest inventory data and allometric[22] equations developed in areas similar to the Project Area and adopting standard values from the literature or recommended by VCS VM0015
Purpose of data	• Determination of the baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	See document: Forest Carbon Stock Agropalma REDD+ Project v1.4

Data / Parameter	**Cbb_{cl}**
Data unit	t CO_2-and ha_{-1}
Description	Average stock per hectare of CO_{2-e} biomass in the underground pool
Source of data	Calculated by allometric equations, conversion factors from the literature and data measured in the field
Value applied	121.8
Justification of choice of data or description of measurement methods and procedures applied	Estimates of belowground carbon stock were obtained using forest inventory data and allometric[22] equations developed in areas similar to the Project Area and adopting standard values from the literature or recommended by VCS VM0015
Purpose of data	• Determination of the baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	See document: Forest Carbon Stock Agropalma REDD+ Project v1.4

Data / Parameter	**Cdw_{cl}**
Data unit	t CO_{2}-and ha_{-1}
Description	Average stock per hectare of CO_{2-e} biomass in standing and ground dead wood
Source of data	Calculated by allometric equations[22], density and volume equations, literature conversion factors and forest inventory data
Value applied	119.0
Justification of choice of data or description of measurement methods and procedures applied	Estimates of carbon stock in standing and ground dead wood were obtained using forest inventory data and allometric[22] equations and equations of density and volume recommended by VCS VM0015
Purpose of data	• Determination of the baseline scenario • Calculation of baseline emissions • Calculation of project emissions • Calculation of leakage
Comments	See document: Forest Carbon Stock Agropalma REDD+ Project v1.4

Data / Parameter	**DBH**
Data unit	cm
Description	Diameter at breast height (130 cm) for each tree
Source of data	Measured in field by Biodendro Consultoria Florestal
Value applied	See worksheet with field data
Justification of choice of data or description of measurement methods and procedures applied	Requirement demanded by VCS methodology VM0015. Forest inventory data collected less than 10 years ago in multiple plots located in wide spatial distribution. Parameter measured only in trees with a diameter at breast height equal to or greater than 5 cm
Purpose of data	Variable used in the allometric equations for calculating biomass above and below ground and in the volume equation for calculating standing dead wood biomass

Comments	

Data / Parameter	**H**
Data unit	meters
Description	Tree height
Source of data	Measured in field by Biodendro Consultoria Florestal
Value applied	See worksheet with field data
Justification of choice of data or description of measurement methods and procedures applied	Requirement demanded by VCS methodology VM0015. Forest inventory data collected less than 10 years ago in multiple plots located in wide spatial distribution
Purpose of data	Variable used in the volume equation to calculate standing dead wood biomass
Comments	

Data / Parameter	**$Volume_{dc}$**
Data unit	m^3
Description	Volume of dead wood on the ground
Source of data	Measured in laboratory b Biodendro Consultoria Florestal
Value applied	See worksheet with field data
Justification of choice of data or description of measurement methods and procedures applied	Requirement demanded by VCS methodology VM0015. Calculation of the amount of dead wood biomass on the ground in rotten, intermediate and hard samples with a diameter greater than 10 cm.
Purpose of data	Calculation of the average stock per hectare of carbon biomass in dead wood on the ground
Comments	

Data / Parameter	**D_{dc}**
Data unit	$t\ m^{-3}$

Description	Density of dead wood on the ground
Source of data	Measured in laboratory b Biodendro Consultoria Florestal
Value applied	
Justification of choice of data or description of measurement methods and procedures applied	Requirement demanded by VCS methodology VM0015. Calculation of the amount of dead wood biomass on the ground in rotten, intermediate and hard samples with a diameter greater than 10 cm.
Purpose of data	Calculation of the average stock per hectare of carbon biomass in dead wood on the ground
Comments	

Data / Parameter	$\mathbf{D_j}$
Data unit	t m^{-3}
Description	Standing dead wood density
Source of data	Average density of standing trees in the Reference Region (Nogueira, et al, 2007[90]
Value applied	0.642
Justification of choice of data or description of measurement methods and procedures applied	Variable used to convert volume to standing dead wood biomass
Purpose of data	Calculation of the average stock per hectare of carbon biomass in standing dead wood
Comments	

Data / Parameter	$\mathbf{R_j}$
Data unit	dimensionless

[90] Nogueira, E.M.; Fearnside, P.M.; Nelson, B.W.; França, M.B. Wood density in forests of Brazil's 'arc of deforestation': Implications for biomass and flux of carbon from land-use change in Amazonia. Forest Ecology and Management 248, p. 119–135, 2007.

Description	Root-shoot ratio
Source of data	Literature: GOFC-GOLD, 2008[91] and VCS VM0015, 2012
Value applied	0.24
Justification of choice of data or description of measurement methods and procedures applied	Suggested default value for tropical rainforest regions with aboveground biomass greater than 125 t $_{ha-1}$ (GOFC-GOLD, 2008; VCS Methodology VM0015, p. 140, Table -2)
Purpose of data	Calculation of the average stock per hectare of carbon biomass in bellowground pools
Comments	

Data / Parameter	**CF**
Data unit	t C
Description	Carbon fraction in biomass
Source of data	Literature: IPCC, 2006[92]
Value applied	0.47
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value
Purpose of data	Determination of the carbon biomass fraction in the above and below ground pools and in dead wood
Comments	

Data / Parameter	**44/12**
Data unit	t CO_{2}-e
Description	Conversion factor from mass of carbon to mass of CO_{2-e}

[91] http://www.gofcgold.wur.nl/redd/sourcebook/GOFC-GOLD_Sourcebook.pdf
[92] IPCC, 2006. Guidelines for National Greenhouse Gas Inventories. Volume 4: Agriculture, Forestry and Other Land Use. Chapter 4: Forest Land

Source of data	Literature: IPCC, 2006[25]
Value applied	44/12
Justification of choice of data or description of measurement methods and procedures applied	IPCC default value
Purpose of data	Determination of the average stock of $CO_{2\text{-}e}$ biomass in above and below ground pools and in dead wood
Comments	

3.3.2 Data and Parameters Monitored

Parameters for monitoring deforestation, emissions and credit generation

Data / Parameter	$ABSLPA_t$
Data unit	ha
Description	Forest cover areas converted to non-forest cover areas within the Project Area in year t of Agropalma REDD+ Project
Source of data	Calculated using remote sensing and data available from reliable sources
Description of measurement methods and procedures to be applied	Monitoring of the forestry component through remote sensing using satellite images and data from reliable sources
Frequency of monitoring/recording	Annual
Value applied	Average annual deforestation in the Project Area projected in the baseline: 1,144 ha
Monitoring equipment	Geotechnologies: remote sensing and geographic information systems

QA/QC procedures to be applied	In mapping changes in forest cover and defining land use classes, data obtained at medium spatial resolution (between 10m and 100m) will be used. Subsequently, for validation and refinement of the described mapping, data obtained by high resolution sensors (up to 5m pixels) will be used. The minimum accuracy of the land use and land cover classification map is 80%
Purpose of data	• Calculation of emissions in the Project Area
Calculation method	-
Comments	-

Data / Parameter	$\Delta CUDdPA_t$
Data unit	tCO_2-e
Description	Total change in actual carbon stock due to unavoided and unplanned deforestation in year t in the Agropalma REDD+ Project Area
Source of data	Calculated from the detected areas of forest loss due to unplanned deforestation in the Project Area and the estimated average carbon stock for the initial forest class
Description of measurement methods and procedures to be applied	Monitoring the $ABSLPA_t$ indicator for later calculation of the change in carbon stock from unplanned and unavoided deforestation
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Emissions spreadsheet
QA/QC procedures to be applied	Good practices applied to the calculation of $ABSLPA_t$

Purpose of data	• Calculation of emissions in the Project Area
Calculation method	The parameter is estimated from the multiplication of unplanned deforestation areas by the estimated average carbon stock value for the initial forest class. The sum of residual emissions from the carbon stock below the ground and in dead wood is also considered, as these pools have an annual decay of 1/10, causing emissions over the years. Finally, the value of the estimated carbon stock for the Reference Region in a post-deforestation scenario is subtracted from this result, obtaining the net value of the carbon stock that was reduced by unplanned and unavoided deforestation
Comments	-

Data / Parameter	$AUFPA_{icl,t}$
Data unit	ha
Description	Areas affected by forest fires in the initial icl forest class in which carbon stock recovery occurs in year t of Agropalma REDD+ Project
Source of data	Calculated using remote sensing and data available from reliable sources
Description of measurement methods and procedures to be applied	Identification of affected areas from reliable sources with data regarding hot spots and fire scars. Photointerpretation technique with high resolution images for validating the data obtained, identifying and quantifying the affected areas.
Frequency of monitoring/recording	Whenever the occurrence of forest fires is identified
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Geotechnologies: remote sensing and geographic information systems

QA/QC procedures to be applied	In validating and refining the mapping of areas affected by fires, data or images obtained from high-resolution sensors (up to 5m pixels) will be used. Minimum mapping accuracy is 80%
Purpose of data	• Calculation of emissions in the Project Area
Calculation method	-
Comments	-

Data / Parameter	$\Delta CUFdPA_t$
Data unit	tCO_2-e
Description	Total reduction in carbon stock due to unplanned (and planned - when applicable) forest fires in year t in the Agropalma REDD+ Project Area
Source of data	Calculated through the areas affected by forest fires in the Project Area and the estimated average carbon stock for the initial forest class
Description of measurement methods and procedures to be applied	Monitoring of the $AUFPA_{icl,t}$ parameter for later calculation of the change in carbon stock of areas affected by forest fires.
Frequency of monitoring/recording	Whenever the occurrence of forest fires is identified
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Emissions spreadsheet
QA/QC procedures to be applied	Good practices applied to the calculation of $AUFPA_{icl,t}$
Purpose of data	• Calculation of emissions in the Project Area

Calculation method	The carbon stock variation is estimated by multiplying the area affected by the forest fire and the estimated average carbon stock for the initial forest class
Comments	-

Data / Parameter	$ACPA_{icl,t}$
Data unit	ha
Description	Area affected by catastrophic events in the icl class in year t in Agropalma REDD+ Project Area
Source of data	Calculated using remote sensing and data available from reliable sources
Description of measurement methods and procedures to be applied	Identification of affected areas from reliable data sources. Photointerpretation technique with high resolution images for validating the data obtained, identifying and quantifying the affected areas.
Frequency of monitoring/recording	Whenever the occurrence of catastrophic events is identified
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Geotechnologies: remote sensing and geographic information systems
QA/QC procedures to be applied	In validating and refining the mapping of areas affected by catastrophic events, data or images obtained from high-resolution sensors (up to 5m pixels) will be used. Minimum mapping accuracy is 80%
Purpose of data	• Calculation of emissions in the Project Area
Calculation method	-
Comments	-

Data / Parameter	$\Delta CUCdPA_t$
Data unit	tCO_2-e
Description	Total reduction in carbon stock due to catastrophic events in year t in the Agropalma REDD+ Project Area
Source of data	Calculated through the areas affected by forest fires in the Project Area and the estimated average carbon stock for the initial forest class
Description of measurement methods and procedures to be applied	Monitoring of the $ACPA_{icl,t}$ parameter for later calculation of the change in carbon stock from areas affected by catastrophic events
Frequency of monitoring/recording	Whenever the occurrence of catastrophic events is identified
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Emissions spreadsheet
QA/QC procedures to be applied	Good practices applied to the calculation of $ACPAi_{cl,t}$
Purpose of data	• Calculation of emissions in the Project Area
Calculation method	The carbon stock variation is estimated by multiplying the area affected by catastrophic events and the estimated average carbon stock for the initial forest class
Comments	-

Data / Parameter	$\Delta BSLLK_t$
Data unit	ha
Description	Forest cover areas converted to non-forest cover areas within the Leakage Belt in year t of Agropalma REDD+ Project

Source of data	Calculated using remote sensing and data available from reliable sources
Description of measurement methods and procedures to be applied	Monitoring of the forestry component through remote sensing using satellite images and data from reliable sources
Frequency of monitoring/recording	Annual
Value applied	Average annual deforestation in the Leakage Belt projected at baseline: 584 ha
Monitoring equipment	Geotechnologies: remote sensing and geographic information systems
QA/QC procedures to be applied	In mapping changes in forest cover and defining land use classes, data with medium spatial resolution (between 10m and 100m) will be used. Subsequently, for validation and refinement of the described mapping, data obtained by high resolution sensors (up to 5m pixels) will be used. The minimum accuracy of the land use and land cover classification map is 80%
Purpose of data	• Calculation of emissions in the Leakage Belt
Calculation method	-
Comments	-

Data / Parameter	$\Delta CADLK_t$
Data unit	tCO_2-e
Description	Total reduction in carbon stocks due to displaced deforestation in year t in the Leakage Belt of Agropalma REDD+ Project
Source of data	Calculated from the detected areas of forest loss in the Leakage Belt, the average carbon stock and the estimated loss in carbon stock projected by the baseline

Description of measurement methods and procedures to be applied	Monitoring of the $\Delta BSLLK_{icl,t}$ indicator for later calculation of the change in carbon stock from deforestation displaced to the Leakage Belt
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Emissions spreadsheet
QA/QC procedures to be applied	Good practices applied to the calculation of $\Delta BSLLK_{icl,t}$
Purpose of data	• Calculation of emissions in the Leakage Belt
Calculation method	The parameter is estimated from the multiplication of areas of forest loss by the average carbon stock value estimated for the initial forest class. The sum of residual emissions from the carbon stock below the ground and in dead wood is also considered, as these pools have an annual decay of 1/10, causing emissions over the years. Then, the value of the estimated carbon stock for the Reference Region in a post-deforestation scenario is subtracted from this result, obtaining the net value of the carbon stock that was reduced by displaced deforestation. Finally, the estimated loss of carbon stock in the Leakage Belt projected by the baseline is subtracted from this value.
Comments	-

Data / Parameter	$APSLK_{fcl,t}$
Data unit	ha
Description	Portion of area within Leakage Management Areas with decreasing carbon stock in year t
Source of data	Project activity follow-up report and other records related to leakage prevention activities

Description of measurement methods and procedures to be applied	Follow-up of activities, following the guidelines of section 8.1.1 of methodology VM0015 v1.1
Frequency of monitoring/recording	Only when applicable
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Spreadsheet of records and relevant documents
QA/QC procedures to be applied	To be defined when the parameter is applicable
Purpose of data	• Calculation of emissions in the Leakage Belt
Calculation method	Emissions will be calculated using the guidelines in section 8.1.1 of methodology VM0015 v1.1
Comments	No leak prevention activities are foreseen that generate a decrease in the carbon stock

Data / Parameter	$\Delta CLPMLK_t$
Data unit	tCO_2-e
Description	Decrease in carbon stock due to leakage prevention measures in year t
Source of data	Calculated from the quantitative value of the area within the Leakage Management Areas with decreasing carbon stock, the initial average carbon stock and the estimated loss of carbon stock in the Leakage Belt projected by the baseline
Description of measurement methods and procedures to be applied	Monitoring of grazing activities following the guidelines of section 8.1.1 of methodology VM0015 v1.1

Frequency of monitoring/recording	Only when applicable
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Emissions spreadsheet
QA/QC procedures to be applied	To be defined when the parameter is applicable
Purpose of data	• Calculation of emissions in the Leakage Belt
Calculation method	Emissions will be calculated using the guidelines in section 8.1.1 of methodology VM0015 v1.1
Comments	No leak prevention activities are foreseen that generate a decrease in the carbon stock

Data / Parameter	$EgLK_t$
Data unit	tCO_2-e
Description	Emissions from animals on pastures in the leakage management areas in year t
Source of data	Existing records on the practice of grazing
Description of measurement methods and procedures to be applied	Monitoring of grazing activities following the guidelines of section 8.1.1 of methodology VM0015 v1.1
Frequency of monitoring/recording	Only when applicable
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Emissions spreadsheet

QA/QC procedures to be applied	To be defined when the parameter is applicable
Purpose of data	• Calculation of emissions in the Leakage Belt
Calculation method	Emissions will be calculated using the guidelines in section 8.1.2 of methodology VM0015 v1.1
Comments	No activities involving grazing are foreseen.

