MANOA REDD+ PROJECT

Prepared by:
Biofílica Investimentos Ambientais S.A.

Project Title:	Manoa REDD+ Project
Version	v. 1.0
Date of issue	August 30, 2016
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Project Title:	Manoa REDD+ Project
Project Location	Brazil, State of Rondônia, Cities of Cujubim, Itapoã do Oeste, and Porto Velho
Project Proponents	• Biofílica Investimentos Ambientais (Project Main Proponent): Plinio Ribeiro, plinio@biofílica.com.br, +55 11 3073-0430 • Triângulo Pisos e Paineis Ltda Douglas Granemann de Souza, triangulo@triangulo.com.br, +55 41 2106-5113
Auditor	• Rainforest Alliance: Klaus Geiger, kgeiger@ra.org, +1 (202) 903-0717 • IMAFLORA – Instituto de manejo e Certificação Florestal e Agrícola: Bruno Brazil de Souza, bruno@imaflora.org, +55 19 3429-0848
Project Start Date	April 01, 2012
Project Duration	30 years
GHGs Accounting Period	April 01, 2012 to March 31, 2042
Complete Validation or Gaps Validation	Complete Validation
History in CCB	Validation started on August 30, 2016
CCB Standards Edition	CCBA. 2013. Climate, Community, and Biodiversity Standards Third Edition. CCBA, Arlington, VA, USA. December 2013. At: www.climate-standards.org.
Short description of the expected benefits for the Climate, Community, and Biodiversity	• Expected benefits for the Climate: A total of **4,687,440 tCO2eq emissions avoided** by the project, opposing a baseline scenario of 5,196,050 tCO2eq emissions due unplanned deforestation. The project leads to a scenario in which 11,732 hectares of deforestation is avoided along 30 years, as well as an average of 156,248.0 tCO2eq of reduced emissions. • Expected benefits for the Community: with low impact forest managing infrastructure, the benefits for the community focus on environmental awareness of families living near Manoa Farm in the city of Cujubim, aiming at young people in the region, carrying out activities every three months (four times a year) involving up to 30 people for each course/training; another benefit is provision of skilled labor training for work in the certified wood and nonwood forest management, striving for a regional scope for the target audience. • Expected benefits for Biodiversity: the maintenance of the project area forest coverage, along with the development of low impact forest management activities, ensure habitat protection in the Manoa Farm region, which has great diversity of species including threatened ones, according to IUCN (2014). There will be constant monitoring of high-value attributes, as the habitat hosts 177 of flora and more than 360 fauna species identified by a diagnostic conducted. Out of the fauna endangered species, 12 are of mammals and 9 of birds,

	registered in national and international threatened species lists, according to section 7.1.2 of this document; Manoa Farm is also part of a "green corridor", which connects several Conservation Units, reducing negative impacts of degradation in the region.
Compliance with Gold Level Criteria	The project meets the criteria: GL3. Exceptional Benefits for Biodiversity. Conservation high priority area: contains rare and endemic endangered species (according to IUCN), as the *Ateles chamek* (spider monkey) and *Pteronura brasiliensis* (nutria), both endangered.
PDD Date and Version	August 30, 2016, Version 1.0
Expected VerificationSchedule	First Verification in the CCBS two years after the Validation, and subsequent verification every two years throughout the project life cycle. VCS verifications are expected every two years.

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1 GENERAL

1.1 Project brief description

Manoa REDD+ Project is a partnership between Biofílica and Grupo Triângulo, located at Manoa Farm, city of Cujubim, state of Rondônia, in an area of 73,000 hectares.

The farm`s 73,000 hectares of forest demonstrates the pioneering in sustainable forest management, and are one of the few forest areas remaining in private area in the region, constantly threatened by invasions and timber theft. Manoa is of paramount importance in the landscape connectivity, as it is close to conservation units and provides shelter for several species.

Manoa Project will carry on the following actions to reduce deforestation and consequently reduce emissions:

- Forest protection and monitoring: remote monitoring and in local surveillance, along with the best sustainable forest management practices;
- Scientific research: monitoring of forest management impacts, follow-up and study of identified and/or endemic species, partnerships with educational and research institutions for the production and dissemination of knowledge;
- Local economic development: through its own training center, CEFLOM, the project provides training and capacity building in technical forest management to the regional population;
- Social empowerment: environmental education for the population from regional communities and from the city of Cujubim, aiming at the future of environmental conservation and the consequent improvement in the quality of life of these people.

Benefits to Climate

Avoid the emission of 156,248.0 tons of CO2e per year or 4,687,440 tons of CO2e along 30 years of project. This corresponds to 11,732 hectares of avoided deforestation.

Benefits to the Community

Environmental awareness of families in the project area surroundings, focusing on the young population and college students in the state of Rondônia, aiming at improving their quality of life and dissemination of knowledge.

Dissemination of knowledge on rules and labor rights to their employees and collaborators.

Support given for skilled labor training for work in the certified wood and nonwood forest management, searching for a regional scope for the target audience.

Benefits to Biodiversity

Maintenance of forest coverage, preventing deforestation of approximately 5,573 hectares along 30 years of project.

Conservation of 177 of flora and more than 360 fauna identified species. Out of these species, 12 are mammals and 9 are birds in some type of threat, according to IUCN.

Maintenance of "ecological corridors" with Conservation Units of the state of Rondônia, reducing negative impacts of the region degradation.

1.2 Project location (G1 & G3)

Manoa REDD + Project is located at Manoa Farm, which territory covers an area of 73,821 hectares in the cities of Cujubim, Itapoã do Oeste, and Porto Velho, state of Rondônia state (Figure 1), Northern Brazil. The vertices of Manoa Farm are found in Table 1

The access to the area is made through BR-364 highway, Porto Velho-Ariquemes, covering about 140 km up to RO-205 highway, which connects the city of Cujubim through 50 km of dirt road.

The project zone is defined as the "region that encompasses the project area, in which the activities that directly affect the land and associated resources, including activities related to provision of subsistence alternatives and community development, are implemented" (CCBA), comprising the area of Manoa Farm, totaling 74,009 hectares.

Table 1 . Geographic coordinates of Manoa Farm vertices.

Vertex	X coordinate	Y coordinate
V 01	62° 43' 55.41" W	8° 39' 33.99" S
V 02	62° 40' 37.32" W	8° 40' 54.00" S
V 03	62° 31' 59.93" W	8° 59' 43.00" S
V 04	62 ° 50 '59.63 "W	8° 59' 57.68" S

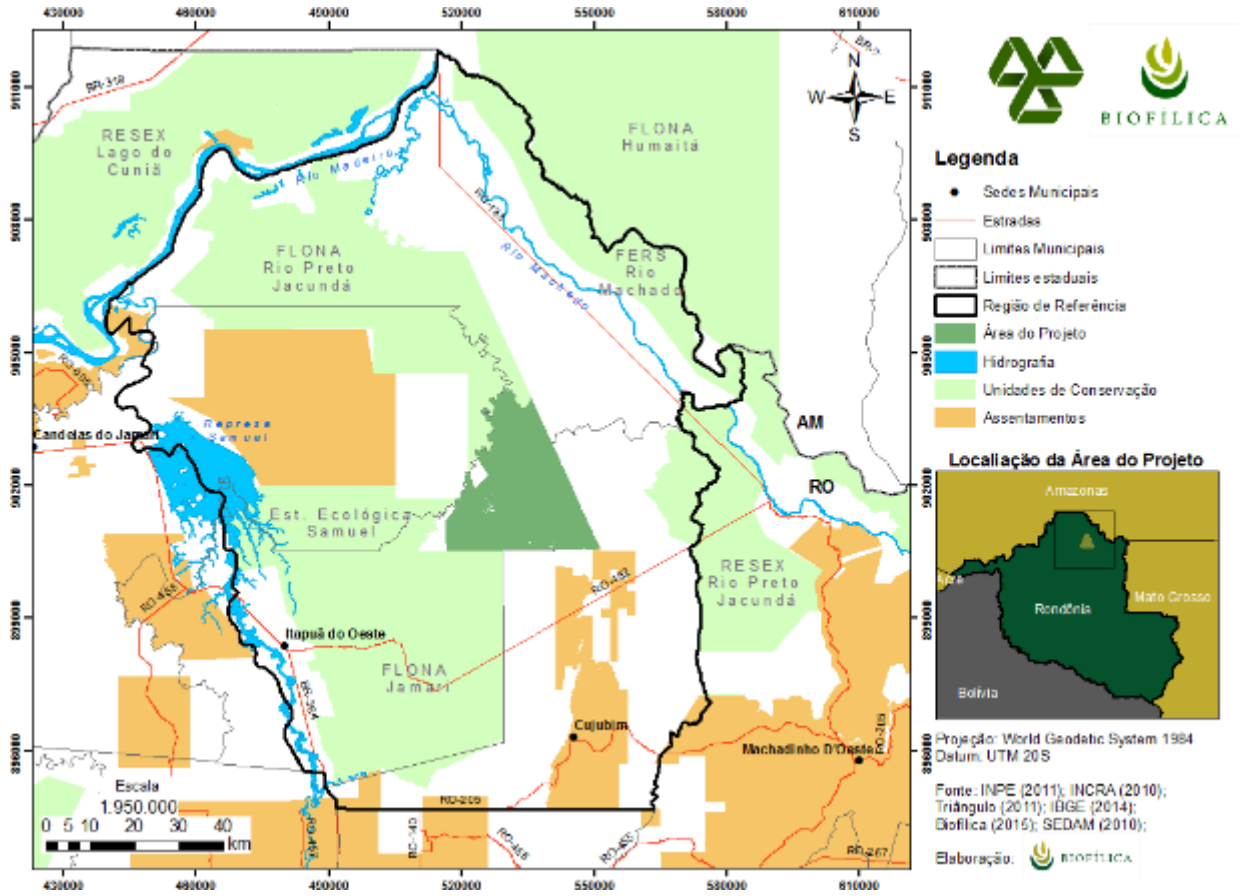


Figure 1 . Location of the project limits

1.3 Project initial conditions (G1)

Manoa Farm has been sustainably managed since 1999, according to the Sustainable Forest Management Plan of the company. The management aims at timber production combined to the conservation of natural resources; therefore, it adopts low-impact harvesting techniques and meets all current legislation and forest certification principles. Thus, the project has not been implemented to generate greenhouse gases (GHG) emissions for the purpose of subsequent reduction, removal, or destruction.