Data / Parameter	$EADLK_t$
Data unit	tCO_2-e
Description	Emissions from forest fires displaced to the Leakage Belt in year t of Agropalma REDD+ Project
Source of data	Calculated using the areas affected by forest fires in the Leakage Belt and estimated average carbon stock for the initial land use class
Description of measurement methods and procedures to be applied	Identification of affected areas from reliable sources with data regarding hot spots and fire scars. Photointerpretation technique with high resolution images for validating the data obtained, identifying and quantifying the affected areas.
Frequency of monitoring/recording	Whenever the occurrence of forest fires is identified
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Geotechnologies: remote sensing and geographic information systems
QA/QC procedures to be applied	In validating and refining the mapping of areas affected by fires, data or images obtained from high-resolution sensors (up to 5m pixels) will be used. Minimum mapping accuracy is 80%

Purpose of data	• Calculation of emissions in the Leakage Belt
Calculation method	The carbon stock variation is estimated by multiplying the area affected by the forest fire and the estimated average carbon stock for the initial land use class
Comments	

Data / Parameter	$\Delta REDD_t$
Data unit	tCO_2-e
Description	Net reduction in anthropogenic greenhouse gas emissions attributable to the AUD Project activity in year t
Source of data	Parameter is calculated by subtracting baseline carbon stock rates from changes in carbon stock over the Project
Description of measurement methods and procedures to be applied	The calculation of net reductions in anthropogenic GHG emissions attributable to Project activities will be calculated using Equation 19 and Table 36 of Methodology VM0015 v1.1
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Emissions spreadsheet
QA/QC procedures to be applied	Good practices applied to the calculation of the base parameters for calculating the emissions of the Project that were previously described
Purpose of data	Parameter used to determine the efficiency of the Project in reducing GHG emissions when calculating net reductions in anthropogenic emissions by the Project over the years and comparing to the baseline scenario

Calculation method	Emissions will be calculated using the guidelines in section 9.2 of methodology VM0015 v1.1
Comments	-

Data / Parameter	VCU_t
Data unit	tCO_2-e
Description	Number of Verified Carbon Units (VCU) to be made available for sale in year t
Source of data	Value resulting from subtracting/discounting the risk factor (buffer) of net reductions in anthropogenic GHG emissions ($\Delta REDD_t$)
Description of measurement methods and procedures to be applied	The calculation of VCU's will be performed using Equation 20,21 and 22 and Table 36 of Methodology VM0015 v1.1
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Emissions spreadsheet
QA/QC procedures to be applied	Good practices applied to the calculation of the base parameters for calculating the emissions of the Project that were previously described
Purpose of data	Parameter used to determine the amount of carbon credits (VCU) tradable by the Project
Calculation method	Emissions will be calculated using the guidelines in section 9.3 of methodology VM0015 v1.1
Comments	-

Monitoring parameters of General Scope activities

Data / Parameter	Number of reports
Data unit	Number
Description	This parameter will be responsible for accounting for the amount of all material produced and designed with considerations, clarifications and content containing information that demonstrate actions for implementation, monitoring and evaluation of the activities developed by REDD+ Agropalma Project
Source of data	Calculated through reports, minutes of meetings, monitoring guides, procedures and memoranda developed and focused on matters related to Project management (governance, implementation, monitoring and evaluation of activities)
Description of measurement methods and procedures to be applied	All documents that can be understood as “reports” produced for the Project will be stored in digital files throughout the crediting period of the Project. In this way, reports from the activity of "Implementation, monitoring and evaluation of the activities developed by the Project" will be monitored and accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Information systematized in reports will be validated among the proponents, allowing for greater reliability and quality of data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Monitoring parameters for Climate Scope activities

Data / Parameter	Number of reports
Data unit	Number
Description	This parameter will be responsible for accounting for the amount of all material produced that demonstrate actions for monitoring deforestation as well as other asset surveillance activities
Source of data	Calculated through the number of reports, meeting minutes, monitoring guides and bulletins developed in the Climate Scope activity (Strengthening asset surveillance)
Description of measurement methods and procedures to be applied	All documents that can be understood as “reports” produced for the Project will be stored in digital files throughout the crediting period of the Project. In this way, the reports from the activity of "Strengthening asset surveillance)" will be monitored and accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Information systematized in reports will be validated among the proponents, allowing for greater reliability and quality of data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Data / Parameter	Number of procedures and protocols
Data unit	Number
Description	This parameter will be responsible for accounting for the amount of all material produced, in the form of procedures and protocols, which will be established and continuously executed to develop deforestation monitoring and strengthen the Project's asset surveillance.
Source of data	Calculated through the number of documents, in the form of procedures and protocols, continuously developed and executed over time in the Climate Scope activity (Strengthening asset surveillance)
Description of measurement methods and procedures to be applied	All documents that can be understood as procedures and protocols produced and executed by the Project will be stored in digital files throughout the crediting period of the Project. In this way, the reports from the activity of "Strengthening asset surveillance" will be monitored and accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Information systematized in the procedures and protocols will be validated among the proponents, allowing for greater reliability and quality of data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Data / Parameter	Number of trainings
Data unit	Number
Description	This parameter aims to measure the number of all courses and training carried out that will be defined and implemented throughout the Project, specifically for the activity of “Strengthening asset surveillance”. It is important to highlight that although monitoring frequency is annual, it is expected to decrease over time, as this indicator is associated with short and medium term actions for the Project
Source of data	Calculated through the number of documents, in the form of an attendance list, contracts, photographs, among other documents
Description of measurement methods and procedures to be applied	All documents produced by the Project will be stored in digital files throughout the crediting period of the Project. In this way, the training carried out in the activity of "Strengthening asset surveillance)" will be monitored and accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Information systematized in the documents that prove the completion of training will be validated among the proponents, allowing for greater reliability and quality of data In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Data / Parameter	Number of occurrences
Data unit	Number
Description	This parameter aims to measure the number of occurrences of illicit activities within the Project Area, such as deforestation, wood theft, fires and hunting.
Source of data	Calculated through the number of incident records, in the form of bulletins, photographs, among other documents
Description of measurement methods and procedures to be applied	All documents produced by the Project will be stored in digital files throughout the crediting period of the Project. In this way, the records of occurrences carried out in the activity of "Strengthening asset surveillance)" will be monitored and accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	Information systematized in the documents that prove the records of occurrences of illegal activities will be validated between the proponents, allowing for greater reliability and quality of data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

3.3.3 Monitoring Plan

The Climate Impacts Monitoring Plan will encompass key issues for demonstrating the reduction of emissions from deforestation and degradation due to avoided unplanned deforestation, in accordance with the applied

methodology VM0015. Thus, the main objective is to monitor changes in the carbon stock throughout the Project's life cycle, resulting from changes in land use within the Project Area and in the Leakage Belt.
The monitoring plan consists of two main parts:
i) Monitoring of changes in carbon stocks and GHG emissions considering periodic checks that will take place within a fixed baseline period (PART 1);

ii) Monitoring of key parameters for baseline reassessment at the end of a fixed baseline period (PART 2).

PARTE 1. MONITORING CHANGES IN CARBON STOCKS AND GHG EMISSIONS FOR PERIODIC VERIFICATIONS

1.1 Monitoring actual changes in carbon stock and GHG emissions within the Project Area

Monitoring actual changes in carbon stock and GHG emissions within the Project Area involves four main scopes, which are:

i) project implementation;

ii) land use and land cover change;

iii) carbon stocks and non-CO_2 emissions, and

iv) impacts from natural disturbances and other catastrophic events.

The procedures applied to this monitoring plan contemplate what is developed and applied within the perspective of the project, therefore, within the scope, non-CO_2 emissions (iii) were not considered, as emissions were not considered in the baseline derived from biomass burning.

Details on the monitoring of the four scopes are presented below.

a) Technical description of monitoring tasks

Changes in carbon stock due to conversion of forested areas to non-forested areas by unplanned deforestation will be monitored. Likewise, changes in carbon stock due to uncontrolled forest fires and other catastrophic events will be monitored and considered under the Project scenario where they are significant.
As explained in Section 2.1.11, the proponents will develop the activity “Strengthening asset surveillance”, which consists of remote and continuous monitoring of the Project Area in order to allow agility in identifying and checking deforestation events, in addition to improvements in procedures for communication, approach offenders and verification of occurrences.

b) Data to be collected

Data/Parameter	Description	Unit	Source	Frequency
ABSLPAicl,t	Forest cover areas of initial icl forest class converted to non-forest cover areas within the Project Area in year t	ha (hectare)	Calculated using remote sensing and data available from reliable sources	Annual
ΔCUDdPAt	Total change in actual carbon stock due to unavoidable unplanned deforestation in year t in the Project Area	tCO_2-e	Calculated from the detected areas of forest loss due to unplanned deforestation and estimated average carbon stock for the initial forest class	Annual
AUFPAicl,t	Areas affected by forest fires in the initial icl forest class in which carbon stock recovery occurs in year t	ha (hectare)	Calculated using remote sensing and data available from reliable sources	Annual
ΔCUFdPAt	Total reduction in carbon stock due to unplanned (and planned - when applicable) forest fires in year t in the Project Area	tCO_2-e	Calculated from the areas affected by forest fires and the estimated average carbon stock for the initial forest class	Annual

Data/Parameter	Description	Unit	Source	Frequency
ACPAicl,t	Area affected by catastrophic events in the icl class in year t in Project Area	ha (hectare)	Calculated using remote sensing and data available from reliable sources	Annual
ΔCUCdPAt	Total reduction in carbon stock due to catastrophic events in year t in the Project Area	tCO_2-e	Calculated through the areas affected by forest fires in the Project Area and the estimated average carbon stock for the initial forest class	Annual

c) Brief description of data collection procedures

Monitoring the implementation of Project activities

Monitoring the implementation of REDD+ activities will be carried out through schedules, activity performance reports, registration of indicators, financial reports, attendance lists, minutes of meetings, plans, established procedures and protocols, updated forest cover maps, among other relevant documents. As described in Section 2.1.11, the proposed activity “Implementation, monitoring and evaluation of activities carried out by the Project” will promote efficient management of the Project over the years, ensuring effectiveness in the execution of activities so that positive impacts are achieved.

Monitoring of land use and land cover change within the Project Area

This monitoring will be carried out by mapping the forest cover of the Project Area, using qualified and scientifically recognized data sources, such as PRODES and DETER, databases developed through the National Institute for Space Research, data made available by MapBiomas (collaborative network formed by NGO’s, universities and technology startups), among other qualified and recognized sources that can be used in the future. The choice of methodology for identifying and quantifying changes in land use must meet the requirements of quality of data and minimum accuracy, according to the indications of Methodology VM0015.

In addition, different classification techniques and visual interpretation can be used during the course of the Project, both to identify deforestation and forest degradation and to validate and refine secondary data, such as photointerpretation using high-resolution satellite images, alternative sensors and data collected in field. After collecting deforestation data, these will be compared with the baseline scenario, and the emission reduction values for the monitored period will be based on the comparison between expected deforestation and actual deforestation.

Monitoring of carbon stock changes

It is expected that the ex ante estimate of the carbon stock for the forest class does not change during the baseline period. However, Methodology VM0015 requests monitoring of the carbon stock in the Project Area subject to relevant decrease in the Project scenario in accordance with the ex ante assessment due to deforestation of areas subject to unplanned and significant decrease in the carbon stock in the Project scenario. Thus, the monitoring of changes (reduction) in the carbon stock of these areas will be carried out as follows:

These areas of unplanned deforestation are multiplied by the average carbon stock value in the initial forest class (Ctot) established as an indicator in the validation of the Project. The sum of residual emissions from the carbon stock below the ground and in dead wood is also considered, as these pools have an annual decay of 1/10, causing emissions over the years. Finally, the value of the estimated carbon stock for the Reference Region in a post-deforestation scenario is subtracted from this result, obtaining the net value of the carbon stock that was reduced by unplanned and unavoided deforestation. If there is a significant reduction in the carbon stock due to deforestation in the Project Area, this reduction will be presented in the verification processes using Table 29 of Approved Methodology VM0015 version 1.

Monitoring of non-CO2 emissions

Monitoring of non-CO2 emissions will be based on sources of secondary data from reliable bases, such as hot spots or fire scars. Complementarily, the technique of photointerpretation of high resolution images will be used for validation of secondary data, classification and quantification of affected areas. In order to verify the damage and recovery of vegetation over time, NDVI analyses will be carried out, and, when necessary, field checks of points of interest to assess vegetation in situ. If forest areas are affected, the possible reduction in the carbon stock caused by forest fires will be evaluated based on the multiplication of the mapped area of forest loss by the average forest carbon stock. If change is significant, it will be reported in the verification processes using Tables 25e, 25f and 25g of methodology VM0015 version 1.1.

Monitoring of natural disturbances and other catastrophic events

Carbon stock reduction and increase in GHG emissions, as well as significant carbon stock reductions caused by natural disturbances or catastrophic events will be tracked, monitored and reported similarly to non-CO2 emissions in the Project Area. Therefore, if there is a significant decrease in the carbon stock due to natural disturbances or catastrophic events, this reduction will be reported in the verification processes using Tables 25e, 25f and 25g of Approved Methodology VM0015 version 1.1.

d) Quality control and quality assurance procedures

In order to monitor the activities of Agropalma REDD+ Project, the activity of "Implementation, monitoring and evaluation of the activities developed" is foreseen, which will allow continuous monitoring of the Project, accompanied by evaluation processes, allowing the incorporation of learning and improvements and, consequently, quality assurance for the Project.

As described in the previous items, changes in carbon stock due to conversion of forested areas to non-forested areas by unplanned deforestation will be monitored. Likewise, changes in carbon stock due to uncontrolled forest fires and other catastrophic events will be monitored and discounted against the project scenario where they were significant. Monitoring quality control and assurance of these parameters will be carried out through the accuracy process indicated by methodology VM0015 version 1.1, which will be the same regardless of the type of data used in monitoring.

An analysis of general accuracy and the kappa index obtained from a confusion matrix such as Congalton's (1999) will be performed[93]. Through a geographic information system, at least 100 points will be generated and randomly distributed in the area of interest. Validation will be performed using high spatial resolution satellite images and/or data collected in field. The minimum mapping accuracy, according to VM0015, for each class or category in the land use and land cover map, must be 80%.

In addition to the accuracy process carried out, when necessary, field verifications will also be carried out in areas where unplanned deforestation events, uncontrolled forest fires and catastrophic events are identified.

e) Data archiving

[93] CONGALTON, R. G.; KASS GREEN. Assessing The Accuracy Of Remotely Sensed Data: Principles And Practices. New York – CRC Press, 1999.

Biofílica Ambipar Environmental will store all data and reports related to Agropalma REDD+ Project in digital files throughout the Project's duration. All documents related to the Project's monitoring will be made available to the auditors at each verification event.

f) Organization and responsibilities of the parties involved in all of the above points

The procedures described will be responsibility of the Project proponents: Biofílica Ambipar Environmental and Agropalma.

1.2 Leakage monitoring

Leakage monitoring by the Project involves two main scopes, which are:

i) changes in carbon stocks and GHG emissions associated with leakage prevention activities; and,

ii) changes in carbon stocks and GHG emissions associated with leakage from displacement of activities.

The procedures applied to this monitoring plan contemplate what is developed and applied within the perspective of the project, thus, within the scope ii) the monitoring of changes in GHG emissions derived from the burning of biomass was not contemplated, as it was not considered on the baseline.

Details on the monitoring of the two scopes are presented below.

a) Technical description of monitoring tasks

It is not expected that there will be any changes in the carbon stock and GHG emissions associated with leakage prevention activities, since there is no activity expected, such as intensive agriculture, management of pasture areas or forage production, which may alter the carbon stock and increase GHG emissions when compared to the baseline scenario.

However, although no stock reduction in leakage prevention activities is foreseen, should they prove necessary during Project implementation, the ex ante changes in carbon stock and GHG emissions associated with these activities will be estimated according to step 8 of Methodology VM0015. If results are significant, they will be monitored and data will be made available to verifiers at each verification event using Tables 30b, 30c, 31, 32 and 33 of Methodology VM0015 version 1.1.

Changes in carbon stock and GHG emissions associated with leakage from displacement of activities will be monitored using the same technique applied in monitoring changes in carbon stock due to conversion of forested areas to non-forested areas by unplanned deforestation in the Project Area.

Data/Parameter	Description	Unit	Source	Frequency
$\Delta BSLLK_{icl,t}$	Forest cover areas of the initial icl forest class converted to non-forest cover areas within the Leakage Belt in year t	ha (hectare)	Calculated using remote sensing and data available from reliable sources	Annual
$\Delta CADLK_t$	Total reduction in carbon stocks due to displaced deforestation in year t in the Leakage Belt	tCO_2-e	Calculated from the detected areas of forest loss in the Leakage Belt, the average carbon stock and the estimated loss in carbon stock projected by the baseline	Annual
$APSLK_{fcl,t}$	Portion of area within Leakage Management Areas with decreasing carbon stock in year t	ha (hectare)	Project activity follow-up report and other records related to leakage prevention activities	Only when applicable
$\Delta CLPMLK_t$	Decrease in carbon stock due to leakage prevention measures in year t	tCO_2-e	Calculated from the quantitative value of the area within the Leakage Management Areas with decreasing	Only when applicable

Data/Parameter	Description	Unit	Source	Frequency
			carbon stock, the initial average carbon stock and the estimated loss of carbon stock in the Leakage Belt projected by the baseline	
$EgLK_t$	Emissions from animals on pastures in the leakage management areas in year t	tCO_2-e	Existing records on the practice of grazing	Only when applicable
$EADLK_t$	Emissions from forest fires displaced to the Leakage Belt in year t of Agropalma REDD+ Project	tCO_2-e	Calculated using the areas affected by forest fires in the Leakage Belt and estimated average carbon stock for the initial land use class	Only when applicable

c) Brief description of data collection procedures

Changes in carbon stocks and GHG emissions associated with leak prevention activities

As explained in item a), it is not expected that there will be changes in the carbon stock and GHG emissions associated with leakage prevention activities, since no activity capable of altering the carbon stock and increasing GHG emissions is foreseen when compared to the baseline scenario. However, should such activities prove necessary, ex ante changes in carbon stock and GHG emissions associated with these activities will be monitored and data will be made available to auditors at each verification event using Tables 30b, 30c, 31, 32 and 33 of Methodology VM0015 version 1.1.

Monitoring, considering data collection procedures, will consider the following activities:

- List of leakage prevention activities;
- Production of a map showing the areas of intervention and the type of intervention;
- Recognition of areas where leakage prevention activities have an impact on the carbon stock;

- The existing non-forest classes in these areas in the baseline case will be identified;
Carbon stocks in the identified classes will be measured or a literature conservative estimate will be used;
- Changes in carbon stock in the leakage management areas under the project scenario will be reported using Table 30b of VM0015;
- Calculation of net changes in carbon stock caused by leakage prevention measures during the fixed period of the project baseline and crediting period;
- The calculation results will be reported by Table 30c of the approved Methodology VM0015.

Changes in carbon stock and GHG emissions associated with leakage from displacement of activities

These will be monitored through the same methods applied to monitor the conversion of forest areas to non-forest areas due to unplanned deforestation in the Project Area, that is, qualified and scientifically recognized sources will be used, such as PRODES, DETER and MapBiomas, in which quality of data and accuracy requirements will be used for evaluation. If in the Leakage Belt there is an event of deforestation larger than expected for the baseline scenario and it is attributed to agents of deforestation in the Project Area, the carbon stock losses will be accounted for and reported using either Table 22c or Table 21c of Methodology VM0015 version 1.1.

d) Quality control and quality assurance procedures

Quality control and assurance in relation to the monitoring of changes in the carbon stock and GHG emissions associated with leakage prevention activities will be determined according to the activity, if implemented. As for changes in the carbon stock and in the GHG emissions associated with leakage due to displacement of activities, they will be carried out through accuracy analysis, as indicated by methodology VM0015 version 1.1.
The classification accuracy analysis will be carried out through the analysis of general accuracy and the kappa index obtained from a confusion matrix such as that of Congalton and Green (2008), in which at least 100 points distributed randomly in relation to the analyzed area will be generated through a geographic information system. Validation will be performed using high spatial resolution satellite images and/or data collected in field. The minimum mapping accuracy, according to VM0015, for each class or category in the land use and land cover map, must be 80%.

e) Data archiving

Biofílica Ambipar Environmental will store all data and reports from Agropalma REDD+ Project in digital files during the entire duration of the Projects.
All documents relating to Project monitoring will be made available to auditors at each verification event.

f) Organization and responsibilities of the parties involved in all of the above points

The procedures described will be responsibility of the Project proponents: Biofílica Ambipar Environmental and Agropalma.

1.3 Monitoring ex post reductions in net anthropogenic GHG emissions
Details on monitoring are presented below.

a) Technical description of monitoring tasks
In the verification procedures, results will be represented using Table 36 of Methodology VM0015 version 1.1, together with spatial data (deforestation maps, when available).
A map showing the cumulative areas credited within the Project Area will be updated and presented to VVB at each verification event.

b) Data to be collected

Data/Parameter	Description	Unit	Source	Frequency
ΔREDD,t	Reductions in net GHG emissions attributable to Project AUD activities year t	tCO_2-e	Calculated by subtracting ex post carbon stock changes from the baseline scenario	Annual

Data/Parameter	Description	Unit	Source	Frequency
VCU,t	Number of Verified Carbon Units (VCU's) to be made available for commercialization in year t	tCO_2-e	Calculated by subtracting ex post Project net GHG emission reductions from the buffer	Annual

PARTE 2. MONITORING BASELINE PROJECTIONS IN THE FUTURE

2.1 Updating information on agents, drivers and underlying causes of deforestation

The Project baseline will be updated and used in revising the baseline projections after a fixed period of 6 years, in addition to statistical and spatial data, studies and information on agents, motivations and underlying causes of deforestation necessary to carry out the Steps 2 and 3 of Approved Version of Methodology VM0015.

2.2 Updating the baseline land use change and land cover component

The Project will monitor updates regarding the national and sub-national baselines, and thus, will apply if improvements compatible with the rigor applied to the Project are verified. Otherwise, step 4 of Methodology VM0015 will be redone considering the period of the last 6 years and using updated variables on the agents, drivers and underlying causes of deforestation in the Reference Region. The area of annual deforestation and the location of deforestation in the baseline are the two main components to be reviewed.

Assumptions and hypotheses considered in modeling the dynamic component of future deforestation (population data) as well as data used in the spatial projection (update of roads, location and distance of new deforestation) will be reviewed and updated.

2.3 Baseline carbon component update

According to the results generated during changes in the carbon stock monitoring processes throughout the Project, the spatial estimate of the carbon component can be revised in Methodology VM0015 version 1.1, Part 3, item 1.1.3. Thus, if there are more accurate estimates from the use of techniques such as LIDAR or SAR interferometric data, they will be applied to the baseline revisitation period.

3.3.4 Dissemination of Monitoring Plan and Results (CL4.2)

The monitoring plan, as well as the results obtained by monitoring Agropalma REDD+ Project, will be made available to the public through a page on the official website of Biofílica Ambipar Environmental Investments. The summarized documents referring to the monitoring plan and results, as well as relevant information, will be made available to communities and stakeholders through meetings, lectures and by physical means on the premises of Agropalma Farm.

3.4 Optional Criterion: Climate Change Adaptation Benefits

Under development.

3.4.1 Regional Climate Change Scenarios (GL1.1)

Under development.

3.4.2 Climate Change Impacts (GL1.2)

Under development.

3.4.3 Measures Needed and Designed for Adaptation (GL1.3)

Under development.

4 COMMUNITY

4.1 Without-Project Community Scenario

4.1.1 Descriptions of Communities at Project Start (CM1.1)

As mentioned in Section 2.1.9, the 23 communities identified around the Project Area are categorized as traditional communities (6 communities); family farmers (8 communities); occupation areas (4 communities); land reform settlements (3 communities); and urban centers (2 communities).

The emergence of these communities, in general, happened around the 1960's, and the occupation of the areas is strongly impacted by the PA-150 Highway, with migratory processes of workers coming, both from other municipalities in the state itself, and from the Northeast region in search of land and opportunities arising from the large government projects of the 1970's, the exploitation of natural resources (wood), agriculture (cocoa) and the implementation of agricultural companies (Agropalma and Brasil Biofuels - BBF), which employ the population around their oil palm production areas as workforce.

From the interviews conducted during the Socio-Economic Diagnosis, it appears that men are in the majority in relation to women, with 58% of the total number of people interviewed in the communities. Women represent 42% of the total number of people interviewed and carry out domestic activities, take care of children and, in some cases, contribute to the planting and harvesting of subsistence crops such as rice, corn and cassava.

With regard to age distribution, 44% of respondents are aged between 31 and 50 years old, followed by the ranges from 51 to 65 years old (29%), from 21 to 30 years old (14%), 66 years old or more (11 %) and, finally, up to 20 years old (2%).

Of the 338 people interviewed, 53% came from other municipalities in the state of Pará, which are located in the area surrounding the project, and others from municipalities such as Belém, Bragança and São Miguel do Guamá. About 28% of them are from other states, especially those in the Northeast region, such as Maranhão and Ceará. The others are from another community (2%), from the community itself (2%) or did not inform (15%). This formation results, to a large extent, from the internal and external migration process to the state caused by the beginning of investments made in large projects in the Amazon, and in the case of the Northeast region of Pará, there is also the contribution of the advancement of transport infrastructure and ports.

Distribution of the respondents' education level indicates that there is a low level of education in the communities, since, when accumulating the respondents with complete and incomplete primary education, we have 61.0% of the total number of people. Only 16% have completed high school and 5% have not finished high school. There are also illiterate people (6%). Those with a technical course represent 2%, as well as those with incomplete higher education (2%), followed by those with complete higher education (8%).

As for income, 46.0% of respondents have a family income of less than one minimum wage, and 37.0%, from one to less than two. Therefore, 83.0% of respondents earn less than two minimum wages. This shows the income vulnerability of most people residing in the communities.

The main productive activity carried out by respondents is agriculture, with 40.7% of the cases, followed by wage earners (14.8%), public servants who work in schools and in the health sector (12.2%), people who work in commerce (12.6%), those who receive benefits such as the *Auxílio Brasil* (8.4%), and retirees (6.6%).

There are cases in which the family income is formed by the combination of more than one activity such as agriculture, social benefit and retirement.

With regard to public services provided in communities, such as health, education and sanitation, in general, they are non-existent or precarious, with inadequate infrastructure, causing residents to move from one community to another in search of better service conditions. Electricity and cell phone services, in turn, were considered good or fair by most communities.

4.1.2 Interactions between Communities and Community Groups (CM1.1)

There is a relationship/interaction between community groups and entities/institutions in all communities, with emphasis on actions to integrate family farmers with oil palm companies.

Interaction with community groups is observed in the following communities: Nova Paz, Olho D'água, Betânia, Calmaria II, Calmaria I, Forquilha, Arauaí, Boa Esperança, Sempre Alegre, Nova Esperança, Turi-Açu, and Urucuré. This interaction aims at the participation of producers from neighboring communities in production activities and transfer of agricultural practices; for mutual aid in the production of flour; and collaboration between the Catholic and Evangelical churches present in the communities.

However, only 20.0% of rural landowners participate in some type of associative entity, which may be a threat to the Project, since the disarticulation between producers makes it difficult to define actions and implementation of projects, since this interest group is dispersed with a low level of trust between producers and representatives of these associative entities.

4.1.3 High Conservation Values (CM1.2)

The concept of High Conservation Values (HCV) was developed by the Forest Stewardship Council (FSC, 1996)[94] for the certification of wood products derived from responsible forest management, according to standardized Principles and Criteria that reconcile environmental and ecological safeguards with social benefits and economic viability (FSC, 2014)[95].

High Conservation Value Areas (HCVA) are those that have extreme or critical importance due to some particular characteristic, such as a significant concentration of biodiversity, seasonal concentration of species,

[94] FOREST STEWARDSHIP COUNCIL (FSC). FSC principles and criteria for forest stewardship. FSC-STD-01-001 (version 4-0) EN. FSC, Bonn. 1996.
[95] FOREST STEWARDSHIP COUNCIL (FSC). Indicadores genéricos internacionais. FSC-STD-BRA-01-004. V1-0 PT. FSC, Bonn. 2014.

threatened and rare ecosystems, presence of endangered species, provision of essential ecosystem services, social, historical and cultural values, among others. Within this context, as defined by the HCV Resource Network, there can be six types of high conservation values, one of which is directly related to the surrounding communities:

HCV 4: Basic ecosystem services in critical situations, including protection of water sources and erosion control on vulnerable soils and slopes.

For this definition, the concepts defined in the General Guide for the Identification of High Conservation Values (HCV) were used, which is a guide for the interpretation of HCV definitions and their identification in practice, to achieve a standardization in the use of this approach. The document can also help developers of National HCV Interpretations by providing a reference to adapt definitions, data sources and examples in national contexts.

High Conservation Value	Areas of natural vegetation in the Project Area/Zone
Qualifying Attribute	Areas with natural vegetation cover that provide essential ecosystem services to the surrounding communities, helping to maintain the quantity (availability) and quality of water and soil, as well as contributing to improving air quality and thermal comfort
Focal Area	Vegetation areas in the Project Area and Zone help maintain the quantity and quality of water for the surrounding areas, used by the communities, as well as contribute to improving air quality and thermal comfort. Therefore, they need continuous monitoring to verify the maintenance of the environment's structure. The surveillance actions carried out on the farm help to contain illegal entry and extraction of resources

4.1.4 Without-Project Scenario: Community (CM1.3)

Current socio-economic indicators characterize a region with low conditions of well-being for communities, low education, lack of representative organization and with few productive economic alternatives. From this, some scenarios may lead to the advance of deforestation in the region.

- Political-Social: the absence of public power leads to difficulty in accessing public policies that guarantee goods and services, health services, communication, infrastructure such as roads and accesses; non-compliance with environmental legislation; and the absence of property rights. The lack of representativeness

structures weakens social relations and hinders the formation of cooperatives. Thus, there is institutional insecurity, increase in violence, and the consequent maintenance of conditions of social fragility.

- Levels of education: low levels of education represent a perpetuation of current conditions, with social fragility, deforestation, absence of the institutional structure of the state and violence. Increase in the level of schooling, both fundamental and higher, may promote the generation of diversified income for communities, in addition to expanding knowledge and training of specialized labor, thus allowing the implementation of new production methods, which allow sustainable and more profitable exploitation of natural resources.