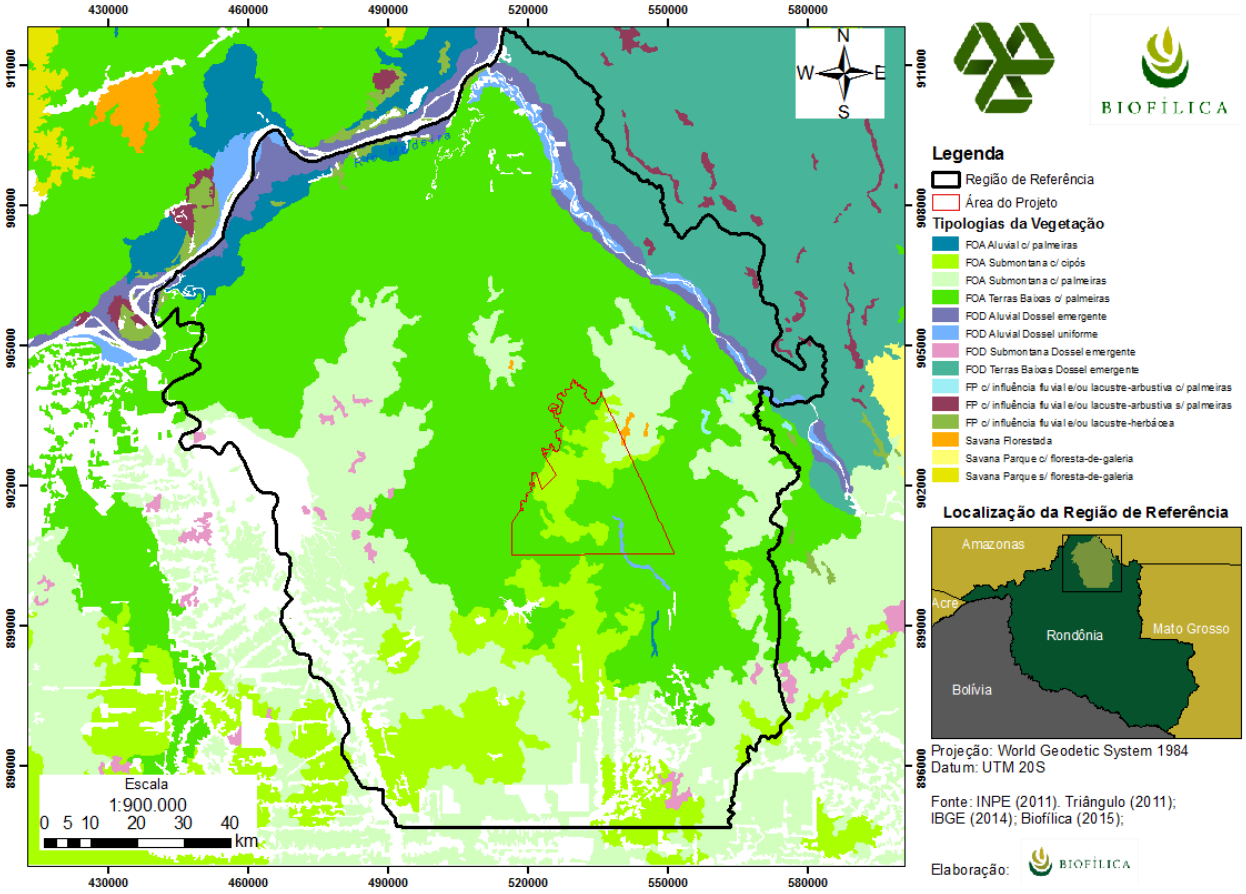
The following describes the conditions found prior to the Project start.

1.3.1 Biodiversity

Flora

The vegetation typologies found in the reference region are Open Ombrophilous Forest in the categories of lowland forests with palm trees, submontane forests with palm trees, and submontane with

vines. Small spots of Ombrophilous Dense Forest under the uniform canopy submontane classification, as well as the forested savanna typologies, and emerging canopy alluvial forest can be observed. The Open Ombrophilous Forest tipology predominates in the project area, with formation of lowlands with palm trees, followed by Open Ombrophilous Forest, submontane with vines, and Open Ombrophilous Forest spots, submontane with palm trees (Casa da Floresta, 2015).



Phytosociology

The phytosociological survey conducted in the project area showed a total of 177 arboreal species belonging to 45 botanical families. The family holding the largest species diversity is the Fabaceae with 50 species, followed by Arecaceae and Mavacea with 9 species each, Moracea, Sapotaceae and Lecythidaceae, with 8, 7 and 6 species, respectively.

Mammalian Fauna

The study conducted in the project area sampled 43 mid-size and large size mammal species, belonging to seven orders and 19 families. Carnivora and Primates are the most representative orders, with 12 and 11 species, respectively.

Avifauna

The project area registered 273 bird species, belonging to 22 orders and 53 families. This number, however, should significantly increase with greater sampling intensity. Literature points out a number of 472 bird species for the reference area.

Herpetofauna

Manoa Farm registered 44 species of herpetofauna, among which 30 are anuran amphibians and 14 are reptiles. The relatively low number of species may be associated to insufficient sampling effort, as well to the seasonality in which certain species are displayed.

Ichthyofauna

Literature data indicates the presence of 234 species of fish belonging to nine orders, and 38 families were registered for the reference area. The project area randomly registered 11 fishing fish species, according to **Erro! Fonte de referência não encontrada.** .

1.3.2 Physical parameters

Climate Aspects

According to Alvares et al. (2013) cited in Casa da Floresta Assessoria Ambiental Ltda. (2015), Rondônia state climate is classified as Am in the Köppen system, which means tropical monsoon climate, and the coldest month temperature is above or equal to 18°C, the driest month rainfall is below 60 mm and annual average total above 1,500 mm.

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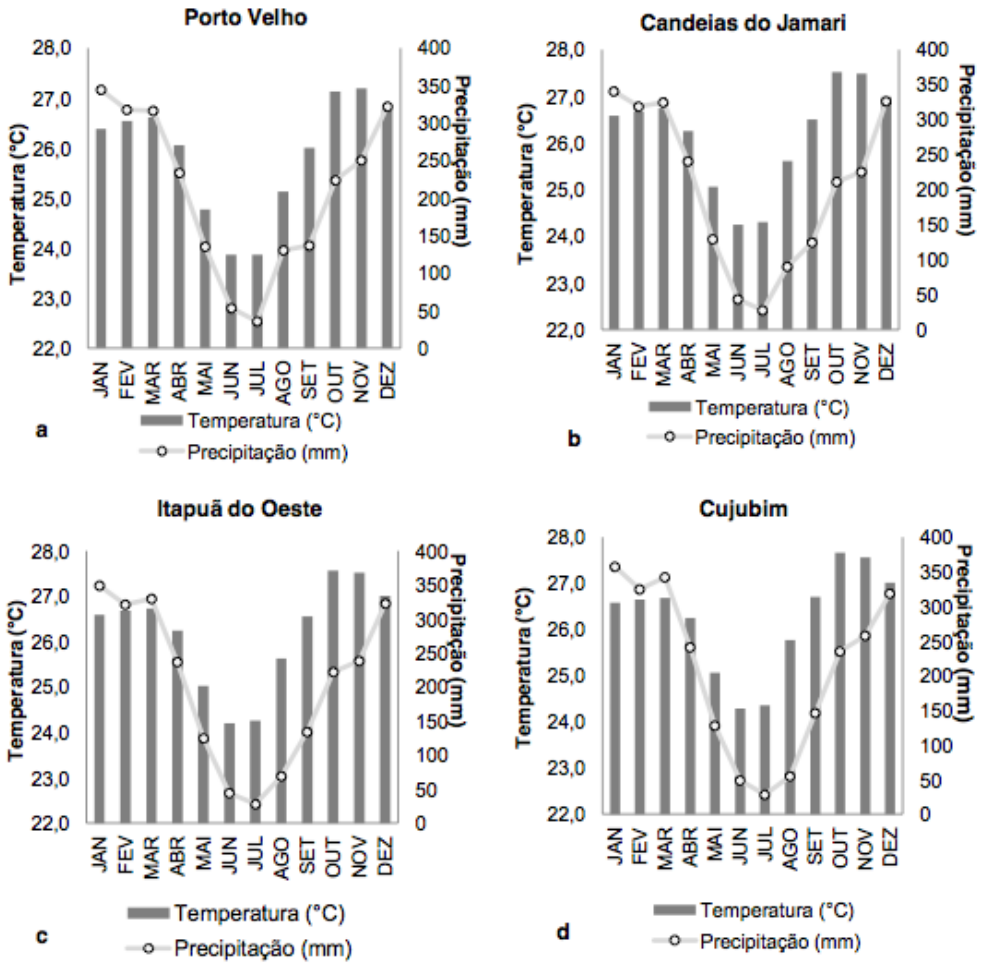


Figure 2. Climate charts of the cities that make up the reference region. a) Average monthly temperature and rainfall of Porto Velho; b) Monthly average temperature and rainfall of Candeias do Jamari; c) Monthly average temperature and rainfall of Itapuã do Oeste; d) Monthly average temperature and rainfall of Cujubim. Source: Alvares et al. (2013) cited in Casa da Floresta Assessoria Ambiental Ltda. 2015.

Erro! Fonte de referência não encontrada. and **Erro! Fonte de referência não encontrada.** show the spatial distribution of annual average rainfall and annual average temperature, respectively, for the reference region.

Hydrographic Aspects

The state of Rondônia is inserted in the Amazon Basin, sub-basin of Madeira River, where all state rivers converge. The main rivers of Madeira River sub-basin are Jamari, Machado (or Ji-Paraná), Guapore, Mamoré, Alto Madeira, and Abunã.

The reference region is partially composed of the Jamari River basin in the far west, by Machado River basin in the mid-east region, and by the high basin of Madeira River, in the far north (**Erro! Fonte de referência não encontrada.**).

Pedological aspects

As a result of long lasting weathering and leaching actions, the sedimentary rocks and the crystalline basement found in the reference area during Neogene resulted in deep soils, such as Latosols, Argisols, and Espodosols, which predominate in the state of Rondônia (DANTAS; ADAMY, 2010 cited in CASA DA FLORESTA ASSESSORIA AMBIENTAL LTDA, 2015).

In the reference region, in Madeira River plains, there are Dystrophic Haplic Gleysols, Dystrophic Red-Yellow Latosol, Dystrophic Yellow Latosol, and Fluvic Neosols (SHINZATO et al., 2010 apud CASA DA FLORESTA ASSESSORIA AMBIENTAL LTDA, 2015) (**Erro! Fonte de referência não encontrada.**).

On the banks of the Madeira River and Jamari River lower, in the composition of Samuel HPP, we observe Eutrophic and Dystrophic Gleysols. Gleysols develop in saturated conditions, without the presence of dissolved oxygen, forming a Gleysols horizon, of gray and greenish colors. Eutrophic Gleysols have higher cations saturation exchangeable with plants, and the dystrophic ones have lower base saturation.