- Economic activities: economic activities, mainly related to agriculture, are carried out with the absence of technologies and good production practices, which contributes to deforestation in the region. Small producers use the traditional slash-and-burn technique, with difficulties in including products such as acai berries, cocoa, palm oil and black pepper in the value chains. The lack of a structure that allows the organization of productive structures hinders the processing, commercialization and profitability of these activities. Reinforcing the cycle of low productivity, the search for new areas and the implementation of extensive livestock is justified.

The use of new planting techniques and the implementation of processing of agricultural products, including the establishment of cooperatives, are options that will allow the population to overcome the conditions of poverty and extreme poverty observed, control the prices practiced, increase the added value of products, generate new employment and income options. In addition, the industry's participation in local society can be increased, with an increase in technology and knowledge.

That said, it is possible to see that the region's socio-economic and infrastructure conditions can encourage illegal activities, such as the predatory extraction of wood and non-timber forest products, in addition to illegal hunting and fishing, leading to a series of negative impacts on ecological processes. of the forest and the depletion of natural resources of interest (Asner et al., 2009)[96]. It is also confirmed that agricultural activities with traditional techniques of slashing and burning, other agricultural crops, monocultures, extensive livestock and logging and non-logging exploitation are the basis of subsistence, and may represent the greatest potential for processes to increase deforestation.

In this scenario, considering no significant improvement in public management models, the tendency would be for the deforestation rate to remain the same or to increase, and with that the socio-economic context shown above would remain stagnant or would worsen due to the demographic increase and the increase in pressures from hidden causes of deforestation. In the hypothesis of a catastrophic scenario, it is possible that

[96] Asner, G.P., Rudel, T.K., Aide, T.M., Defries, R., Emerson, R., 2009. A contemporary assessment of change in humid tropical forests. Conserv. Biol. J. Soc. Conserv. Biol. 23, 1386–1395. https://doi.org/10.1111/j.1523-1739.2009.01333.

in the situation of the communities surrounding Agropalma REDD+ Project, the indicators of deterioration in the questions may deepen.

a) Social: continuity of levels of education, health, access to public policies that guarantee goods and services, communication, infrastructure such as roads and accesses, in an incipient way. Increased violence and social insecurity;

b) Economic: stagnation and decrease in family income, agriculture and alternatives to promote diversification and verticalization of production, production flow, in addition to the lack of sustainable production. Difficulty in implementing new technologies, options for processing the generated products;

c) Environmental: forest degradation, potential invasions by illegal loggers, looting of existing natural resources, in addition to increase in illegal hunting and fishing. Failure to comply with current legislation and lack of inspection.

In the scenario with the presence of Agropalma REDD+ Project, communities may be seen with increased levels of socio-economic conditions, reaching levels of development from production to access to public policies that guarantee the continuity of families in the communities, avoiding rural depopulation. In addition, with the Project and based on the promotion of the proposed activities, an innovation process is created in the sense of developing a strategy for a business structure with social impact, generating a favorable and sustainable business.

4.2 Net Positive Community Impacts

4.2.1 Expected Community Impacts (CM2.1)

Positive impact

Community groups	Communities surrounding the Agropalma Farm with predominance of family farmers: - Betânia - Sempre Alegre - Forquilha - Igapó Açu - Ipiranga - Jupuuba - Nova Paz

	- Santo Expedito
Impact(s)	- Strengthening of human capital based on access to training, capacity building and technical assistance to encourage sustainable and adaptive agricultural production practices and models; - Strengthening of capital stock; - Integration in value chains; - Environmental awareness and permanence of families on their lands; - Income generation and diversification.
Type of benefit/cost/risk	• Expected benefits: - Direct and indirect positive impact on the community; • Costs: - Human and physical resources related to qualification actions, training and technical assistance;
Changes in Well-being	- Income improvement; - Food security; - Territorial belonging

Community groups	Communities surrounding the Agropalma Farm with a predominance of traditional populations: - Arauaí - Cipoteua - Gonçalves - Jandira - Nazaré Aui-Açu - Soledade
Impact(s)	- Strengthening of human capital based on access to training, capacity building and technical assistance to encourage sustainable and adaptive agricultural production practices and models; - Strengthening of capital stock; - Integration in value chains; - Environmental awareness and permanence of families on their lands; - Income generation and diversification.
Type of benefit/cost/risk	• Expected benefits: - Direct and indirect positive impact on the community;

	• Costs: - Human and physical resources related to qualification actions, training and technical assistance;
Changes in Well-being	- Income improvement; - Food security; - Territorial belonging

Community groups	Communities surrounding the Agropalma Farm with predominance of populations in occupation areas and settlements: - Boa Esperança - Nova Esperança - São Francisco de Assis - Urucuré - Calmaria II - Calmaria I - Olho D'água
Impact(s)	- Strengthening of human capital based on access to training, capacity building and technical assistance to encourage sustainable and adaptive agricultural production practices and models; - Strengthening of capital stock; - Integration in value chains; - Environmental awareness and permanence of families on their lands; - Income generation and diversification; - Environmental education and awareness against the hunting of wild animals
Type of benefit/cost/risk	• Expected benefits: - Direct and indirect positive impact on the community; • Costs: - Human and physical resources related to qualification actions, training and technical assistance;
Changes in Well-being	- Income improvement; - Food security; - Territorial belonging

Community groups	Communities surrounding the Agropalma Farm with a predominance of populations in urban centers: - Palmares - Turi-Açu
Impact(s)	- Strengthening local governance; - Empowerment of local leaders; - Environmental awareness and permanence of families on their lands; - Environmental education and awareness against the hunting of wild animals
Type of benefit/cost/risk	• Expected benefits: - Direct and indirect positive impact on the community; • Costs: - Human and physical resources related to qualification actions, training and technical assistance;
Changes in Well-being	- Territorial belonging; - Valuing and strengthening social relationships; - Representativeness in decision-making

Negative impact

Community groups	Communities that practice extractivism in community forest areas or on Agropalma Farm: - Arauaí - Betânia - Nazaré Aui-Açu - Boa Esperança - Nova Esperança - Gonçalves
Impact(s)	- Restricting access to non-timber forest resources - Decrease in food and income diversity
Type of benefit/cost/risk	• Risk: Direct negative impact - Restricting access of families, mainly from Boa Esperança community, to the forest areas of Agropalma Farm for the practice of extracting non-timber forest products. • Risk: Indirect negative impact

	- Increased pressure for deforestation of community forest areas
Changes in Well-being	- Decrease in food diversity; - Possible decrease in income

4.2.2 Negative Community Impact Mitigation (CM2.2)

As mentioned in the section above (Section 4.2.1), Agropalma REDD+ Project does not have significant negative impacts on the well-being of most local communities surrounding the Project Area. However, as mentioned, some communities practice extractivism as a supplementary form of income or to obtain food diversity, using community forests or forests in private areas. Among them, Boa Esperança community may be negatively impacted due to the restriction of access to Agropalma Farm's forest resources, since, as reported in the socio-economic and environmental diagnosis (SEED), some families from this community enter the Farm's area to collect fruits, nuts or seeds. Another risk would be the increased pressure for deforestation in the surrounding forest areas, due to possible displacement of deforestation agents, limiting the availability of forest resources for dependent families.

Still, other potential risks are the lack of interest from other stakeholders, decrease in population numbers due to rural exodus and lack of commitment by communities to participate in the Project.

In order to mitigate these risks, some measures can be taken, such as the consolidation of mechanisms that promote transparency and encourage the involvement of all parties involved in the decision-making processes of Project activities, in addition to improving the communication tools already existing for improvement of social relations between proponents and impacted parties.

With regard to the risks and negative impacts raised, a mitigating measure is to prioritize the involvement of the most affected communities in alternative activities such as the promotion of diversified and sustainable agricultural production practices and models, the development and strengthening of value chains for agricultural products or forestry, which aim to guarantee income and food security, while minimizing possible negative impacts and reducing the pressure for deforestation.

Regarding the maintenance and improvement of the Area of High Conservation Value (AAVC), actions were proposed with the purpose of protection and conservation of forest areas in order to guarantee essential ecosystem services to the communities (AAVC 4). Thus, these actions include the strengthening of patrimonial vigilance in the Project Area and the encouragement of alternative economic activities that reduce the pressure for deforestation and degradation of these priority areas for conservation, either by promoting sustainable agricultural practices or by developing and strengthening value chains for local products.

Finally, the strengthening of asset surveillance, with actions that prevent deforestation and forest degradation, such as remote and continuous monitoring and the presence of forest watchmen, help maintain the forest cover in the Project Area and generate essential ecosystem services for the survival of surrounding communities.

4.2.3 Net Positive Community Well-Being (CM2.3, GL1.4)

Agropalma REDD+ Project, through the proposed activities, encourages socio-economic and sustainable development of the communities involved, focusing on training, qualification and assistance for the promotion of sustainable practices and production models, in the development and strengthening of value chains and in the engagement through a mechanism of transparency, communication and encouragement of collective participation in the actions developed by the Project.

In the scenario without the Project, as described in Section 4.1.4, the low-income context, lack of access to public policies and other services, make families belonging to the communities seek alternatives to increase their income, based on economic activities and livelihood practices practiced in an unsustainable and unplanned way.

Based on this scenario, the Project plans to create opportunities for the communities, causing the following net positive impacts:

• Encourage the adoption of diversified and adaptive agricultural production models that integrate protection of forest resources with sustainable production, ensuring food security for families;

• Increase community engagement based on their participation in Project activities, in addition to promoting actions to strengthen local governance and empower local leaders;

• Strengthening skills, knowledge and human capabilities related to sustainable economic activities, management and productive organization, in order to develop and strengthen value chains;

• Increase levels of knowledge about sustainable practices, such as hunting and fishing activities, promoting the protection and conservation of forest cover and biodiversity, promoting alternative means of subsistence and income generation for impacted families;

• Permanence of families in communities;

• Implementation of strategic partnerships for the on-site execution of the proposed actions.

The main problems that will be faced in this context are:

• Low access to public policies related to goods, basic services and infrastructure;

• Unsustainable economic activities, with low technology, productivity and little assistance;

• Difficulty in mobility and access;

Thus, the Project intends to influence the social issues and the living conditions of communities surrounding the Project area, in order to reduce social vulnerability and rural exodus of those families that make up the surrounding communities, providing improvement in the quality of life and income stability, in addition to allowing conditions for access to goods and services that promote economic and social well-being.

4.2.4 High Conservation Values Protected (CM2.4)

So far, during the preliminary assessment conducted with the SEED studies (socio-economic and environmental diagnosis), no negative impacts were identified on high conservation value attributes related to social issues (HCV 4 – Section 4.1.3). However, if these are identified in the future, measures must be taken to ensure that there are no net negative impacts on the attributes.

To ensure that no HCV related to the well-being of communities will not be negatively affected, the activities proposed by the Agropalma REDD+ Project, incorporate measures and actions with the purpose of protection and conservation of forest areas in order to guarantee the essential ecosystem services to the communities, which will be contemplated by the activities designed for the Project (Section 2.1.11).

4.3 Other Stakeholder Impacts

4.3.1 Impacts on Other Stakeholders (CM3.1)

For Agropalma REDD+ Project, significant negative impacts on other stakeholders are not expected. However, any possible negative impacts of these activities are unlikely and could be:

- Lack of engagement of communities and other actors in Project activities and other articulations;

- Failure to communicate the Project's actions and establishment of possible conflicts arising from the implementation and conduct of activities.

However, it is possible to observe positive impacts of the project, which can bring well-being to other actors, such as:

- All local communities, as well as other actors residing in the project region, whether or not participating in project activities, will benefit from all the positive impacts related to the conservation and protection of forest cover and biodiversity;

- All communities and other actors will benefit from sustainable development, as well as from the opportunities generated by the Project's activities, improving the quality of life and well-being;

- All stakeholders in the region will benefit not only from project activities, but also from the expected positive impacts such as strengthening local governance and increasing social and human capital;

4.3.2 Mitigation of Negative Impacts on Other Stakeholders (CM3.2)

As mentioned above, significant negative impacts on other actors in this Project are not expected. However, mitigating measures include the implementation of a transparency mechanism, communication and consultation channels, seeking to map and engage potential stakeholders not directly impacted by the Project.

4.3.3 Net Impacts on Other Stakeholders (CM3.3)

As described and detailed in Section 4.3.1, significant negative impacts on the well-being of other groups of local actors are not foreseen, since the activities to be carried out foresee articulation with government agencies and other local institutions precisely for the promotion of improvement in local living conditions, greater access to public policies, in addition to activities related to improving practices already carried out and the implementation of transparency and consultation mechanisms. Thus, the activities outlined and proposed for this Project aim only at impacts that promote the inclusion and well-being of communities and other parties involved, while at the same time making it possible to minimize possible risks to other stakeholders and the communities directly involved.

4.4 Community Impact Monitoring

4.4.1 Community Monitoring Plan (CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

Monitoring the Project's impacts on communities and other actors is an important management tool, enabling assessment of the effectiveness of activities in achieving the proposed objectives. In this sense, it is suggested the development of a monitoring system for the Project, based on the goals foreseen for the construction of indicators to be collected, on the verification tools and on the procedures of analysis and assessment of results and evaluation, when necessary, to indicate the essential measures to improve the intended advances.

Monitoring benefits to communities has three components:

- Strengthening of local governance, in which actions that seek to strengthen capital stock in communities will be implemented and monitored, in addition to ensuring collective engagement and transparency in the execution of activities proposed by the Project, as well as monitoring risks and improvements related to them;

- Promotion of sustainable agricultural practices, which seeks to encourage the implementation of sustainable practices and production models adapted to local demands, which may be related to the needs of stakeholders, as well as promoting training and other actions within the defined and mapped target audience, in addition to seeking strategic partnerships to support the development of activities;

- Development of value chains, which aims to map the main development opportunities based on sustainable practices, promote strategies to facilitate the process of commercialization and appreciation of local production, in addition to seeking strategic partnerships to support the development of activities.