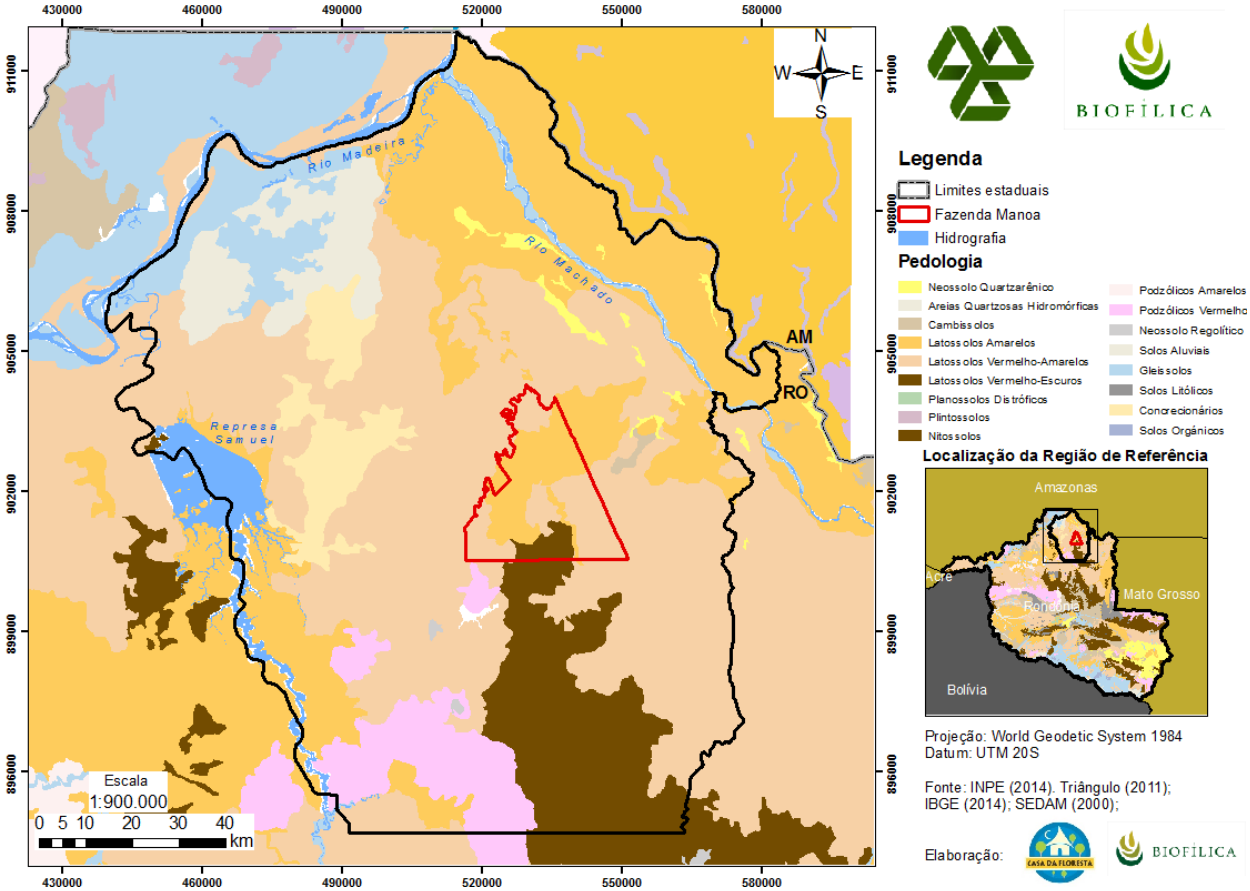
Check possibility of summarizing the pedological aspects

Yellow Latosols are found east and far west of the reference region, characterized by the yellowish color, due to the almost exclusive presence of goethite in the iron oxides in the clay fraction, resulting from high humidity in the region (Casa da Floresta, 2015).

Red-Dark Latosols are found in Cujubim's south-central, southern of the reference region, in the Formations of Santa Clara and Serra da Providência. (Casa da Floresta, 2015).

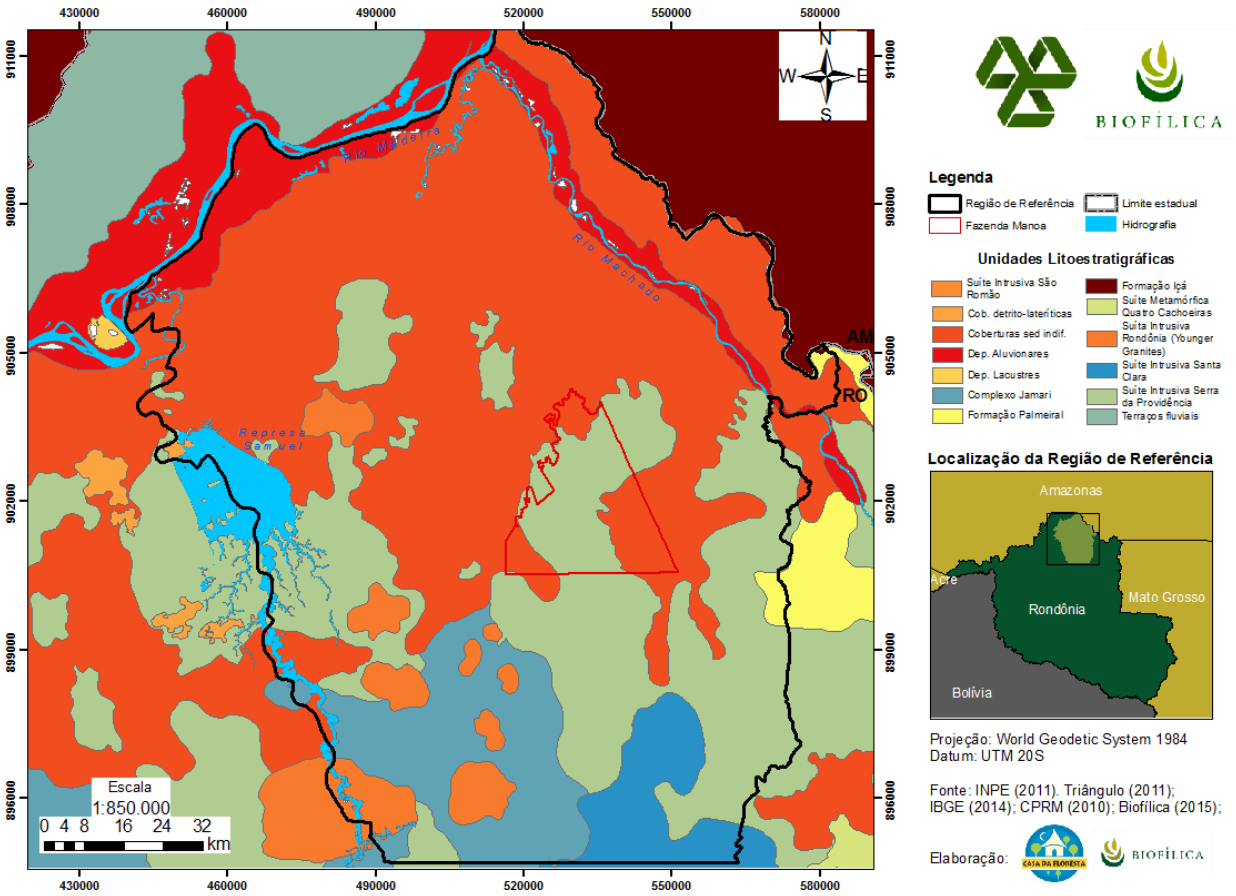
The Quartzarenic Neosols are found among the Yellow Latosols, at the Machado River banks, far east of the reference region. They have essentially sandy texture in all horizons and high to moderate acidity, with low saturation by bases and low fertility (Casa da Floresta, 2015).

Concretionary Dystrophic soils are found in the inselbergs of Serra da Providência, west part of the reference region, near Samuel HPP. They are characterized by the presence of petroplinthites (but in insufficient quantities to be defined as Plinthosol), originated from wetting and severe dryness, with formation of ferruginous nodules and concretions (SANTOS et al., 2012 cited in CASA DA FLORESTA ASSESSORIA AMBIENTAL LTDA, 2015). Small areas of Regolithic Neosols are found south-central of the reference region. Dystrophic Red-Yellow Argisols are found in the end south of the reference region. Dystrophic Haplic Cambisols are found east of the reference region.



Geological aspects

The state of Rondônia is inserted in the west/southwest region of the Amazonian Craton in Central Brazil Shield. The Amazon Craton is one of the largest Precambrian areas of the world, representing one of the main tectonic units of South America. Parnaíba, Xingu and Alto Tapajós, Parecis, Solimões, Tacutu and Amazonas are Phanerozoic basins located inside the Craton.



1.3.3 Socioeconomic parameters

Identification of parties

The choice for the methodology used to conduct the socioeconomic analysis of Manoa REED+ Project Reference Region took into account the need to combine data obtained from local authorities, government departments, and data obtained in fieldwork activities carried out in the city of Cujubim, in addition of secondary data.

Therefore, we applied questionnaires to three groups of the study target, which were the population of urban areas, rural areas, and farm workers, who served as basis for future analysis. The questions focused on meeting the particularities listed in the Terms of Reference of the study, and consequently the particularities of REED+ projects validators standards. The questionnaires were formulated with closed and open questions, as this model enables researchers to observe some subjectivities of the respondent, and could be hidden in a later stage of tabulation and data analysis.

The questionnaires were applied in fieldwork activities carried out between the 8th and 17th of October 2014. The number of applied questionnaires referred to the sampling effort obtained in the deadline given to the field survey. We have chosen this procedure in the field stage because the following

activities were conducted in this period: Interviews with residents from Cujubim's urban perimeter, from rural areas, and with Manoa Farm workers; the project, during this period, also observed how researchers perceived the condition of the city, as it was possible to contact city administration departments, with which we have conducted open interviews with audio recording, upon permission of the respondents.

The secondary data were obtained through public information available in official websites, as well as requested through official letter to state agencies from several socioeconomic areas, once few replied.

We emphasize the difficulties in obtaining official information in the data collection period, due to the election time, as much information were unavailable concerning the current legislation.

1.4 Project Proponents (G4)

Table 2. Identification and responsibility of Manoa REDD+ Project Proponents

ORGANIZATION	DESCRIPTION
Biofílica Investimentos Ambientais S.A (primarily responsible for the design and implementation of the project).	Biofílica Investimentos Ambientais is a Brazilian company that promotes the management of forest areas in the Amazon biome. The company was founded in 2008, striving to create pioneering alternatives and turn environmental conservation into an economically interesting activity for forest owners, communities, and investors. Biofílica's mission is to reduce deforestation and carbon emissions into the atmosphere, conserve biodiversity and water resources, and promote social inclusion and the development of communities that live in the Amazon biome. This mission is achieved by commercializing environmental services credits, by fostering and financing scientific research activities, and by developing sustainable business chains. **Responsibilities in the Project:** overall coordination of the socioeconomic and environmental diagnosis (DSEA), baseline studies and carbon stock; development and financing of PDD (Project Design Document); validation/verification and sale of credits; project co-management throughout its duration. **Contact Information** Plínio Ribeiro **Phone:** +55 (11) 3073-0430 **Email:** plinio@biofilica.com.br **Website:** www.biofilica.com.br

Triângulo Pisos e Paineis Ltda	Triângulo Pisos e Paineis is the owner of Manoa Farm, in the city of Cujubim, state of Rondônia, property in which Manoa REED+ Project is installed. Dedicated to wood industrialization since 1972, it strives to the responsible timber production, continuous product development, and forest protection with social responsibility. The company invests in the conservation of its native forests through responsible management. Project Responsibilities: Triângulo Pisos e Paineis Ltda. owns the land where the project will be implemented. Co-management and control of project activities. Contact Information: Douglas Granemman de Souza Phone: +55 (41) 2106-5113 Email: triangulo@triangulo.com.br Website: www.triangulo.com.br

1.5 Other entities involved in the project (G4)

Table 3 Identification and responsibility of other entities involved inManoa REDD+ Project.

ORGANIZATION	DESCRIPTION
Casa da Floresta Assessoria Ambiental Ltda.	Casa da Floresta Assessoria Ambiental is a company specialized in biodiversity and sustainability research. Casa da Floresta holds 15 years of experience in environmental consulting area, and is nationally recognized for conducting high level work, always meeting the needs of its clients, without forgetting its mission and maintaining the quality of its products and services. The company's team is dynamic and of innovative character, composed of forest engineers, agronomists, biologists, ecologists, geographers, and social workers that integrate a skilled team of researchers and specialists able to conduct activities and environmental assessments in the different biomes and terrestrial and water ecosystems in Brazil; thus, combining scientific knowledge with its clients' needs. **Responsibilities in the Project**: Development of characterization studies on the physical environment and biodiversity assessment of Manoa REDD+ Project area.

	Contact Information: Eng. Florestal Me. Klaus D. Barretto - Forest Engineer - Master's Degree Agrônoma Ma. Mônica C. de Brito - Agronomist Engineer - Master´s Degree **Phone:** +55 (19) 3433-7422 **Email: Elson Fernandes de Lima <elson@casadafloresta.com.br>** **Website:** www.casadafloresta.com.br
Ecoporé - Guaporé Ecological Action	Ecoporé-Guaporé Ecological Action is an environmental non-profit association. Founded in June 1988 to legitimize its actions, which were developed against predatory timber exploitation, to fight illegal deforestation and invasion of Conservation Units. The association has executed projects aimed at environmental conservation and sustainability, in partnership with governmental and non-governmental institutions and traditional populations. **Responsibilities in the Project:** Development of Socioeconomic and Environmental Diagnostic in Manoa REDD + Project Region. Contact Information: Marcelo Ferronato Phone: +55 (69) 3224-7870 **E-mail**: ecopore@ecopore.org.br Website: www.ecopore.org.br
Florestal - Planejamento, Paisagismo e Consultoria Ltda	It was founded in 1986 in the Ariquemes, state of Rondônia. With 28 years of experience in the forestry industry in Rondônia, the entity is dedicated to the management and use of forest resources. In addition to conducting forest inventory activities and preparing Sustainable forest management plan and the Annual Operational Plan (PMFS)/ POA), the entity is also responsible for technical support during exploration activities of its clients´ management projects, carrying out refreshing courses in Reduced Impact Exploration and Training in Safety at Work . **Responsibilities in the Project:** Development of Manoa REED+ Project Forest Carbon Stock Estimate study.. Contact Information: Eng. Fltal. Márcio José Lovatti - Forest Engineer Phone: +55 (69) 3535-4501 **E-mail:** florestal@florestalro.com.br Website: www.florestalro.com.br

HDOM Engenharia e Projetos Ambientais Ltda.	Founded in 2009 in the city of Manaus, state of Amazonas, Hdom Consultoria Ambiental is a dynamic and multidisciplinary consulting company specialized in providing a set of solutions in environmental education, biodiversity, and forestry. The company provides services throughout Brazil and abroad, always looking for support, developing with the client. **Responsibilities in the Project:** Manoa REED+ Project Baseline Development Contact Information: Mateus Bonadiman, M.Sc. Phone: +55 (92) 98128-3936 **E-mail**: mateus.bonadiman@hdom.com.br Website: www.hdom.com.br

1.6 Project Start Date

Manoa has been taking action to reduce deforestation in its area through the installation of Annual Production Units of Forest Management, ensuring effective physical presence and occupation on its outskirts, since the beginning of its Management Plan. Thus, it is considered the beginning of the project on April 1, 2012, when harvest activities happened which effectively it is a barrier to deforestation and consequent generation of GHG emission reductions.

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1.7 Project crediting period (G3)

The crediting period is April 1, 2012. The finish date will take place on March 31, 2042 completing the 30-year period.

The activities will be developed throughout the project crediting period, as detailed in item 2.2 Description of Project activities.

2 DESIGN

2.1 Sectoral scope and project type

- Sectoral Scope: 14 - Agriculture, Forestry and Other Land Use (AFOLU)
- Reducing Emissions from Deforestation and Forest Degradation (REDD)

- Methodology for Avoided Unplanned Deforestation (AUD)
- This is not a clustered project.

2.2 Description of project activities (G3)

Striving to avoid greenhouse gas emissions due to deforestation and forest degradation, as well as to generate net benefits to local populations and biodiversity, the project main activities are the following:

Activities for the Climate:

Activities	Processes	Results	Impacts		Period
			Positive	Negative	
Microzonation	Hydrography mapping with GPS	Hydrographic maps	Assist in the road network planning	-	Yearly
		Delimitation of the Permanent Preservation Areas	Ensure the preservation of rivers and springs	-	
Inventory	Measure all trees that meet pre-established criteria	Quantity and Quality of stocks	Select individuals to maintain stocks	Intervention in Forest	Yearly
			Business planning according to the available stock		
			Facilitate the planning of forest operations		
Opening roads/patios	Open all roads and patios according to the pre-planning	Patios to store logs	Reduce distance of logs dragging	Deforestation and Soil Compaction	Yearly
			Reduce impacts on forest soil		

Activities	Processes	Results	Impacts		Period
			Positive	Negative	
		Access in traffic conditions	Facilitate logs flow		Yearly
					Traffic throughout the harvest
Cutting	Cut selected trees	Raw material stock for consumption and sale	Generation of jobs and income	Damage to remaining forest	Yearly
Dragging planning	Define the best way for the skidder	Mapping planning and delineation in the field	increased production	-	Yearly
			Less damage to the remaining forest	-	
Dragging	Remove forest logs	Logs in the patios	Facilitate transportation	Damage to remaining forest and in soil	Yearly
Deforestation Monitoring	Generated reports; deforestation records	Comparison between predicted and occurred deforestation; better understanding and adaptation of actions; proposition of preventive and mitigating measures	Maintenance of forest cover	-	Yearly
Property security	Number of patrols conducted; identified agents	Comparison between predicted and occurred deforestation; better understanding and adaptation of actions; proposition of preventive and mitigating measures	Maintenance of forest cover	-	Continuous

Activities for the community:

Activities	Processes	Results	Impacts	Period
Conduct political/institutional coordination between public agencies and private entities	Participate/support participation of at least one conservation unit council and one city/state council	Word with Conservation Units Boards together with Manoa Farm and City/State Councils Municipal Councils/State	Work in coordination with other environmental protection agents	Continuous throughout the project
	Establish at least one partnership per year for productive/social activities in the city of Cujubim	Creation of partnerships between public/private entities and local agents	Local organizations receiving external support to the project and enabling income generation diversification	
Promote socio-environmental education activities in the city of Cujubim	Develop CEFLOM's political pedagogical project	Political Pedagogical Project developed in a participatory manner with local agents and being used as a training tool.	Reduce local and social-environmental impacts	Continuous throughout the project
	Conduct educational activities in urban and rural areas, following calendar of environmental dates	More people accessing information about social-environmental issues in the city and acting as multipliers		

Activities for biodiversity

Activities	Processes	Results	Impacts
Monitoring of avifauna	02 systematic field campaigns per year	Knowledge of local wealth	Biodiversity Conservation
Monitoring of Mammalian fauna	02 systematic field campaigns per year	Knowledge of local wealth	Biodiversity Conservation
Monitoring of endangered species	02 systematic field campaigns per year	Maintenance of key species	Gold Level Maintenance
Monitoring "Saleiro" HCVA (HCV 1 and 3)	02 systematic field campaigns per year	Maintenance of HCV	Maintenance of key resource for species

2.3 Project benefits risk management (G3)

The risks to climate benefits, both natural and human-induced, were measured using the tool "AFOLU Non-Permanence Risk Tool v3.2", reported in the "Manoa REDD+ Non-permanence Risk Report" according to summary table below (Table 4).

Table 4. Non-permanence risk final score

Category	Score
a) Internal risk	0
b) External risk	10
c) Natural risk	0
Overall Score (a + b + c)	**10**

The risks to climate, community and biodiversity benefits are listed in Table 5 below, with the respective mitigation measures.

Table 5. Risks to project benefits and mitigation measures

Risk	Mitigation
Problems in the commercialization of carbon credits, due to credit price variations and absence of a regulated market, and consequent lack of resources for financing proposed activities.	One of Biofílica roles in the project is to provide funds to credit sale, publishing dissemination materials and keeping constant contact with key market players and potential buyers, establishing a contact network of contacts essential to the sales commercialization effort. Moreover, alternative financing options, such as donations and partnerships for direct implementation of project activities (not necessarily linked to credit sales), will be sought by the applicants.
Lack of interest in communities, research agencies, and other stakeholders	Integrate stakeholders in the project decision-making processes.

2.4 Project governance

The project will be managed by Biofílica and Grupo Triângulo, the parties will have the following obligations concerning the project:

(i) Compliance with Convention 169 of the International Labour Organization, with the Federal Constitution and current legislation, aimed mainly at ensuring respect for the social, cultural, political, and environmental rights;

(ii) keep the coordinators previously indicated by the respective Parties to represent and monitor the Project implementation;

(iii) Keep the other Party updated on the progress of the work activities, forwarding, in a timely manner, all reports and providing relevant information toward the project progress.

The project governance responsibility for Grupo Triângulo:

(i) Reflect internally, develop and implement, in a participatory manner, a socioeconomic transition plan to avoid unplanned deforestation and ensure the Property conservation, meeting expectations of an emission reduction project from deforestation and degradation (REDD +), and ensuring long-term benefits to the Property and Community;

(ii) Monitor and supervise the Project implementation, to meet the proposed objectives;

(ii) Represent the Property in the Carbon Project construction, as a proponent entity;

(iv) Monitor and support activities performed by Biofílica technicians and its associates;

(V) Support Biofílica in the development and implementation of local development plans and other property conservation actions;

(vi) Monitor Carbon Project activities in partnership with Biofílica;

(vii) Keep the Environmental Development Secretariat of the State of Rondônia - SEDAM and other public institutions properly updated on the Carbon Project progress; and

The project governance responsibility for Biofílica:

(i) Conduct Initial and Complementary Investments, provide technical support, including legal, to the formulation and implementation of the Project, and conduct the negotiation and sale of Property of carbon credits to third parties, all in compliance with Sections Two and Third mentioned above;

(ii) Provide information and training on payment systems for environmental services, especially concerning forest carbon market, to the Property Owner, with information and knowledge necessary for the assessment and negotiation with potential buyers and other market sectors;

(iii) prepare the Property PDD, incorporating technical data provided by the partner organizations of this initiative;

(iv) Contribute to partners in the PDD overall development and support the elaboration of a funding approach for an emission reduction project due to deforestation and forest degradation, for forest conservation, sustainable management, and carbon stocks increase (REDD +).