The Monitoring Plan for Impacts on Communities essentially covers process indicators and part of result indicators. It is intended, subsequently, to carry out the complementation of this initial monitoring plan, with the need for its evaluation and validation by stakeholders.

a) Data to be collected

Data / Parameter	Number of partnerships established
Data unit	Number
Description	This parameter aims to measure the number of partnerships that the Project carries out throughout its life cycle to contribute to the development and improvement of actions and activities linked to the Project's social activities.
Source of data	Reports (e.g. follow-up report of project activities that have been implemented), contracts, memos, emails, meeting minutes and/or other supporting documents as evidence that a partnership has been established and built
Description of measurement methods and procedures to be applied	All documents produced will be stored in digital files throughout the crediting period of the Project. In this way, the creation of partnerships linked to the Project's social activities will be monitored and accounted for
Frequency of monitoring/recording	At every verification event
Value applied	To be accounted for after the start of the Project

Monitoring equipment	Not applicable
QA/QC procedures to be applied	Systematized information from partnerships established for social activities will be validated by proponents, allowing greater reliability and quality of data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Demonstrate that the Project is dedicating itself and expanding its activities in its social scope through partnerships carried out
Calculation method	Not applicable
Comments	

Data / Parameter	Number of beneficiaries
Data unit	Number
Description	This data will account for any person that has managed, through the planned actions and activities related to the Social Scope, to benefit from the implementation and monitoring of such Project.
Source of data	Reports (e.g. activity monitoring report), interviews, feedback on results and/or consultations, attendance lists, presentations, and other documents that corroborate as evidence that a person, whether community member or not, has benefited from the Project
Description of measurement methods and procedures to be applied	All documents produced will be stored in digital files throughout the crediting period of the Project. In this way, information on the people benefited by the activities of the Social Scope of the Project will be monitored and the amount accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable

QA/QC procedures to be applied	The systematized information of the people benefited by the social activities will be validated by proponents, allowing for greater reliability and quality of data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Data / Parameter	Number of qualifications
Data unit	Number
Description	This parameter aims to measure the number of courses, qualifications and training carried out in the social activities proposed by the Project
Source of data	Reports (e.g. follow-up report of project activities that were implemented), attendance lists of participants, contracts, photos, among other documents
Description of measurement methods and procedures to be applied	All documents produced will be stored in digital files throughout the crediting period of the Project. In this way, the qualifications, courses and training carried out by the activities of the Social Scope of the Project will be monitored and accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	The systematized information on qualifications, courses and training proposed by the social activities will be validated among the proponents, allowing for greater reliability and quality of data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements

	in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Data / Parameter	Number of governance structures built
Data unit	Number
Description	This parameter aims to measure the number of both formal and informal governance structures that were implemented as a direct or indirect result of the “Strengthening of local governance” activity within Social Scope
Source of data	Reports (e.g. activity monitoring report), contracts, memos, emails, meeting minutes and/or other supporting documents as evidence that some local governance structure has been implemented
Description of measurement methods and procedures to be applied	All documents produced will be stored in digital files throughout the crediting period of the Project. In this way, the construction of governance structures linked to the Project's social activities will be monitored and accounted for
Frequency of monitoring/recording	At every verification event
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	The systematized information on the governance structures developed and built will be validated among the proponents, allowing for greater reliability and quality of data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project

Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Data / Parameter	Area with adoption of sustainable agricultural production practices and models
Data unit	m^2
Description	This parameter aims to measure the amount of area in which sustainable practices and models of agricultural production occur and that have been implemented through the activity of "Promotion of sustainable agricultural practices" within the Social Scope of the Project
Source of data	Reports (e.g. activity monitoring report), contracts, maps, photographs, geographic data, meeting minutes and/or other documents that corroborate as evidence that sustainable agricultural practices and production models are being implemented
Description of measurement methods and procedures to be applied	All documents produced will be stored in digital files throughout the crediting period of the Project. In this way, the areas with the adoption of sustainable practices and production models linked to the Project's social activities will be monitored and accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	The systematized information on the areas with the adoption of sustainable production practices and models will be validated among the proponents, allowing for greater reliability and quality of the data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and,

	when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Data / Parameter	Percentage of families inserted in production and commercialization structures
Data unit	%
Description	This parameter aims to measure the percentage of families benefited by the Project that are inserted in production and commercialization structures (cooperatives, value chains, local productive arrangements, etc) as a direct and indirect result of the "Development and strengthening of value chains" activity within the social scope of the Project
Source of data	Reports (e.g. activity monitoring report), contracts, meeting minutes and/or other documents that corroborate as evidence that a person, whether community member or not, has benefited from the Project and is inserted in collective structures of production and commercialization
Description of measurement methods and procedures to be applied	All documents produced will be stored in digital files throughout the crediting period of the Project. In this way, information on the people benefited by the activities of the Social Scope of the Project and inserted in collective structures of production and commercialization will be monitored and the amount accounted for
Frequency of monitoring/recording	Annual
Value applied	To be accounted for after the start of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	The systematized information of the families benefited by the social activities that are inserted in structures of production and commercialization will be validated among the proponents, allowing

	for greater reliability and quality of the data. In addition, the Project will undergo continuous evaluation of information generated, through the identification of improvements in the collection and registration processes and, when applicable, the incorporation of adjustments in the strategic planning of the Project
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

b) Summary of data collection procedure

Data will be collected during and after activities with stakeholders, as well as whenever a dialog is established with a possible local partner responsible for developing an activity in locu. This information will be systematized and presented through reports of the Project's social activities.

c) Quality control and assurance procedures

Data collected and portrayed in the reports will be presented and validated during the meetings between proponents and potential partners, as well as in the meetings with stakeholders to present the results achieved by the Project.

d) Data archiving

All data and reports produced by Agropalma REDD+ Project will be stored by Biofílica Ambipar Environmental Investments through digital files during the life cycle of the Project. Original (physical) reports, minutes of meetings and field files produced during the execution of social activities will be stored by Agropalma, as well as by a possible local partner acting in locu. Biofílica Ambipar Environment Investments will keep a copy of these documents in digital format during the Project. All documents relating to Project monitoring will be made available to the verification body at each verification event.

e) Organization and responsibilities of the parties involved in the above

All monitoring activities are responsibility of Biofílica Ambipar Environmental Investments, Agropalma and any possible local partner.

4.4.2 Monitoring Plan Dissemination (CM4.3)

The monitoring plan, as well as the results obtained by monitoring Agropalma REDD+ Project, will be made available to the public through a page on the official website of Biofílica Ambipar Environmental. The summarized documents referring to the monitoring plan and results, as well as relevant information, will be made available to communities and stakeholders through meetings, lectures and by physical means on the premises of Agropalma Farm.

4.5 Optional Criterion: Exceptional Community Benefits

Not applicable. Agropalma REDD+ Project does not intend to be validated for the gold level of this section.

4.5.1 Exceptional Community Criteria (GL2.1)

Not applicable.

4.5.2 Short-term and Long-term Community Benefits (GL2.2)

Not applicable.

4.5.3 Community Participation Risks (GL2.3)

Not applicable.

4.5.4 Marginalized and/or Vulnerable Community Groups (GL2.4)

Not applicable.

4.5.5 Net Impacts on Women (GL2.5)

Not applicable.

4.5.6 Benefit Sharing Mechanisms (GL2.6)

Not applicable.

4.5.7 Benefits, Costs, and Risks Communication (GL2.7)

Not applicable.

4.5.8 Governance and Implementation Structures (GL2.8)

Not applicable.

4.5.9 Smallholders/Community Members Capacity Development (GL2.9)

Not applicable.

5 BIODIVERSITY

5.1 Without-Project Biodiversity Scenario

5.1.1 Existing Conditions (B1.1)

The Forestry Reserves areas of Agropalma S/A are located in the Eastern portion of the Amazon, in one of the eight Amazon Endemism Centers, the Belém Endemism Center, a portion with the highest deforestation rates in the whole place (Almeida-Maués et al., 2022)[97]. Belém Endemism Center is bordered by Tocantins River and the East bank of Gurupi River and less than 20% of its original primary vegetation remains, which are protected under some type of legislation (Almeida-Maués et al., 2022).

The clipping of the project's reference region with information from the IBGE database containing the classification of vegetation types, updated in 2021 and produced at the scale of 1:250,000, indicates that the predominant native vegetation in the region is the Dense Ombrophylous Forest of the Lowlands, concentrating its more preserved part without secondary activities in the Southwest region. Then, there is the Alluvial Dense Ombrophylous Forest, Campinarana and Submontane Dense Ombrophylous Forest.

Still, a large part of the existing vegetation occurs simultaneously with some activity (agriculture, farming and livestock) or with secondary vegetation, where there is a predominance of the Dense Ombrophylous Forest of the Lowlands with secondary vegetation in 59.29% of the studied area.

In this context, the areas of Agropalma S/A Forest Reserves are important habitat for several endemic species of the Eastern Amazon.

Flora

Data analysis for the phytosociological study was carried out based on the results of the forest inventory carried out to estimate carbon by the Biodendro Team, obtained from the sampling technique with identification of popular names (vernacular), in 2022. Ten clusters were randomly installed in the Project Area, each with 4 plots of 2,000 m², totaling 80,000 m² (8 hectares) sampled. Plots were subdivided into 4 subplots of 500 m², in which individuals were sampled considering different inclusion criteria, according to the DBH

[97] Almeida-Maués, P.C.R., Bueno, A.S., Palmeirim, A.F., Peres, C.A., Mendes-Oliveira, A.C., 2022. Assessing assemblage-wide mammal responses to different types of habitat modification in Amazonian forests. Sci. Rep. 12, 1797. https://doi.org/10.1038/s41598-022-05450-1

measurement. In this study, data from individuals sampled in the 4 sub-plots of 20 m x 25 m of the 10 clusters were used, in which all trees with DBH above 5 cm were surveyed, totaling 20,000 m² of sampled area.

In this survey, 2,623 tree individuals (1,311.5 ind.ha^{-1}) were sampled, distributed in 36 botanical families and 199 species. Of these, 15 were identified at the gender level and 79 individuals were not identified.

Altogether, considering the information from the SpeciesLink website database for the study area and those surveyed in field, 631 species were counted, distributed in 66 botanical families. In the context of phytogeographic distribution, 370 species (58.63%) are exclusive to the Amazon Forest domain.

Regarding endemism, it was possible to observe that 53 species (8.39%) recorded in the study area are restricted to Pará and the Amazon biome (FORZZA et al. 2012)[98], with 21 species being registered in the primary surveys carried out in the study area.

Only two rare species were registered for the studied community, namely *Hevea camargoana* Pires (Euphorbiaceae), species registered in SpeciesLink; and *Raputia amazonica* (Huber) Kallunki (Rutaceae), found in the survey carried out by Grupo Agroplama (2014).

Regarding endangered flora species, 12 species are classified in some threat category according to the official federal list (MMA, 2014); 17 according to the Red list (CNCFlora, 2018); and 8 endangered species according to the List of Threatened Species in the State of Pará, 6 of them with confirmed occurrence in Agropalma area, as shown in Table XX below.

Table 47 - List of species classified as threatened with confirmed occurrence in dense forest located in the Sustainable Production Area of Palm Agropalma, and of probable occurrence, located in the municipalities of Moju, Acará, Tailândia and Tomé Açú in Pará, Brazil, categorized according to Family, Scientific name and threat category. Key: Threat category (Ca); critically endangered (CR); endangered (EN); vulnerable (VU); near threatened (QA) (NT); safe or least concern (LC); data not available (DD)

[98] FORZZA, R.C.; LEITMAN, P.M.; COSTA, A.F.; CARVALHO JR., A.A.; PEIXOTO, A.L.; WALTER, B.M.T.; BICUDO, C.; ZAPPI, D.; COSTA, D.P.; LLERAS, E.; MARTINELLI, G.; LIMA, H.C.; PRADO, J.; STEHMANN, J.R.; BAUMGRATZ, J.F.A.; PIRANI, J.R.; SYLVESTRE, L.; MAIA, L.C.; LOHMANN, L.G.; QUEIROZ, L.P.; SILVEIRA, M.; COELHO, M.N.; MAMEDE, M.C.; BASTOS, M.N.C.; MORIM, M.P.; BARBOSA, M..; MENEZES, M.; HOPKINS, M.; SECCO, R.; CAVALCANTI, T. B. & SOUZA, V.C. 2012. Introdução. In: Lista de Espécies da Flora do Brasil. Jardim Botânico do Rio de Janeiro. URL http://floradobrasil.jbrj. gov.br/2012/ (accessed 04.02.22)

		Ocorrência confirmada		Provável Ocorrência	Listas de Ameaça de Extinção (Ca)		
Família	Espécie	Agropalma	Biodendro	SpeciesLink	CNCFlora, 2018	MMA, 2014	Pará, 2009
Apocynaceae	***Aspidosperma desmanthum* Benth. ex Müll. Arg**	x		x	LC	-	VU
Apocynaceae	*Aspidosperma sandwithianum* Markgr.			x	DD	-	VU
Bignoniaceae	*Handroanthus impetiginosu* s (Mart. ex DC.) Mattos			x	NT	-	
Fabaceae	*Albizia decandra* (Ducke) Barneby & J.W.Grimes			x	NT	-	
Fabaceae	***Hymenaea parvifolia* Huber**	x	x	x	VU	VU	
Fabaceae	*Hymenolobium excelsum* Ducke			x	VU	VU	VU
Fabaceae	***Vouacapoua americana* Aubl.**	x	x	x	EN	EN	
Lauraceae	***Mezilaurus itauba* (Meisn.) Taub. ex Mez**	x			VU	VU	VU
Meliaceae	*Cedrela odorata* L.			x	VU	VU	VU
Meliaceae	Swietenia macrophylla King			x	VU	VU	VU
Moraceae	*Ficus sphenophylla* Standl.			x	NT	-	
Myristicaceae	*Virola surinamensis* (Rol. ex Rottb.) Warb.			x	VU	VU	
Rutaceae	***Euxylophora paraensis* Huber**	x	x	x	CR	CR	VU
Rutaceae	*Pilocarpus microphyllus* Stapf ex Wardlew.			x	EN	EN	EN
Sapotaceae	*Manilkara paraensis* (Huber) Standl.			x	NT	-	
Sapotaceae	*Pouteria bullata* (S.Moore) Baehni			x	EN	EN	
Sapotaceae	*Pouteria macrocarpa* (Mart.) D.Dietr.			x	VU	-	
Sapotaceae	*Pouteria multiflora* (A.DC.) Eyma			x	-	VU	
Sapotaceae	***Pouteria oppositifolia* (Ducke) Baehni**	x	x	x	NT	-	

Source: results of research

Current botanical records in the municipalities encompassing the project indicate that the area has a high richness and endemism of angiosperms, among the richest areas in the neotropics, including high richness of endangered species. This is an area of great importance for conservation.

The floristic composition, structure and diversity indexes presented in the studied community, allow classifying them as an area of extremely high biological value, representative of the natural (undisturbed) upland forests of the Amazon. Still, it revealed that the area is rich in number of families and species.

Some species showed significant rarity, while other species occur abundantly in the study area, which highlights the need for different planning for the forest. The evaluation of regeneration in the community is valid to verify the species that are occupying the space in this stratum, guaranteeing its constant permanence, without running the risk of extinction.

Therefore, considering the importance of many of these species both from an ecological and economic point of view for the Amazon region, as well as the occurrence of species in endangered and endemic categories, associated with the accelerated advance of deforestation in the Amazon domain, the need for urgent conservation actions becomes evident.

Fauna

To characterize the fauna of the Study Area, bibliographic data (literature review) and field sampling were used.

In total, 458 bird species were recorded in the baseline data, distributed in 68 families; and 39 species of medium and large mammals, belonging to 22 families. Regarding herpetofauna, 47 anuran species were

found, distributed in 13 families; and 53 species of reptiles, distributed in 16 families. 111 species of ichthyofauna were also found, distributed in 27 families, in addition to a wide variety of insects.

Birds

To complement the list of bird species recorded in the reserve areas of Agropalma S/A, the quantitative technique of MacKinnon lists was used (RIBON 2010) [99]. This technique is indicated to maximize the number of species recorded in a location.

Of the total number of species recorded for the Agropalma reserve areas (Table 48), 19 (4.1% of the total) are mentioned in the lists of endangered fauna. Of these, six species are mentioned in the list of the state of Pará (Decree 802/2008); 11 in the national list; and 14 in the global species list. Five species (2.6%) are considered endemic to Belém Endemism Center. The results indicate that the region has a rich avifauna, with many sensitive, threatened or restricted species. Still, 14 taxa found (3%) are species or subspecies endemic to Bélem Center, that is, they are not found in other Amazonian regions.

Among the recorded birds, the golden macaw (*Guaruba guarouba*), dusky-backed (*Psophia obscura*), the red-necked araçari (*Pteroglossus bitorquatus bitorquatus*) and the pearl parakeet (*Pyrrhura coerulescens*) stand out, all mentioned in the three lists of endangered fauna. This species has a restricted distribution and has had a significant reduction in its populations due to habitat loss or pressure from hunting or capture for trade.

In addition, the dusky-backed also stands out for being a species cited as critically endangered and is endemic to Belém Endemism Center. The taxon that does not appear in the lists of secondary data, however, has a restricted occurrence for Belém Center, with historical records for the region of the reserve areas of Agropalma S/A, is the curassow (*Crax fasciolata pinima*). Also worthy of mention are the vulturine parrot (*Pyrilia vulturina*), jacupiranga (*Penelope pileata*) and the Bethlehem woodpecker (*Piculus paraensis*), species that are endangered nationally and globally, which have been showing reductions in their populations in recent years (ICMBio, 2018)[100].