2.5 Project financing (G3 & G4)

Manoa REDD+ project initial activities, developed between 2013 and 2016, were financed with private investment provided by Biofílica. Annual investments provided by Biofílica's resources are programmed from the first generation of credits, aimed at expenses of subsequent verifications and of deforestation monitoring.

Striving to ensure the remaining activities and the generation of positive net impacts on climate, community and biodiversity, the funding will be made through the sale of carbon credits in the voluntary market, avoiding the emission of 442,332 t CO2eq in the first 10 years of the project, and a total of 4,687,440 t CO2 by 2031. The verified credits enable the maintenance of a cash flow to support the proposed activities and to sustainability to those in progress.

2.6 Job opportunities and safety at work *(G4)*

Training

One of Manoa Farm's goal is the capacity building of its employees, visitors and other stakeholders. Table 6 shows the training offered by the company between 2008 and 2010.

Table 6. Courses, conventions, and visits held at Manoa between the 2008 and 2010.

ACTIVITY TYPE	TOPIC	INSTITUTION	# OF PARTICIPANTS	DURATION	OBSERVATION
COURSE	AMAZON ECOLOGY	UNIR	28	03 DAYS	2008
CONVENTION	MAMMALIAN FAUNA	UNIR	4	SEVERAL SURVEYS IN 01 YEARS	2009 AND 2010
CONVENTION	SMALL RODENTS	UNIR	2	SEVERAL SURVEYS IN 01 YEARS	2009 AND 2010
VISIT	BIOLOGY	UNIR	5	02 DAYS	2010

CONVEN TION	FOREST MANAGEMENT	FAAR	35	03 DAYS	2009 AND 2010
CONVEN TION	FOREST MANAGEMENT	FARO	27	03 DAYS	2009
VISIT	FOREST MANAGEMENT	INDIVIDUAL	SEVERAL		

Health and Safety

Triângulo Pisos e Painéis Ltda. perceives work health and safety as primordial aspects of the company's daily activities. Therefore, it fully complies with the Occupational Health Medical Control Program (PCMSO), carrying out medical evaluations on employees at admission, annually, return to work, on leave of absence exceeding 30 days, and in case of dismissal. The company also complies with the Environmental Risks Prevention Program (PPRA), which monitors and proposes measures to reduce the risks related to each work activity.

Several activities part of responsible forest management operations entails risks to the health and safety of workers, such as those performed in cutting tree areas, loading patio, concentration patio, and supply area. Striving to ensure health and safety of workers, the company has a general procedures manual for forest management (Douglas A. Grenemann de Sousa and Industria de Madeiras Manoa Ltda., 2012), which must be followed by all employees.

The manual describes the mandatory use of safety equipment for each function, procedures for properly and safely perform each activity, instructions on proper disposal of waste, hygiene measures, and others. The manual also describes the health and safety monitoring plan at the workplace, which is summarized in an internal semi-annual audit conducted by Manoa/Douglas, followed by meeting between the forest engineer and the third party company to inform nonconformities and deadlines of corrective actions. After the deadlines, another meeting is held for concluding the corrective actions.

Among the audited items are food products, quality of water provided, living conditions in the camps, occupational health programs, ergonomic conditions of activities, provision of environmental risk prevention program, training, workers transportation, fuel transportation, hazardous areas communication system, machinery and equipment condition, and rest period between working shifts.

2.7 Stakeholders (G3)

Biofílica ordered a socio-economic and environmental assessment of the project area to Ecoporé - Ação Ecológica Guaporé (Ecoporé), which identified the population nearby Manoa Farm who could be affected by the project.

The diagnosis was based on literature data and information obtained from the municipal administrations and government departments of cities in the reference region, except for Cujubim, which also provided primary data. Primary data were collected through open and closed questions questionnaires applied on three groups of the study population: rural and urban areas and farm workers.

The choice to collect data in the city of Cujubim was made as the city undergoes direct social and economic impacts from Manoa Farm, once the access, job generation, and allocation of raw material (wood) take place in this city.

Ecoporé observed in the regions surrounding Manoa Farm the presence of large farms conducting cattle raising and soybeans activities, as well as small farmers producers of milk, cocoa, coffee, and subsistence agriculture, in addition of fish farming, which has been attracting new producers to the region. The practice of incorporating small farms to large farms was also observed. The small farmers, unable to keep their activities due to the lack of soil productivity, lack of resources to invest in property, combined with lack of public policies on health, education, and technical assistance, end up abandoning or selling their land to large farmers, and move to areas still covered with forest, restarting the deforestation cycle.

The city of Cujubim counts on 72 timber business units, which, only in 2013, processed 354,000 m^3 of wood.

Figure 14 shows the source of income of respondents living in Cujubim's urban area

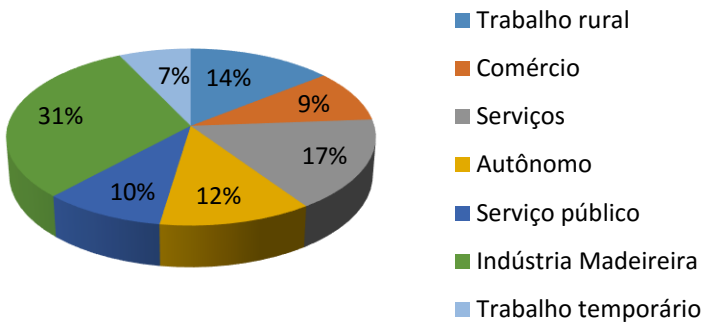

Figure 3. Source of income of the population interviewed by Ecoporé in the urban area of Cujubim, state of Rondônia.

There were no traditional peoples and communities located, according to definition given by Decree No. 6,040, of February 7, 2007, which established the National Policy for the Sustainable Development of Traditional Peoples and Communities, with exception of remaining rubber tappers located around FLONA Jamari, nearby Itapuã do Oeste, as well as large Riparian communities along Madeira River and Machado River.

These communities, although located in the reference region, have no connection with the project area; thus, they are located outside the project area, and there is no actions or programs available to these populations (Ecoporé, 2015).

2.8 Commercially sensitive information

The information below is considered commercially sensitive and are only made available to validators/verifiers. They are confidentially and not available to the public.

- Project budget;
- Financial projections;
- Triângulo financial statements;
- Biofílica financial statements;
- Agreements and contracts held between the parties involved.

3 LEGAL STATUS

3.1 Compliance with laws, statutes, property rights, and other regulatory frameworks (G4 & G5)

Compliance with Laws, Statutes, and with other relevant regulatory bodies to the project are mostly linked to forest management activities. In the State of Rondônia, the project activities are licensed by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), along participation of the Environment State Department (SEMA-RO), so applicable laws are at federal and state levels. The state law is applied secondarily to federal legislation.

Manoa obtained its first FSC certification in late 2005, for management operations and chain of custody, becoming the first FSC certified forest management area in the State of Rondônia. The following FSC Principles were required to obtain the certification:

Principle 01: Obedience to FSC Laws and Principles.

Principle 02: Responsibility and Right of Ownership and Land Use.

Principle 03: Rights of Indigenous Peoples.

Principle 04: Community Relations and Workers' Workers.

Principle 05: Forest Benefits.

Principle 06: Environmental impact.

Principle 07: Management plan.

Principle 08: Monitoring and Evaluation.

Principle 09: Maintenance of High Conservation Value Forests.

Nationally, the most significant effort to date was the submission of Bill No. 195/2011, which "establishes the national system to reduce emissions from deforestation and degradation, conservation, sustainable forest management, maintenance and increase of carbon stocks (REDD+), and other provisions", which are still in progress.

The main legislation and relevant federal and state regulations are described below, although legal compliance is not limited to only these ones. In addition, a brief analysis on international climate agreements that have been guiding the creation and development of REDD+ initiatives was conducted.

Although Brazil and the State of Rondônia do not hold an official designated authority for REDD+ projects approval, information and consent from formal and traditional authorities were obtained, along with the identification, consultation, and engagement for participation in the project design. This project consulted the surrounding populations impacted by the project, agencies and departments of the cities of Porto Velho, Candeias do Jamari, Itapuã do Oeste, and Cujubim.

International Agreements

FCCC/CP/2005/Misc.1: Reducing emissions from deforestation in developing countries: approaches to stimulate action. Submission from Parties. 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 or “Action Bali Plan”. COP 13, Bali, 2007.

FCCC/CP/2009/Add.1: Report on 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 or “Copenhagen 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 or “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 Conference of the Parties at its seventeenth session. 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.

FCCC/CP/2013/Add.1: Warsaw Framework for REDD-plus, held in Warsaw, Poland, from 11 to 22 November 2013, in particular the following decisions:

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. 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.

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.

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.

Decision14/CP.19: Modalities for measuring, reporting and verifying.

Decision15/CP.19: Addressing the drivers of deforestation and forest degradation.

CITES, - 03/03/1973: “Convention on International Trade in endangerments Species of Wild Fauna and Flora”, signed in Washington D.C. on March 03, 1973, amended in Bonn on June 22, 1979.

International Labour Organization Convention held on 29, 1930, ratified by Brazil in 04/25/1957: It provides for the abolition of forced labor.

International Labour Organization Convention No.87, 1940: It provides for freedom of association.

International Labour Organization Convention No.97, 1949, ratified by Brazil on 06/18/1965, provides for migrant workers.

International Labour Organization Convention No.97, 1949, ratified by Brazil on 11/18/1952, provides for freedom of association and collective negotiation.

International Labour Organization Convention No. 100, 1951, ratified by Brazil on 04/25/1957: It provides for equal pay for men and women.

International Labour Organization Convention No. 105, ratified by Brazil on 6/18/1965: It provides for the abolition of forced labor.

International Labour Organization Convention No. 111, 1958, ratified by Brazil on 03/01/1965: It provides for discrimination in employment and occupation.

International Labour Organization Convention No. 131, 1970, ratified by Brazil on 5/4/1983: It provides for minimum wage establishment, especially in developing countries.

International Labour Organization Convention No. 138, 1973, ratified by Brazil on 6/28/2001: It provides for the minimum age for admission.

Convention of the International Labour Organization No.142, 1975, ratified by Brazil on 11/24/1981: It provides for the development of human resources.

International Labour Organization Convention No.143, 1975: It regulates immigrations conducted under abusive conditions and the promotion of equal opportunities for migrant workers.

International Labour Organization Convention No.155, 1981, ratified by Brazil on 5/18/1992: It provides for workers' safety and health.

International Labour Organization Convention No.169, 1989, ratified by Brazil on 7/25/2002: It provides for indigenous and tribal communities' rights.

International Labour Organization Convention No. 1825, ratified by Brazil on 2/2/2000: It provides for prohibition of the worst forms of child labor and immediate action for its elimination.

Federal Legislation and Regulations

Law 12,651 of 05/25/2012: It provides for the protection of native vegetation; amending Laws No. 6938, of August 31, 1981, Law No. 9393, of December 19, 1996, and Law No.11428 of December 22, 2006; revoking Laws No. 4771, of September 15, 1965, and No. 7754 of April 14 1989, and Provisional Measure No. 2166-67, of August 24, 2001; and other measures.

Law No. 12187 of 12/29/2009: It established the National Policy on Climate Change (PNMC) and provides other measures.