The results of the present study and of previous studies carried out at Agropalma show that the presence of forest remnants in the landscape promotes the maintenance of bird communities on a regional scale. It is suggested that populations of endangered and endemic species be monitored using techniques that provide

[99] RIBON, R. 2010. Amostragem de aves pelo método de listas de Mackinnon. In: Ornitol. e Conserv. Ciência Apl. Técnicas Pesqui. e Levant. (eds. Von Matter, S., Straube, F., Accordi, I., Piacentini, V. & Cândido-Junior, J.). Technical Books, Rio de Janeiro, pp. 33–44

[100] ICMBio, 2018. Livro Vermelho da Fauna Brasileira Ameaçada de Extinção, 1. ed. ed. ICMBio/MMA, Brasília, DF.

temporal series of abundance and/or occupation of the referred species. Conducting periodic studies with standardized quantitative methodologies allows the continuous assessment of biota responses to habitat alterations caused by productive activities.

Table 48 - List of species mentioned in the lists of threatened fauna registered for the region of Agropalma S/A reserve areas, according to bibliographic data, considering End: endemic species of Belém Endemism Center; PA: species listed in the List of Threatened Fauna of Pará (Decree 802/2008); BR: Species listed on the National List of Endangered Fauna (MMA, 2018); IUCN: Species listed on the Global List of Endangered Fauna (IUCN, 2021) – degrees of threat: near-threatened species (NT), endangered species (EN), vulnerable species (VU), critically endangered species (CR).

Taxon	END	PA	BR	IUCN
Dendrocolaptes medius			VU	
Guaruba guarouba		VU	VU	VU
Harpia harpyja			VU	NT
Morphnus guianensis			VU	NT
Patagioenas subvinacea				VU
Penelope pileata			VU	VU
Phlegopsis nigromaculata	*X*	EN		
Piculus paraensis	*X*		EN	
Pionites leucogaster				EN
Primolius maracana		VU		
Psophia obscura	*X*	EN	CR	CR
Pteroglossus bitorquatus bitorquatus	X	VU	VU	EN
Pyrilia vulturina			VU	VU
Pyrrhura amazonum				EN
Pyrrhura coerulescens		EN	VU	NT
Ramphastos tucanus				VU
Ramphastos vitellinus				VU
Tangara velia	*X*		VU	
Tinamus tao			VU	VU

Source: results of research

Mammal Fauna

To characterize the medium and large mammals of the Study Area, bibliographic data (literature review) and field sampling through active search and camera traps were used.

The active search method through paths was used aiming at direct visual contact of individuals or visualization of traces such as footprints, feces, burrows and sniffing. The works were carried out from 6:00 am to 11:00 am, and from 3:30 pm to 8:00 pm. Trails were established proportional to the types of environments present in the study areas, taking advantage, as far as possible, of roads, stream banks and pre-existing trails. These trails were all georeferenced with a manual GPS device. Seven (7) digital camera traps with infrared per treatment, activated by movement, model Bushnell Trophy Cam®, with 8 megapixel resolution and built-in flash, were also used.

Most recorded mammalian species have low tolerance to environmental changes and are dependent on forest formations, therefore, it is worth reinforcing the need to maintain areas with native vegetation in order to provide a suitable place for conservation of biodiversity. Another important point is that the presence of endemic species that are sensitive to environmental changes is a strong indication that the fauna community is well established, since the presence of carnivorous species have been observed at the top of the food chain, such as the jaguar (*Panthera onca*) and ocelot (*Leopardus pardalis)*. In addition, several potential seed dispersal species were recorded, such as the agouti (*Dasyprocta leporina*), paca (*Cuniculus paca*), tapir (*Tapirus terrestris*), in addition to the black bearded saki primates (*Chiropotes satanas*), capiora monkey (*Sapajus kaapori*), red-handed howler monkey (*Alouatta belzebul*), black marmoset (*Saguinus niger*) and capuchin monkey (*Sapajus appeal)*.

Mammals play an important role in the recovery processes of altered areas, due to their ability to disperse and predate seeds and seedlings of different plant species (Bascompte & Jordano, 2007) [101]. Medium and large mammals can disperse many seeds over long distances (Stoner et al., 2007) [102]. These plant-animal interactions are fundamental for the biodiversity of the Amazon rainforest, helping to recover the diversity of fauna and associated ecosystem services, which are fundamental for natural regeneration processes in degraded forests(Bowen et al., 2007) [103].

Another important factor is the presence of endangered species (Table 49), such as the jaguar (*Panthera onca*), present in the three lists consulted, being classified as “Vulnerable (VU)” in the state and national lists and as “Nearly threatened (NT)” in the IUCN global list. Another species highly threatened and that is present in the three lists is the black bearded saki (*Chiroptes satanas*), classified as “Critically endangered (CR)” in

[101] Bascompte, J., Jordano, P., 2007. Plant-Animal Mutualistic Networks: The Architecture of Biodiversity. Annu. Rev. Ecol. Evol. Syst. 38, 567–593.
[102] Wright, S.J., Stoner, K.E., Beckman, N., Corlett, R.T., Dirzo, R., Muller-Landau, H.C., Nuñez-lturri, G., Peres, C.A., Wang, B.C., 2007. The Plight of Large Animals in Tropical Forests and the Consequences for Plant Regeneration. Biotropica 39, 289–291.
[103] Bowen, M.E., McAlpine, C.A., House, A.P.N., Smith, G.C., 2007. Regrowth forests on abandoned agricultural land: A review of their habitat values for recovering forest fauna. Biol. Conserv. 140, 273–296. https://doi.org/10.1016/j.biocon.2007.08.012

the state and national lists and as “Endangered (EN) in the global list. Other species present in the three lists are the giant armadillo (*Priodontes maximus*) and the giant anteater (*Myrmecophaga tridactyla*), classified as “Vulnerable (VU)” in all of them. Other species present in the three lists consulted are: margay, small wild cat, puma and bush dog. The red-handed howler monkey (*Alouatta belzebul*), tapir (*Tapirus terrestris*) and peccary (*Tayassu pecari*) are only present in the national and global IUCN lists, classified as “Vulnerable (VU)”. The capiora monkey (*Sapajus kaapori*) is present in the national and global lists as “Critically endangered (CR)”. Finally, the red brocket (*Mazama americana*) has been classified as “Data Deficient (DD)” by the IUCN global list.

Table 49 - List of mammal species recorded through primary and secondary data, considering End: endemic species of the Amazon biome; PA: Threatened species in the state of Pará (IDERFLOR-BIO, 2016 and according to COEMA Resolution no. 54, of 10/24/2007); BR: Threatened species in Brazil (MMA, 2018); IUCN: Globally threatened species (IUCN, 2019/3). Threat grades: DD= data deficient; LC= least concern; NT= near threatened; VU=vulnerable; EN= endangered; CR= critically endangered. Exo = exotic species

Espécie	Nome popular	PA	BR	IUCN	End.
Pilosa					
Myrmecophagidae					
Myrmecophaga tridactyla	tamanduá-bandeira	VU	VU	VU	
Megalonychidae					
Choloepus didactylus	preguiça-real				X
Cingulata					
Dasypodidae					
Priodontes maximus	tatu-canastra	VU	VU	VU	
Primates					
Pithecidae					
Chiropotes satanas	cuxiú-preto	CR	CR	EN	X
Cebidae					
Cebus kaapori	macaco-cairara		CR	CR	X
Saimiri sciureus (collinsi)	mico-de-cheiro				X
Atelidae					
Alouatta belzebul belzebul	bugio-de-mãos-ruivas		VU	VU	X
Carnivora					
Felidae					
Leopardus wiedii	gato-do-maracajá	VU	VU	NT	
Leopardus tigrinus	gato-do-mato-pequeno	VU	VU	VU	
Puma concolor	onça-parda	VU	VU	LC	
Panthera onca	onça-pintada	VU	VU	NT	
Herpailurus yagouaroundi	gato-mourisco		VU		
Canidae					
Speothos venaticus	cachorro-vinagre	VU	VU	NT	
Mazama americana	veado-mateiro			DD	
Mazama nemorivaga	veado-roxo				X
Rodentia					
Sciuridae					
Sciurus gilvigularis	caxinguele				X
Microsciurus flaviventer	catipuru				X

Source: results of research

Herpetofauna

The methodology used in field work was active search, that is, visual and auditory contacts. The active search carried out during the day (6:00 am to 11:00 am) is directed towards records of reptiles and possibly amphibians, since the period of greatest amphibian activity is in the afternoon/night. In this method, visual inspections are carried out in places with the greatest potential to harbor species representing these groups,

covering pre-existing trails and bodies of water. The afternoon searches were carried out from 5:00 pm to 7:00 pm, and the night searches from 7:00 pm to 10:00 pm, for records of amphibians and reptiles.

Most of the registered herpetofauna species inhabit both open areas and forests, and may use temporary puddles throughout the year to reproduce, in the case of (Haddad et al., 2013[104]; Haddad and Prado, 2005)[105]. Thus, they have a wide distribution and prolonged reproductive behavior and do not exclusively need forest environments for reproduction or feeding. The strictly forest species recorded during the campaign carried out are *Trachycephalus coriaceus*, *Callimedusa tomopterna* and *Cnemidophorus lemniscatus*, highlighting the need to maintain preserved areas close to the cultivation areas. No species were found on the endangered species list.

Fish and insects

For these groups, only secondary data for the area and region were used, and no endangered species were found.

5.1.2 High Conservation Values (B1.2)

As defined by the HCV Resource Network, there can be six types of high conservation values, three of which are directly related to the biodiversity of the Project Area.

HCVA 1: Concentrations of biological diversity including endemic, rare, threatened, or endangered species that are significant at global, regional, or national levels.

HCVA 2: Globally, regionally or nationally significant large, landscape-level ecosystems and ecosystem mosaics containing viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance.

HCVA 3: Rare, threatened, or endangered ecosystems, habitats, or refugia of biodiversity.

[104] Haddad, C., Toledo, L., Prado, C., Loebmann, D., Gasparini, J., Sazima, I., 2013. Guia dos Anfíbios da Mata Atlântica - Diversidade e Biologia. Anolis Books. URL https://www.anolisbooks.com.br/produtos/detalhes/1502/guia-dos-anfibios-da-mata-atlantica-diversidade-e-biologia (accessed 12.12.22).

[105] Haddad, C.F.B., Prado, C.P.A., 2005. Reproductive Modes in Frogs and Their Unexpected Diversity in the Atlantic Forest of Brazil. BioScience 55, 207. https://doi.org/10.1641/0006-3568(2005)055[0207:RMIFAT]2.0.CO;2

High Conservation Value	Regarding the flora, there are 4 threatened species according to the federal official list (MMA, 2014), being 01 species considered Endangered (EN): Vouacapoua americana, 01 Vulnerable (VU): Hymenaea parvifolia and 01 Critically Endangered (CR): Euxylophora paraenses. Considering the CNCFlora Red List of Threatened Species, it includes 01 species considered Endangered (EN): Vouacapoua americana, 01 Vulnerable (VU): Hymenaea parvifolia, 01 Critically endangered (CR): Euxylophora paraenses and 01 Near threatened (NT): Pouteria oppositifolia. In the list of threatened species in Pará, Euxylophora paraenses is listed as vulnerable (VU). Regarding fauna, there are 19 species of birds and 12 mammals mentioned in any of the lists (State, National and IUCN Global) of threatened fauna. Furthermore, the Project Area is located within the Belém Center of Endemism (CE) (AAVC 2), with the occurrence of "campinarana" vegetation in the Project Zone (AAVC 3).
Qualifying Attribute	The project area is located within the Belém Endemism Center (CE), forest fragments and remnants and PPA's in the project area and its area of influence are extremely important for the conservation of regional fauna, presenting a High Conservation Value. They are home to species or subspecies of many faunal groups whose distribution area is restricted to CE Belém, in addition to several endangered fauna and flora species. It is also important to highlight the presence of "campinaranas" in the Project Zone, ecosystems that are exclusively Amazonian.
Focal Area	We can highlight, based on the evidence shown, that the entire Project Area must be the target of preservation, as it promotes the maintenance of fauna and flora communities on a regional scale, housing several endangered and endemic species. It is suggested that populations of endangered and endemic species

	be monitored using techniques that provide temporal series of abundance and/or occupation of the referred species.

5.1.3 Without-project Scenario: Biodiversity (B1.3)

Agropalma S/A REDD+ project area is located in the Eastern portion of the Amazon, in one of the eight Amazon Endemism Centers, the Belém Endemism Center, a portion with the highest deforestation rates in the whole place (Almeida-Maués et al., 2022)[106]. In 2004, deforestation reached 76% in Belém Endemism Center (Almeida-Maués et al., 2022), even so, this portion of the Amazon Forest still maintains several taxa of endemic and threatened animals. In this way, scenarios without the implementation of the project maintain the pressure of deforestation in the forest remnants present in the Project Area, further reducing the habitat of many species of endemic and endangered animals that occur in these environments.

Among the future impacts to biodiversity in the without-project scenario, loss of restricted species, loss of habitat, loss of connectivity, and loss of ecosystem services can be listed. In addition, it can also be considered that studies and monitoring of biodiversity would no longer be carried out without the project's incentive.

Forest fragmentation caused by deforestation tends to cause a drastic reduction in species richness, whose density and distribution is lower in small fragments, mainly affecting more specialist taxa (Laurance et al., 2001)[107], many of which are threatened, endemic or have restricted distribution.

Therefore, the implementation of the REDD+ project tends to improve the initial conditions of the study area for the local and regional fauna.

5.2 Net Positive Biodiversity Impacts

5.2.1 Expected Biodiversity Changes (B2.1)

Expectations of changes to biodiversity as a result of the Project were estimated using the Theory of Change method or causal model, further defined in Section 2.1.11. Based on this definition, we can better visualize

[106] Almeida-Maués, P.C.R., Bueno, A.S., Palmeirim, A.F., Peres, C.A., Mendes-Oliveira, A.C., 2022. Assessing assemblage-wide mammal responses to different types of habitat modification in Amazonian forests. Sci. Rep. 12, 1797. https://doi.org/10.1038/s41598-022-05450-1

[107] Laurance, W.F., Cochrane, M.A., Bergen, S., Fearnside, P.M., Delamônica, P., Barber, C., D'Angelo, S., Fernandes, T., 2001. The Future of the Brazilian Amazon. Science 291, 438–439. https://doi.org/10.1126/science.291.5503.438

the cause and effect relationship between the Project activities outlined, the actions involved and their expected results in the short, medium and long term.

That said, all activities have been defined with the aim of promoting the long-term preservation of forest cover in the Project Area. For biodiversity, it is evident that the biggest changes, compared to the scenario without the Project, are associated with the preservation of natural habitats, providing for the maintenance or increase of the diversity of floristic and faunal species, which would be threatened by unplanned deforestation, and which, without the intervention of the REDD+ mechanism, threats tend to increase for the Amazon region as a whole.

Thus, it is clear that ensuring forest protection through activities and through the REDD+ mechanism will enable the predicted changes to biodiversity to be positive. Still, as an essential tool for this, the biodiversity monitoring plan will make it possible to verify and ascertain whether any changes are impacting biological diversity in a negative way, portraying the photograph of the local biota throughout the life cycle of the Project, providing greater lucidity about the population dynamics of species, including endemic and vulnerable ones, as well as the conflicts generated by the coexistence of man and nature.