Provisional Measure No. 571, of 05/25/2012: It amends Law 12651 of May 25, 2012, which provides for protection of native vegetation; amending Laws No. 6938, of August 31, 1981, Law No. 9393, of December 19, 1996, and Law No.11428 of December 22, 2006; revoking Laws No. 4771, of September 15, 1965, and No. 7754 of April 14 1989, and Provisional Measure No. 2166-67, of August 24, 2001.

Law No. 58,054 of 3/23/1966: It promulgates the Convention for the protection of flora, fauna and scenic beauties of the American countries. .

Decree No. 96944 of 10/12/1988: It created the Program in Defense of the Ecosystem Complex of the Legal Amazon, and other measures.

Decree No. 2661 of 7/8/1998: It regulates the sole paragraph of art. 27 of Law 4.771 of September 15, 1965 (Forest Code), by establishing precautionary standards for activities involving fire in agropastoral and forestry practices, and other measures.

Decree No. 2959 of 2/10/1999: It provides for measures to be implemented in the Legal Amazon, for monitoring, prevention, environmental education, and forest fire fighting.

Decree No. 5975 of 11/30/2006: It regulates art. 12, final part, 15, 16, 19, 20 and 21 of Law 4771 of September 15, 1965, art. 4, item III, of Law 6938 of August 31, 1981, art. 2 of Law No. 10650, of April 16, 2003, amends and adds provisions to Decrees 6514/08 and 3420/00, and other provisions.

Decree No. 7390 of 12/9/2010: Regulates articles 6, 11 and 12 of Law 12187 of December 29, 2009, establishing the National Policy on Climate Change (PNMC), and other measures.

Decree-Law No. 5452 of 05/01/1943: Approves Labor Laws Consolidation. CONAMA Resolution No. 16 of 12/07/1989: It establishes the Integrated Program for Assessment and Environmental Control of the Legal Amazon.

CONAMA Resolution No. 378 of 10/19/2006: It defines undertakings potentially responsible for national or regional environmental impact for purposes of item III, paragraph 1, art. 19 of Law 4771 of September 15, 1965, and other measures.

CONAMA Resolution No. 379 of 10/19/2006: It creates and regulates the data system and on forest management under the National Environmental System - SISNAMA.

CONAMA Administrative Rule No. 218 of 5/4/1989: It provides for felling and exploration of native forests and successors forest formations of the Atlantic Forest, and other measures.

IBAMA Administrative Rule No. 37 of 4/3/1992: Recognizes as Official List of Brazilian Endangered Flora Species the list found in the Administrative Rule.

Ministry of Environment Administrative Rule No. 103 of 4/5/2006: It provides for the implementation of the Document of Forest Origin - DOF, and other measures.

Ministry of Environment Administrative Rule No. 253 of 8/18/2006: It establishes, from 1 September 2006 on, under the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), the Document of Forest Origin (DOF), replacing the Authorization for Transportation of Forest Products (ATPFs).

Administrative Rule 1896 of 09/12/2013: It amends Regulatory Norm No. 31. Ministry of Environment Administrative Rule No. 1 of 9/5/1996: It provides for Obligatory Reforestation and

Forest Integrated Plan.

Ministry of Environment Administrative Rule No. 07 of 4/27/1999: It provides for the authorization for deforestation in the Legal Amazon States.

Ministry of Environment Administrative Rule No. 02 of 5/10/2001: It provides for the economic exploration of forests in rural properties located in the Legal Amazon, including Legal Reserve areas and with exception of permanent preservation established in current legislation, which will be carried out through multiple use sustainable forest management practices.

IBAMA Normative Instruction No. 30 of 12/31/2002: It informs the geometric volume calculation of standing trees, applying the volume equation that specifies it, and other measures.

IBAMA Normative Instruction No. 112 of 08/21/2006: It regulates the Document of Forest Origin - DOF, established by Ordinance Ministry of Environment Administrative Rule .253 of August 18, 2006. (Amended by IBAMA Normative Instruction No. 134 of November 22, 2006)

Ministry of Environment Administrative Rule No. 06 of 12/15/2006: It provides for the reforestation and consumption of forest raw materials, and other measures.

IBAMA Normative Instruction No. 178 of 6/23/2008: It defines guidelines and procedures, provided by IBAMA, for consideration and approval on the issue of forest suppression authorizations and other forms

of native vegetation in an area greater than two thousand hectares in rural properties located in the Legal Amazon, and a thousand hectares in rural properties located in the remaining regions of the country.

Regulatory Norm No. 31 of 03/03/2005: Approves the Regulatory Norm for Safety and Health at Work in Agriculture, Cattle Raising, Forestry, Forest Exploration, and Acquafarming.

3.2 Right of use evidence (G5)

Manoa REDD+ Project activities will be developed according to the use and ownership right of Triângulo Pisos e Painéis Ltda., according to the following alternative of VCS Standard v3.2. right of use demonstration:

"4) A right of use arising by virtu of a statutory, property or contractual right on the land, vegetation or conservation or management process that generates GHG emission reduction and/or removals (...)."

The right to ownership and use are demonstrated by the following documents:

Definitive land ownership title of the 73,079 hectares in the city of Cujubim, state of Rondônia;

Updated Land Registry Certificate;

A clear land registry search certificate, covering the previous 20 years showing that the property is free of onuses and encumbrances and all transfers of title during the established period.

Clear title of property; and

Environmental Licensing in Rural Property;

An additional documentary survey concluded that that the property is under good standing status, and there are no encumbrances, liens or limiting the full use of it, also not there, there is no obstacle to carry out the Manoa REDD+ Project such as locks, liens, mortgages, foreclosures, or land disputes. The proof of this legitimacy can also be evidenced by the FSC and Cerflor certification seals obtained, which attest the legality of the project, as explained above.

In addition to the land good standing status to make Manoa REDD+ Project legally feasible, Biofílica Investimentos Ambientais made an legal agreement with Triângulo Pisos e Painéis Ltda., which owns the property, and with Douglas Antonio Granemann de Souza and Carlos Alberto Barbosa Porsh, sustainable forest management operators, ensuring that Biofílica is the sole and exclusive developer of the project regarding the environmental services and other co-benefits.

Moreover, there are no records of disputes with third parties for the property ownership, or existing disputes over access to natural resources or property use, and Manoa Farm holds good relationship with the surrounding population,

3.3 Emission programs and other mandatory limits (CL1)

Brazil is a Kyoto Protocol Non-Annex I Parties, having no obligation to reduce greenhouse gases emissions under the UN Framework Convention on Climate Change (UNFCCC).

Furthermore, Manoa REDD+ Project has no current or historical connection with any credit generation initiative related to the Clean Development Mechanism (CDM), or other regulatory or voluntary schemes.

3.4 Participation in other GHG programs (CL1)

The Manoa REDD+ Project was not registered or seeks for registration in any other GHG program, in addition of submitting the project to validation and verification in VCS (Verified Carbon Standard) and CCBS (Climate, Community and Biodiversity Standard) standards.

VCS is mainly responsible for the certification of the benefits to the climate and carbon accounting, turning the project eligible to generate credits, and CCB ensures the generation of co-benefits for the climate, communities, and biodiversity.

3.5 Other types of environmental credits (CL1)

REDD+ Manoa Project does not hold or wishes to generate any kind of environmental credit related to GHG emissions reduction or removals claimed within the VCS Program.

3.6 Projects rejected by other GHG programs (CL1)

REDD+ Manoa project was not submitted to validation/verification upon any other GHG program and therefore has not been rejected by any other GHG program.

3.7 Respect for rights and involuntary relocation (G5)

No property rights will be affected and there will be no involuntary relocation of people or activities important to the way of life and culture of communities living nearby.

3.8 Illegal activities and project benefits (G5)

In the baseline scenario, the illegal deforestation practiced in the project area generates problems related to a scenario without the project

4 METHODOLOGY APPLICATION

4.1 Methodology title and reference

The methodology used in the project is the Methodology for Avoided Unplanned Deforestation, VM0015 version 1.1 of December 3, 2012.

4.2 Methodology application

The VCS VM0015 methodology, version 1.1 is applicable to REDD+ Manoa Project because it meets the following applicability criteria:

• Project baseline activities include unplanned deforestation as a result of agricultural activities and livestock, according to the latest version of VCS AFOLU Requirements.

• Project activities include forest protection controlled logging and selectively, in accordance with the description of the scope of "D" of the methodology used (details see page 12, Table 1 and Figure 2b document VCS VM0015)

• The project area has different types of forests, especially old growth forests that are consistent with the definition of "forest".

• The project area includes only areas classified as "forest" for a minimum of 10 years before the project start date.

Forest types found in the project area do not include rainforests in swampy areas ("forested wetlands") or common forested areas in peatlands ("peatswamp forests").

4.3 Methodology Deviations

For performing step 4.1.2.1, equation 3 of page 44 of VM0015 was replaced by equation 04 available Puyravaud (2003). This deviation from the methodology represents a amento of accuracy and does not negatively impact the conservatism of the quantification of GHG emission reductions.

Equation 04 Puyravaud (2013) is an exponential decay model, which leads to an improved accuracy derived from a formula used by the Food and Agriculture Organization (FAO) and the Compound Interest Law. The details and assumptions used to derive equation They were published in the Journal Forest Ecology and Management and Article "Standardizing the calculation of the annual rate of deforestation." on the other hand, Equation 3 is the VM0015 a linear model, much simpler and less conservative.

As a comparison between the two equations for the annual deforestation and cumulative was presented to the auditor team on the worksheet "VM0015_planilha of calculo_Manoa" tab "Step 4.1.2.1" table "Table 4.1.2.1" it was made. As a result, Equation 3 VM0015 resulted in a greater accumulated

deforestation 1,263 hectares in 2040, when compared with the results of Equation 4 Puyravaud then selected to be more accurate and conservative.

4.4 Project boundaries

VM0015 Step 1.1 - project spatial limits
Reference Region

The reference region defined in this Project corresponds to an area of 1,612,481 hectares and presented a deforestation rate of 12,670 hectares per year (0.9% per year) between 2000 and 2010. This reference region was defined considering the relevant geographic ranges to determine the Project's baseline, and meeting criteria set out in pages 18 and 19 of VM0015, which are listed below.

Deforestation agents and causes: Illegal loggers and squatters; squatters and small cattle raisers; medium and large farmers.

- **Landscape configuration and ecological** conditions: 100% of the project area holds the same vegetation types found in the reference region; 100% of the Project area is within the elevation range of the reference region; 100% of the Project area is within the slope variation of the reference region
- **Socioeconomic and cultural conditions**: the legal status of the land that dominates the reference region are private owned properties and other uses according to Figure 5 ; the ownership status of the Project area (private property) can be found in other areas of the reference region; use type and land cover classes, current and projected in the Project area are the same over the whole reference region; the project area is ruled by the same laws and regulations applied throughout the reference region.