As a result, the expected changes to the Project's biodiversity are:

- Maintenance and possible addition of species identified in the without-project scenario;

- Ensure the conservation of habitats and species at Belém Endemism Center (CEB);

- Ensure the conservation of habitats and species in the Brazilian Amazon;

- Reduce illegal activities through Project activities;

- Increase awareness of local communities regarding environmental issues, reducing hunting pressure;

- Ensure the conservation of endangered and endemic plant and animal species;

- Promote an ecologically balanced environment;

- Maintain landscape connectivity.

Changes in key elements of biodiversity are described in the tables below.

Biodiversity Element	Flora
Expected changes	Maintenance of flora species by reducing deforestation and forest degradation
Justification for change	Preservation of flora species as a result of of the "Strengthening of patrimonial vigilance" activity through actions such as remote and continuous monitoring by satellite image of deforestation

	and forest fires, favoring the reduction of loss of landscape connectivity, continuity of gene flows and the promotion and maintenance of ecologically balanced habitats. - Preservation of flora species as a result of the activities "Promotion of sustainable agricultural practices" and "Development and strengthening of value chains" through actions that promote production models and sustainable agricultural practices, technical development, valorization of agricultural and forest products, and access to commercialization channels, as strategies to reduce the pressure for deforestation, whether for the expansion of production areas or for the illegal trade in wood, through the promotion of alternative and sustainable economic activities

Biodiversity Element	Fauna
Expected changes	Maintenance of habitats by reducing deforestation and forest degradation
Justification for change	Preservation of fauna species as a result of of the "Strengthening of patrimonial vigilance" activity through actions such as remote and continuous monitoring by satellite image of deforestation and forest fires, favoring the reduction of loss of landscape connectivity, continuity of gene flows and the promotion and maintenance of ecologically balanced habitats. - Preservation of fauna species as a result of the activities "Promotion of sustainable agricultural practices" and "Development and strengthening of value chains" through actions that promote production models and sustainable agricultural practices, technical development, valorization of agricultural and forest products, and access to commercialization channels, as strategies to reduce the pressure for deforestation, whether for the expansion of

	production areas or for the illegal trade in wood, through the promotion of alternative and sustainable economic activities

Biodiversity Element	Fauna and Flora
Expected changes	Environmental awareness, collective awareness, in situ monitoring, sustainable agricultural practices and biodiversity conservation in the Project Zone
Justification for change	Preservation of fauna and flora species as a result of the "Biodiversity conservation program" activity, providing for environmental education actions, with active participation and awareness campaigns in communities, favoring the reduction of hunting and damage to populations of rare, endemic and threatened species. Also, continuous in situ monitoring of species in the Project Area provides indicators to monitor the effectiveness of activities in generating positive net benefits to biodiversity. Furthermore, the development of more sustainable practices applied to production bases, conscious exploration of non-timber forest products, improvement in the management of natural resources by local communities, are actions promoted by the Project's activities in favor of the conservation of local biodiversity.

5.2.2 Mitigation Measures (B2.3)

Data collected for the studies related to biodiversity were satisfactory in the sense of evaluating the current context of biodiversity conservation in the Project Zone, surroundings, and with a focus on the Project Area; however, studies of longer duration are needed to elucidate the variations that occur in the biotic community over the course of forest modifications, whether resulting from the reduction of the forest area in the Project Zone or external to the Project Area or climate change.

Still, according to the Brazilian Diagnosis of Biodiversity & Ecosystem Services[108], the main vectors of threat to biodiversity are climate changes, which alter the configuration and functioning of ecosystems, and changes in land use — in other words: deforestation, or any activity involving the conversion of areas of native vegetation to other uses, such as agriculture, livestock or mining.

In order to seek improvement in the population conditions of species and mitigation of impacts caused by internal and external factors exposed above, all Project activities, in particular the activity "Biodiversity Conservation Program", were designed and structured to act as mitigating measures of the main threats to biodiversity, in addition to mitigation against negative adverse factors in the conservation and maintenance of HCV's.

With this in mind, significant negative impacts on biodiversity are not expected, and the Project's activities have been specifically designed and will be implemented to enhance the protection of the Project's biological diversity and are therefore both mitigation and biodiversity protection measures.

5.2.3 Net Positive Biodiversity Impacts (B2.2, GL1.4)

The activities proposed by Agropalma REDD+ Project seek to generate several benefits for the climate, communities and biodiversity. The main benefits generated for biodiversity are linked to the reduction of deforestation and forest degradation and conservation of biodiversity and habitats. In other words, the activities were primarily designed to reduce deforestation and forest degradation in the region of the Project Area and therefore most of the positive impacts on biodiversity will be assessed based on preserved forest cover and, in a complementary way, from the understanding of the dynamics of the species, especially fauna, in a continuous way.

Simply put, the quantification of positive net benefits for biodiversity can be done over time, through a robust and adequate monitoring plan (see Section 5.4.1). From these expeditions, which will provide a robust database throughout the Project's implementation, the conditions at the beginning of the Project, or the baseline scenario, with the biodiversity conditions after the beginning of the Project can be compared.

Furthermore, it is evident that in order to measure and quantify the positive impacts on biodiversity as a result of the Project, all activities are monitored using a set of indicators that are intended to measure the effectiveness of the Project activity at different stages of implementation, being the indicators defined in this document an important instrument to evaluate positive impacts.

[108] BPBES (2018): Summary for decision makers of the assessment report of the Brazilian Platform on Biodiversity and Ecosystem Services. Campinas, SP. 24 pages.

5.2.4 High Conservation Values Protected (B2.4)

The Project Area has two attributes of High Conservation Value related to biodiversity, which have already been described in Section 5.4.2 and are related to i) areas that contain significant concentrations of biodiversity values on a global, regional or national scale, and ii) large areas at the global, regional or national level where viable populations of most, if not all, naturally occurring species within natural patterns of distribution and abundance exist.

The proposed measures to guarantee integrity of HCV's and thus maintain and improve these attributes, ensuring that they are not negatively affected by the Project, were considered and incorporated by the defined activities of the Project. Therefore, no negative impact was foreseen for these areas and, furthermore, the proposed activities as well as their implementation throughout the life of the Project will generate positive impacts on these attributes.

Thus, it is not expected that the attributes of HCV's will be negatively affected by the Project. On the contrary, by reducing deforestation and forest degradation in the Project Area, what is expected is the preservation of intact and appropriate habitats for the entire biotic community, including the recovery of ecological niches for endemic, rare or threatened species.

5.2.5 Species Used (B2.5)

The main economic activities in the region, encompassing the Project Zone, are subsistence agriculture, monocultures such as oil palm and coconut, and livestock. The rural communities that live in these places are mainly dedicated to subsistence agriculture, cultivating species such as black pepper, cocoa, acai berries cassava, oil palm, fruit species, in addition to the practice of agroextractive activities such as the management of non-timber forest products (PFNM) of species native to the region, such as Brazil nut, bacuri, uxi and piquiá.

However, there is no activity of this nature within the Project Area, as well as resident communities within the Agropalma Farm, as well as the introduction of these described species or any other type within the Project Area.

5.2.6 Invasive Species (B2.5)

In the diagnosis carried out in the Project Area, showing the scenario without a Project for biodiversity, as described in Section 5.1.1 of this document, it is possible to infer the non-occurrence of invasive alien species

in the area, since there was no record of exotic species of popular name consolidation, such as eucalyptus, pine, Australian acacia, leucena, among others, associated with the fact that the evaluated remnant has a well-preserved forest structure that is resilient to the entry of opportunistic exotic plant species.

Furthermore, it is not foreseen, as in the previous section and based on the proposed activities, to incorporate exotic species in the Project Area, since they can compromise the balance of the ecosystem in which they are inserted. Therefore, as already stated in Section 5.2.5, the Project activities will not encourage the inclusion of exotic species and the Project Area will not be affected by the introduction of this type of species, not resulting in any threat or increment as a result of the Project.

It is worth saying that, within Agropalma Farm, there are areas dedicated to the commercial cultivation of palm oil tree (*Elaeis guineenses*). Due to the premises of the Project, such areas were withdrawn, but it is evident that they are very close to the massive forests that make up the Project Area. So far, there is no indication or evidence that such species affect and/or act as invasive species beyond the areas intended for their production within the boundaries of Agropalma Farm.

5.2.7 Impacts of Non-native Species (B2.6)

As described in Section 5.2.5, there are communities in the Project Zone that utilize non-native species for subsistence. However, the main food crops and the producers' sources of income are mostly based on the development and exploitation of products from native species such as cocoa, acai berries, cassava, piquiá, bacuri, Brazil nuts, among others.

Some non-native species, such as black pepper, oil palm tree and some fruit species are used by local communities and other stakeholders in small, medium and in some cases large-scale plantations. These species have been cultivated for years, being part of the cultural history of the region and serving as a source of livelihood for these communities and, until then, even without the insertion of a REDD+ Project, it has not shown any evidence of significant negative impact on biodiversity. Furthermore, the introduction of new exotic species will not be encouraged by the activities of Agropalma REDD+ Project.

Also, as reported in Section 5.2.6, Fazenda Agropalma, there are areas dedicated to the commercial cultivation of oil palm tree (Elaeis guineenses) that are not inserted within the Project Area. Despite this, plantations will be monitored throughout the implementation of the Project, if there is the identification and adverse effects of these species on the forestry component, they will be reported in the monitoring report.

Therefore, it is possible to state that no impact from exotic species is foreseen.

5.2.8 GMO Exclusion (B2.7)

Through Agropalma REDD+ Project, it is guaranteed that no genetically modified organism (GMO) will be used. The reduction or removal of greenhouse gas emissions will be achieved by reducing deforestation and forest degradation.

5.2.9 Inputs Justification (B2.8)

In the Agropalma REDD+ Project Zone, where the activities are intended, there is no intention to use any chemical pesticides, biological control agents or other types of chemical inputs in the activities to be implemented.

In case there is the application of any chemical compound, or the use of biological control agents or any other type of input by the responsible parties, they will be reported in the monitoring report.

5.2.10 Waste Products (B2.9)

Agropalma, proponent of this Project, establishes standards and criteria for the identification, classification and management of waste in all its areas and actions and, based on the construction of the Solid Waste Management Plan - SWMP, aims to meet the requirements of Environmental Laws, in particular Law 12.305 of August 2010 and Federal Decree No. 7.404/2010, which deals exceptionally with the “National Policy on Solid Waste”. The criteria for classification, disposal and transport of waste generated by Agropalma are determined according to NBR 10.004, and established in the "Solid Waste Management Plan", which also establishes conditions for classification in relation to dangerousness, proper disposal, transport, operation of the intermediate disposal area and waste conditioning. Also, its waste management is guided within a context of priority and continuous improvements applied to the concepts of “non-generation”, “reduction”, “reuse” and “recycling”, for example.

Most of the waste generated by Agropalma is reused, whether seeking new uses for products such as tires, drums and wooden pallets, or in organic fertilization, fertirrigation or energy use in the case of industrial organic waste. Materials such as scrap metal, plastic and cardboard are recycled through contracts signed with specialized companies in the region. Solid waste contaminated with oil or chemical products is sent for treatment at a specialized company that performs its adjustment (blending) for energy use, whenever possible, or incineration, as well as outpatient waste that is sent for treatment by incineration. Organic waste and non-recyclable waste, comparable to household waste, are disposed of in Agropalma's own landfill, duly licensed.

For the activities proposed by the Project, no additional generation of waste other than those described above is foreseen. However, if any material is produced that needs to be disposed of correctly, the PGRS will be followed and all environmental laws will be considered.

5.3 Offsite Biodiversity Impacts

5.3.1 Negative Offsite Biodiversity Impacts (B3.1) and Mitigation Measures (B3.2)

In general, a REDD+ Project, based on the assumptions of the methodology VM0015, has as its main objective the reduction of emissions from unplanned deforestation and forest degradation, in addition to maintaining forest carbon stocks. That said, it is indisputable that the conservation provided by this mechanism benefits the Project Zone as a whole.

Specifically for Agropalma REDD+ Project, the intention is to obtain greater control over the occurrence of anthropic disturbances that would negatively impact biodiversity, such as predatory hunting and loss of habitat due to deforestation for the practice of predominant economic activities in the region, such as agriculture, livestock and wood extraction. However, based on the strengthening of measures aimed at conserving the forest and its resources, it may be that these disturbances and activities will naturally move to areas outside the Project Zone, where they are more vulnerable to such events.

Regarding the mitigation measures arising from the Project, it can be mentioned the permanence and strengthening in the Project Zone of alternative economic activities that generate income and employment, such as the promotion of agricultural production models and sustainable practices, development of value chains and environmental education, that is, social activities with potential to mitigate possible negative impacts, with emphasis on environmental awareness and awareness, valuing the forest and the sustainable use of forest resources by local communities.

It's worth saying that all Project activities were discussed and refined in discussions (Section 2.3.7) with communities and stakeholders in order to understand the scope of Project activities and forest conservation. Still, it is worth saying that the activities proposed by the Project will extend to stakeholders located in the Project Zone, but with a potential positive impact beyond these limits.

Furthermore, the Project will seek to strengthen the articulation of proponents, who will practice adaptive management and collectively address any additional negative impacts on biodiversity outside the Project Zone.

5.3.2 Net Offsite Biodiversity Benefits (B3.3)

The main positive impact expected outside the Project Zone is the favoring of biodiversity by maintaining large remaining forests that could function as ecological corridors, as well as refuge and protection for threatened species and ecosystems. Thus, despite the possible displacement of activities and disturbances outside the Project Zone, which may cause specific negative impacts, the connectivity of the landscape and favoring gene flow between forest areas, habitat maintenance and in situ monitoring of endangered species are benefits that justify the presence of Agropalma REDD+ Project in the region.

5.4 Biodiversity Impact Monitoring

5.4.1 Biodiversity Monitoring Plan (B4.1, B4.2, GL1.4, GL3.4)

The Amazon biome, where the Project Area is located, has one of the richest biodiversities on the planet. Since 2004, the Agropalma Group has been monitoring the fauna on the farm, establishing partnerships with universities and non-governmental organizations for this initiative. Since then, more than 1000 animal species have been catalogued, many of them endemic or threatened of extinction. Despite this, the knowledge and identification of the species of this ecosystem is still quite scarce, because it is understood that monitoring the entire biodiversity of a certain region or place is logistically and financially impossible. According to the "Proposal for a Brazilian Biodiversity Monitoring System"[109], a reasonable way to solve this problem, making the monitoring of biodiversity more practical and feasible, is to monitor specific groups of animals and plants, considered as biological indicators, which respond in a calculable way to environmental changes.

Thus, the plan presented considers four main groups of biological indicators to be monitored: arboreal plants, avifauna, medium and large-sized mammals, herpetofauna, and frugivorous butterflies. The choice was based on the methodological ease of monitoring these groups over time, on the sensitivity of these groups to ecological changes in the environment and because they are representative of other groups not included. Furthermore, all of the threatened, rare, and endemic species recorded in the initial assessment, as well as the trigger species selected for the project, belong to these groups.

a) Technical description of monitoring tasks

Taking the above-mentioned roadmap into consideration, the biodiversity monitoring plan for the Agropalma REDD+ Project will focus on biological indicators that should be monitored and evaluated in the face of forest modifications and anthropic actions, whether arising from the reduction of forest area in the Project Zone,

[109] COSTA-PEREIRA, R.; ROQUE, F. O.; CONSTANTINO, P. A. L.; SABINO, J.; UEHARA-PRADO, M. Monitoramento in situ da Biodiversidade: Proposta para um Sistema Brasileiro de Monitoramento da Biodiversidade. 1. ed. Brasília: ICMBio. v. 1, 2013. 61p

hunting, or climate change, in order to better understand their dynamics and track the repercussion of these elements on biological diversity**.**

In the scenario without the Project, described in Section 5.1, the assessment considered different sampling areas. Therefore, this plan will seek, whenever possible, to carry out expeditions to monitor biodiversity considering the same conditions and methodologies used to diagnose the without-project scenario, in which it is possible to compare, observe and assess the effects of Project activities on biodiversity over time.