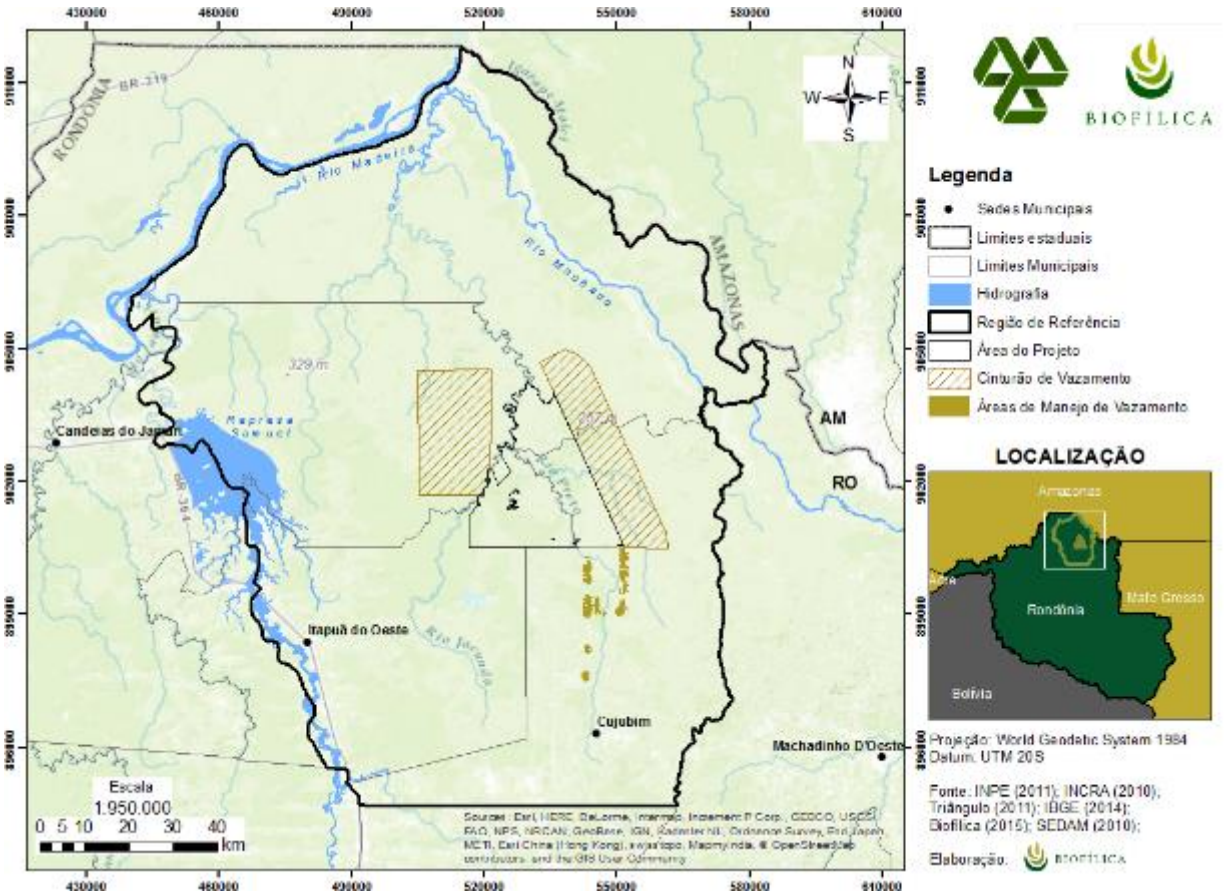

Figure 4 Location of Reference Region, Project Area, and Leakage Belt

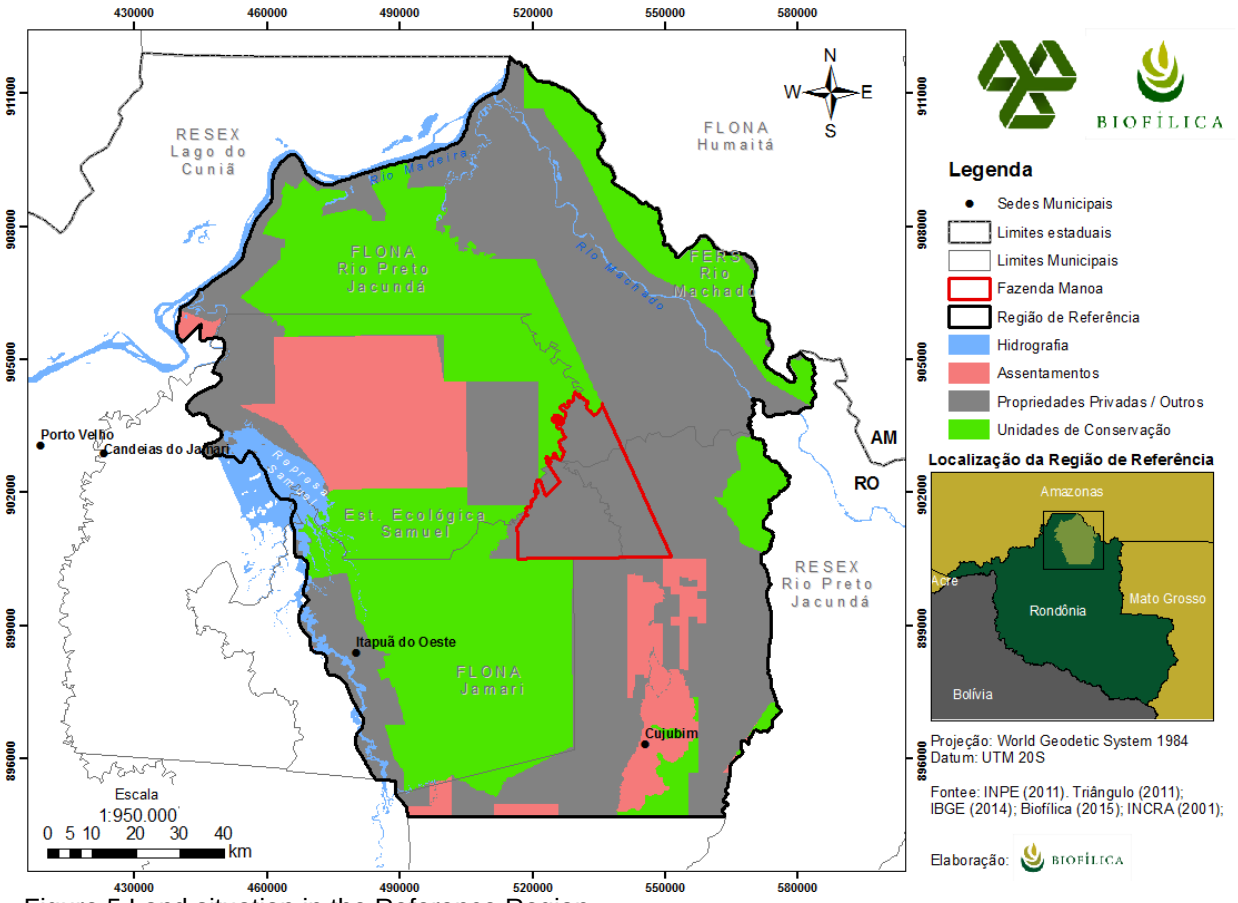

Figure 5 Land situation in the Reference Region

Project Area

Manoa REDD+ Project corresponds to an area of 73,821 hectares of forest controlled by Triângulo Pisos e Painéis, and where the proposed conservation activities will be held. The project area limits were defined according to the property's land situation (Figure 5), the forest area within the property limits when the project began, and the vertices of the property provided by Triângulo, according to Figure 6.

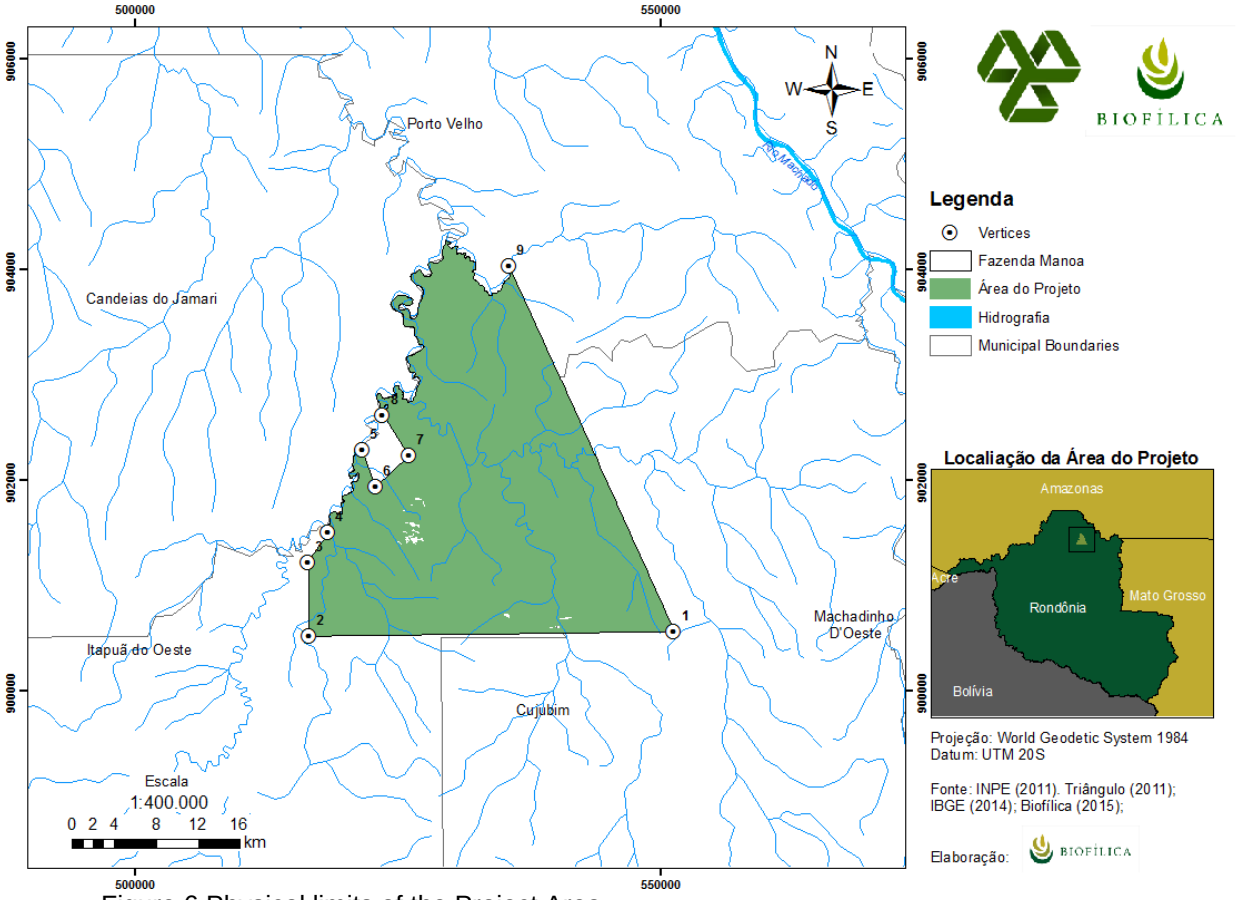

Figure 6 Physical limits of the Project Area.