So, for the monitoring of fauna, the Project will carry out expeditions (to be established), considering the periods of low and high rainfall, so that the presence of migratory species and reproductive periods are considered. For the monitoring of the flora, considering that the dynamics and floristic alterations occur more slowly, the expeditions will be made in periods close to each verification of the Project with the purpose of evaluating eventual alterations that may arise in the structure and composition of floristic species

It is also expected that species of relevance, whether endemic, threatened or rare, are prioritized in the expeditions and collected during the monitoring campaigns, especially key species, considered of great biological importance and high degree of threat, classified either as "Endangered" (EN) or "Critically Endangered" (CR) of extinction, according to the criteria of the IUCN.

Finally, the plan will seek to protect the High Conservation Value (HCV) attributes by stimulating and enhancing knowledge about local biodiversity through continuous in situ monitoring. The evaluation of the effectiveness of the measures adopted to maintain and improve the HCV attributes is contemplated by the tasks described, especially in the monitoring of indicators related to species richness of both fauna and flora. Therefore, the monitoring plan makes it possible to track the permanence of species of relevance, whether they are threatened, rare or endemic in these areas defined as conservation priorities

b) Data to be collected

Data / Parameter	Number of actions focused on Environmental Education
Data unit	Number
Description	This parameter will account for any action that aims to raise awareness and sensitize stakeholders to environmental issues, mainly as prevention of hunting and predatory fishing
Source of data	Reports, attendance lists, presentations, and other documents that corroborate as evidence that an environmental education action was implemented. However, this parameter may be counted from any event, workshop, training, among others, that have in their content, actions that can be considered

	environmental education and that were stimulated and/or executed by any activity of the Project
Description of measurement methods and procedures to be applied	All documents produced will be stored in digital files throughout the project's accreditation period. In this way, the environmental education actions carried out by the Project activities will be monitored and accounted for
Frequency of monitoring/recording	At each verification event
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	The systematized information of the established environmental education actions will be validated among the proponents, allowing for greater reliability and quality of the data. Furthermore, the Project will undergo continuous evaluation of the information generated, allowing the identification of improvements in the collection and registration processes, and the incorporation of these in the Project's strategic planning when they are identified
Purpose of data	Not applicable
Calculation method	Not applicable
Comments	

Data / Parameter	Fauna species richness
Data unit	Number
Description	Number of species found in the Project Area in each monitoring expedition
Source of data	Field sheets, photographs, monitoring reports, among other additional records

Description of measurement methods and procedures to be applied	To be established
Frequency of monitoring/recording	To be established
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	To be established
Purpose of data	Assessment of faunal diversity in the Project Area and maintenance of High Conservation Values (HCV) for biodiversity
Calculation method	Datasheet
Comments	

Data / Parameter	Flora species or morphospecies richness
Data unit	Number
Description	Number of species or morphospecies of flora monitored in permanent plots within the Project Area. If there is difficulty in identifying an individual at a specific level, consider the richness of morphospecies, defined only by morphological similarity
Source of data	Field sheets, photographs, monitoring reports, among other additional records
Description of measurement methods and procedures to be applied	To be established
Frequency of monitoring/recording	To be established
Value applied	To be accounted for after registration of the Project

Monitoring equipment	Not applicable
QA/QC procedures to be applied	To be established
Purpose of data	Assessment of the condition of the monitored forest environment and the maintenance of High Conservation Values (HCVAs) for biodiversity
Calculation method	Datasheet
Comments	The permanent plots will be defined in a similar way to the methodologies used in the initial flora diagnostics

Data / Parameter	Number of individuals of *Pteroglossus bitorquatus*
Data unit	Number
Description	Number of individuals of the species Pteroglossus bitorquatus identified in each monitoring expedition in the Project Area
Source of data	Field sheets, photographs, monitoring reports, among other additional records
Description of measurement methods and procedures to be applied	To be established
Frequency of monitoring/recording	To be established
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	To be established
Purpose of data	Assessing the presence of trigger species in the Project Area to ensure and maintain the requirements for the Gold Level of Biodiversity

Calculation method	Datasheet
Comments	

Data / Parameter	Number of individuals of *Psophia obscura*
Data unit	Number
Description	Number of individuals of the species *Psophia obscura* identified in each monitoring expedition in the Project Area
Source of data	Field sheets, photographs, monitoring reports, among other additional records
Description of measurement methods and procedures to be applied	To be established
Frequency of monitoring/recording	To be established
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	To be established
Purpose of data	Assessing the presence of trigger species in the Project Area to ensure and maintain the requirements for the Gold Level of Biodiversity
Calculation method	Datasheet
Comments	

Data / Parameter	Number of individuals of *Cebus kaapori*
Data unit	Number

Description	Number of individuals of the species *Cebus kaapori* identified in each monitoring expedition in the Project Area
Source of data	Field sheets, photographs, monitoring reports, among other additional records
Description of measurement methods and procedures to be applied	To be established
Frequency of monitoring/recording	To be established
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	To be established
Purpose of data	Assessing the presence of trigger species in the Project Area to ensure and maintain the requirements for the Gold Level of Biodiversity
Calculation method	Datasheet
Comments	

Data / Parameter	Number of individuals of *Chiropotes satanas*
Data unit	Number
Description	Number of individuals of the species *Chiropotes satanas* identified in each monitoring expedition in the Project Area
Source of data	Field sheets, photographs, monitoring reports, among other additional records
Description of measurement methods and procedures to be applied	To be established

Frequency of monitoring/recording	To be established
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	To be established
Purpose of data	Assessing the presence of trigger species in the Project Area to ensure and maintain the requirements for the Gold Level of Biodiversity
Calculation method	Datasheet
Comments	

Data / Parameter	Number of individuals of *Euxylophora paraensis*
Data unit	Number
Description	Number of individuals of the species *Euxylophora paraensis* identified in each monitoring expedition in the Project Area
Source of data	Field sheets, photographs, monitoring reports, among other additional records
Description of measurement methods and procedures to be applied	To be established
Frequency of monitoring/recording	To be established
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	To be established

Purpose of data	Assessing the presence of trigger species in the Project Area to ensure and maintain the requirements for the Gold Level of Biodiversity
Calculation method	Datasheet
Comments	

Data / Parameter	Number of individuals of *Vouacapoua americana*
Data unit	Number
Description	Number of individuals of the species *Vouacapoua americana* identified in each monitoring expedition in the Project Area
Source of data	Field sheets, photographs, monitoring reports, among other additional records
Description of measurement methods and procedures to be applied	To be established
Frequency of monitoring/recording	To be established
Value applied	To be accounted for after registration of the Project
Monitoring equipment	Not applicable
QA/QC procedures to be applied	To be established
Purpose of data	Assessing the presence of trigger species in the Project Area to ensure and maintain the requirements for the Gold Level of Biodiversity
Calculation method	Datasheet
Comments	

5.4.2 Biodiversity Monitoring Plan Dissemination (B4.3)

The Biodiversity monitoring plan and its results will be publicly disclosed on the official website of Biofílica Ambipar Environmental Investments. Relevant information, the summary of the monitoring plan and its results, will be made available to the community, proponents, partners and other stakeholders through meetings, lectures, and physically on the premises of Agropalma Farm.

5.5 Optional Criterion: Exceptional Biodiversity Benefits

5.5.1 High Biodiversity Conservation Priority Status (GL3.1)

Because they are located in Belém Center of Endemism (EC), the fragments and forest remnants and APPs in the Project Area and its area of influence are extremely important for the conservation of regional fauna, sheltering species or subspecies of many faunal groups that have their distribution area restricted to this EC. These areas, therefore, have a high Conservation Value, because many of these species are cited in state, national and global lists of fauna threatened with extinction due to the enormous rates of deforestation in the region.

That said, the presence of threatened species of flora and fauna found in the scenario without Project was verified according to the IUCN Red List of Threatened Species:

Flora

- Critically Endangered (CR) – *Vouacapoua americana*

- Endangered (EN) – *Euxylophora paraenses*

Fauna

- Critically Endangered (CR) – *Psophia obscura*; *Cebus kaapori*

- Endangered (EN) – *Pteroglossus bitorquatus bitorquatus; Chiropotes satanas*

5.5.2 Trigger Species Population Trends (GL3.2, GL3.3)

The key species and their respective population trends for the Agropalma REDD+ Project can be found in the table below (Table 50).

Table 50 - Identification and description of key species and population trend for scenarios without and with Agropalma REDD+ Project.

Flora

Trigger Species	*Euxylophora paraensis*
Population Trend at Start of Project	The species is considered Endangered (EN) by IUCN (2020) and its record in the area meets the criteria set by the CCB standard.
Without-project Scenario	The wood of this species, of high commercial value and with various applications, is intensively exploited in Pará (CNCFlora, 2022)[110]. The forest fragmentation caused by increased deforestation without the implementation of the Project tends to cause a drastic reduction in the richness of species, whose density and distribution is lower in small fragments.
With-project Scenario	The Agropalma REDD+ Project with its purpose of mitigating, reducing deforestation and forest degradation, will promote the increase or at least population maintenance of the species. The conservation of the forest massif should also contribute to the connectivity of the landscape, favoring the gene flow between nearby forest areas.

Trigger Species	*Vouacapoua americana*
Population Trend at Start of Project	The species is considered Critically Endangered (CR) by IUCN (1998) and its record in the area meets the criteria set by the CCB standard.
Without-project Scenario	The forest fragmentation caused by increased deforestation without the implementation of the Project tends to cause a drastic reduction in the richness of species, whose density and distribution is lower in small fragments.
With-project Scenario	The Agropalma REDD+ Project with its purpose of mitigating, reducing deforestation and forest degradation, will promote the increase or at least population maintenance of the species. The conservation of the forest massif should also contribute to the connectivity of the landscape, favoring the gene flow between nearby forest areas.

[110] CNCFlora. Euxylophora paraensis in Lista Vermelha da flora brasileira versão 2012.2 Centro Nacional de Conservação da Flora. Available in em <http://cncflora.jbrj.gov.br/portal/pt-br/profile/Euxylophora paraensis>. Acessed 12 26 2022.

- Avifauna

Trigger Species	Red-necked araçari (*Pteroglossus bitorquatus bitorquatus*)
Population Trend at Start of Project	The species is considered Endangered (EN) for extinction by IUCN (2016) and has a distribution restricted to EC Belém, meeting the criteria defined by the CCB standard. It has had a significant reduction in its populations due to habitat loss. Flocks of red-necked araçari were observed during the field sampling carried out for the Environmental Assessment of the Project Area.
Without-project Scenario	The forest fragmentation caused by increased deforestation without the implementation of the Project tends to cause a drastic reduction in species richness, whose density and distribution is lower in small fragments, affecting mainly more specialized taxa (LAURANCE and VASCONCELOS, 2009)[111], many of which are threatened, endemic or have restricted distribution.
With-project Scenario	The implementation of the Agropalma REDD+ Project will enable the maintenance of forest remnants and APPs in the Project Area and its area of influence, extremely important for the conservation of regional fauna.

Trigger Species	Black-winged Trumpeter (*Psophia obscura*)
Population Trend at Start of Project	The species is considered Critically Endangered (CR) by IUCN (2016) and has a distribution restricted to EC Belém, meeting the criteria defined by the CCB standard. It suffers from hunting and alteration of its habitat, Terra Firme Forests, and has had a significant reduction in its populations due to habitat loss. It is estimated a reduction in its population of more than 80% (MMA, 2018; IUCN 2021-3).
Without-project Scenario	The forest fragmentation caused by increased deforestation without the implementation of the Project tends to cause a drastic reduction in species richness, whose density and distribution is lower in small fragments, affecting mainly more specialized taxa

[111] LAURANCE, W. F., M. a COCHRANE, S. BERGEN, P. M. FEARNSIDE, P. DELAMÔNICA, C. BARBER, S. D'ANGELO, and T. FERNANDES. 2001. Environment. The future of the Brazilian Amazon. Science (New York, N.Y.) 291:438–439.

	(LAURANCE e VASCONCELOS, 2009), many of which are threatened, endemic or have restricted distribution.
With-project Scenario	The implementation of the Agropalma REDD+ Project will enable the maintenance of forest remnants and APPs in the Project Area and its area of influence, extremely important for the conservation of regional fauna.

- Mammals

Trigger Species	Ka'apor Capuchin (*Cebus kaapori*)
Population Trend at Start of Project	The species is considered Critically Endangered (CR) by IUCN (2015) and has a distribution restricted to the Belém EC, meeting the criteria defined by the CCB standard. This species is an extremely rare primate, has a restricted distribution and had a significant reduction in its populations due to habitat loss. It is estimated a reduction in its population of more than 80% in the last 30 years alone (ICMBIO/MMA 2018).
Without-project Scenario	The forest fragmentation caused by increased deforestation without the implementation of the Project tends to cause a drastic reduction in species richness, whose density and distribution is lower in small fragments, affecting mainly more specialized taxa (LAURANCE e VASCONCELOS, 2009), many of which are threatened, endemic or have restricted distribution.
With-project Scenario	The implementation of the Agropalma REDD+ Project will enable the maintenance of forest remnants and APPs in the Project Area and its area of influence, extremely important for the conservation of regional fauna.

Trigger Species	Black Bearded Saki (*Chiropotes satanas*)
Population Trend at Start of Project	The species is considered Endangered (EN) by IUCN (2020) and has a distribution restricted to the CE Belém, meeting the criteria defined by the CCB standard. It occurs in eastern Amazonia, with remaining populations threatened mainly by deforestation and habitat fragmentation. It is estimated a reduction in its population of more than 80% in the last 30 years alone (ICMBIO/MMA 2018).

Without-project Scenario	The forest fragmentation caused by increased deforestation without the implementation of the Project tends to cause a drastic reduction in species richness, whose density and distribution is lower in small fragments, affecting mainly more specialized taxa (LAURANCE e VASCONCELOS, 2009), many of which are threatened, endemic or have restricted distribution.
With-project Scenario	The implementation of the Agropalma REDD+ Project will enable the maintenance of forest remnants and APPs in the Project Area and its area of influence, extremely important for the conservation of regional fauna.

APPENDICES

The following appendices may be used if appropriate. Delete the instruction and heading if not used.

Appendix 1: Stakeholder Identification Table

Use this appendix, if necessary, to identify stakeholders and fulfil the requirements of Section 2.1.8 above. Modify the table, if necessary, to suit the project activities, or delete if not used.

Stakeholder	Rights, Interest and Overall Relevance to the Project
Identify communities and any community groups within them, any cross-cutting community groups, and list other stakeholders.	

Appendix 2: Project Activities and Theory of Change Table

Use this appendix, if applicable, to identify project activities and fulfill the requirements of Section 2.1.11 above. This is an example of just one method of representing the theory of change. Results chains/flow diagrams are another effective way to represent the theory of change. Modify the table, if necessary, to suit the project activities, or delete if not used.

Activity description	Expected climate, community, and/or biodiversity			Relevance to project's objectives
	Outputs (short term)	Outcomes (medium term)	Impacts (long term)	

Appendix 3: Project Risks Table

Use this appendix, if necessary, to identify project risks and fulfill the requirements of Section 2.1.18 above. Modify the table, if necessary, to suit the project activities, or delete if not used.

Identify Risk	Potential impact of risk on climate, community and/or biodiversity benefits	Actions needed and designed to mitigate the risk

Appendix 4: Additional Information

Use appendices for supporting information. Delete this appendix (title and instructions) where no appendix is required.