Table 7 Project Area vertices and coordinates UTM WGS94 - Zone 20S

Vertex	X	Y
1	551181.68	9005592.26
2	516444.01	9005171.36
3	516338.22	9012226.80
4	518258.01	9015019.89
5	521516.54	9022813.71
6	522759.24	9019337.93
7	525954.68	9022296.20
8	523455.14	9026194.85
9	535474.84	9040282.22

Leakage Belt

The leakage belt was defined using the mobility approach (II option available in VM0015 VCS Methodology). This option was selected as there was no data or studies conducted on the reference

region showing that "economic gain" is an important vector of the deforestation observed in the historical reference period. According to a study conducted by Ecoporé (2015), deforestation is the result of a chain of actions related mainly to land ownership insecurity and lack of command and control actions from state and municipal institutions.

Thus, a multi-criteria approach was used to define the space limit of the leakage belt, using as input data the deforestation risk map, prepared in Step 4 of the VM0015, and the land situation map in the surroundings of the project area. This approach considered high accessibility areas, pointed out in the deforestation risk map. Therefore, the leakage belt was allocated in two areas around the Project Area with high accessibility, high risk of deforestation, and with the presence of the following characteristics similar to Manoa Farm: private property with controlled access, surrounded by settlements and conservation units. The total area, referring to the sum of the two areas selected for the leakage belt, totaled 92,874 hectares.

Leakage Management Areas

The areas in which the project intends have influence of its activities to reduce the risk of deforestation south of Manoa Farm. The main criteria for selection of these areas were: areas deforested by 2014 inserted in a hypothetical influence zone of 01 km around the interviews spots conducted by the socioeconomic study (Figure 21). Section describes the activities to be developed by the REDD+ project in the leakage management areas.

Forest

The definition of "forest" used by the Project is in accordance with Resolution No. 2 of the Interministerial Commission on Global Climate Change (CIMGC [1]). Data from the Deforestation Monitoring System in the Amazon (PRODES [2]), prepared by the National Institute for Space Research (INPE), were used to produce the Forest Area Reference Map (VM0015 Step 1.1.5), described in Figure 7 . The smallest mapping unit (MMU) of the PRODES Digital system is 1 hectare (GOFC-GOLD, 2011).

[1] Definition of forest by the Designated National Authority: minimum area of 1 hectare with 30% of surface covered by trees with the potential to reach a minimum height of 5 meters.
[2] www.obt.inpe.br/prodes

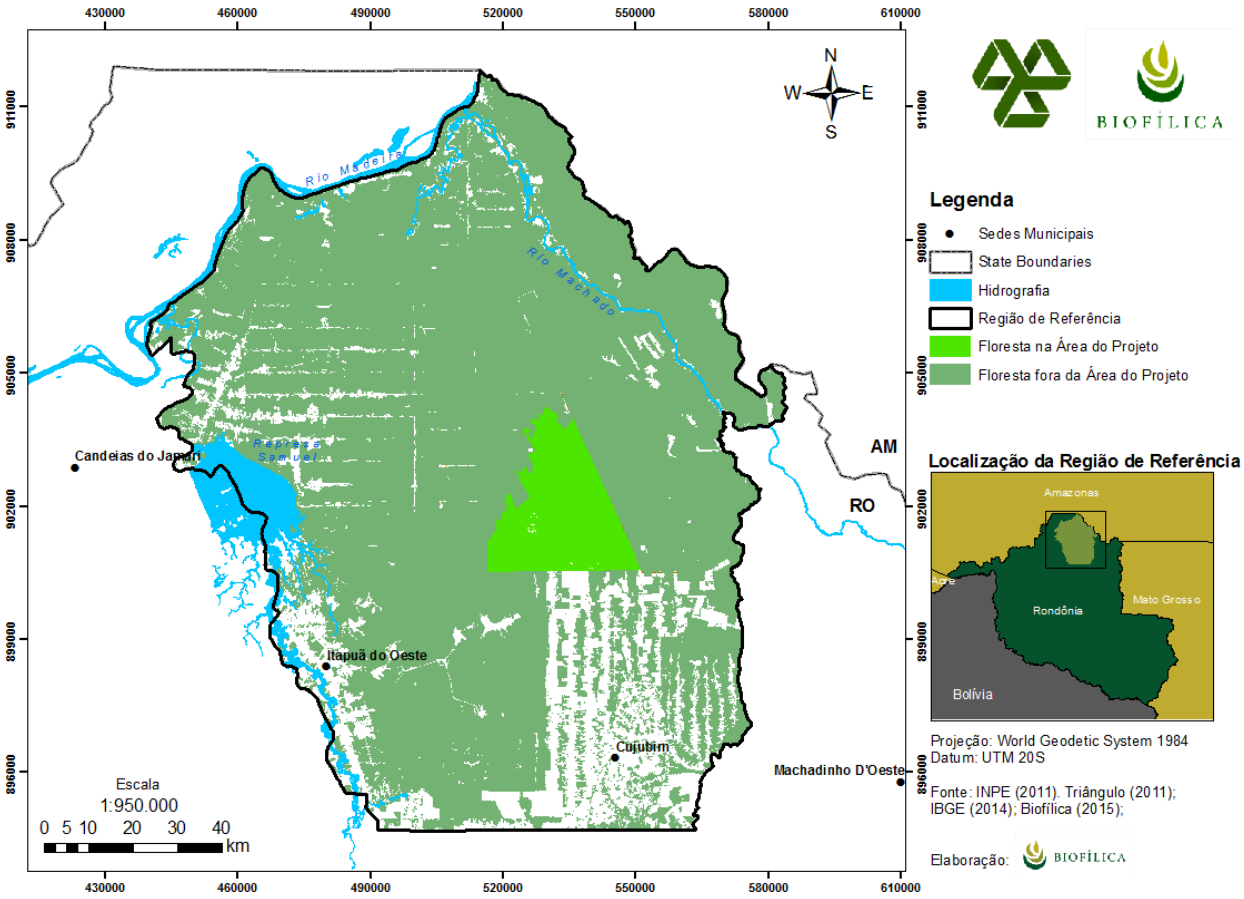

Figure 7 Reference map of forest area in the Reference Region

VM0015 Step 1.2 - Time Limits

- **Start date of conservation activities:** April 1, 2012
- **Starting date of LULCC historical reference period:** 2000
- **Start and end date of the first baseline fixed period:** fixed baseline period is 10 years after the start of project activities, with reevaluation up to 10/01/2022.
- **Monitoring period:** the monitoring period is one year, with activities started in 2012.

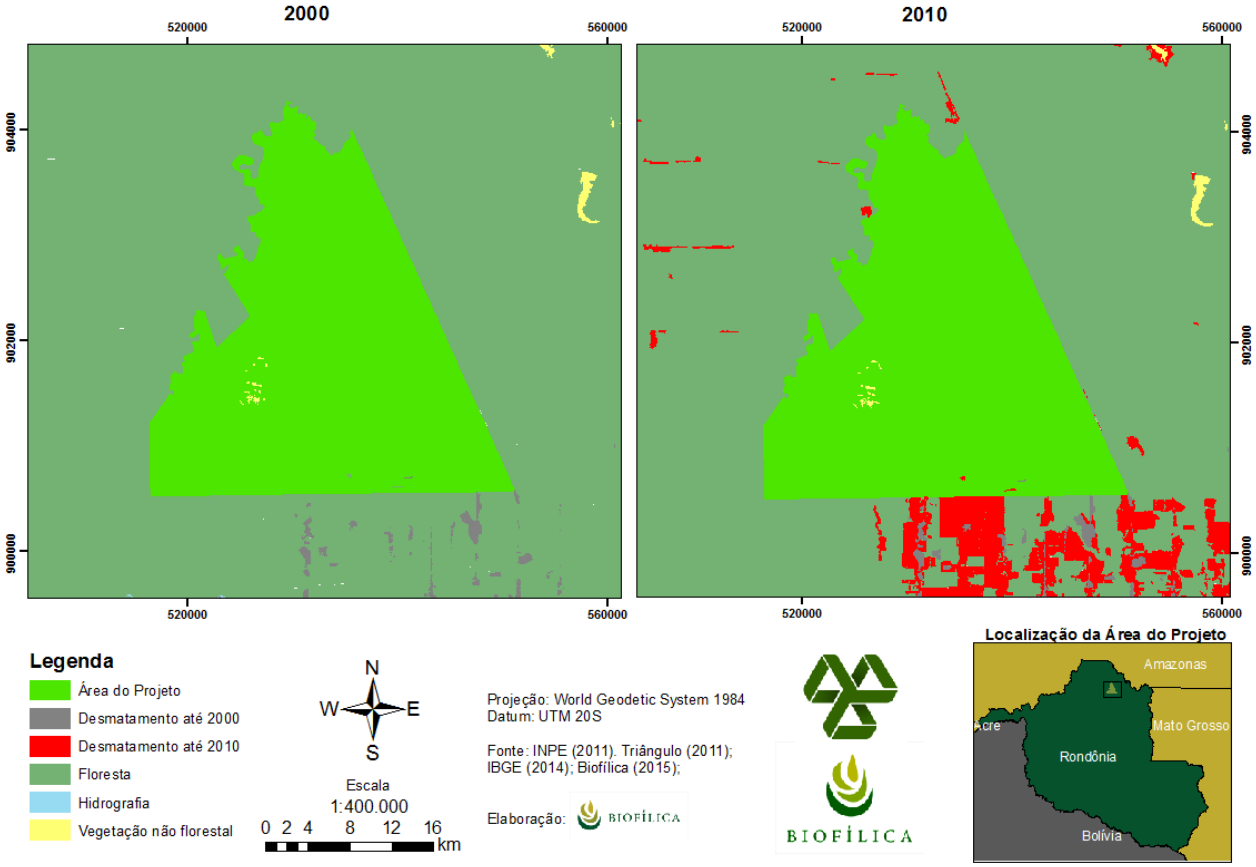

Figure 8 Land use and area from 2000 to 2010

VM0015 Step 1.3 - Carbon reservoirs

The carbon reservoirs considered in the project are found in Table 8 .

Table 8 Carbon reservoirs included in the REDD+ Manoa project (Table 3 of VM0015 methodology).

Carbon Reservoirs	Included /Excluded	Justification/Explanation of Choice
Above ground	Tree: Included	Change in carbon stocks in this reservoir is always significant
	No Tree: Excluded	It should be included in categories in which the final class of land cover is perennial. Reservoir was not inventoried to compose the final forest carbon stock of the project area.
Below Ground	Included	Reservoir represents 15% of the expected emissions in the baseline scenario
Dead wood	Excluded	The changes in carbon stocks for this reservoir are considered insignificant in relation to total emissions and will not be included.

Carbon Reservoirs	Included /Excluded	Justification/Explanation of Choice
Wood products	Excluded	Reservoir not included when wood products in the baseline scenario are smaller than in the scenario with the project.
Litter	Excluded	It should not be inventoried according to VCS program updade on May 24, 2010.
Organic carbon in soil	Excluded	Recommended when forests are converted to agricultural crops. Should not inventoried in conversion to pasture and perennial crops according to VCS Program updates on May 24, 2010. Not applicable to the project.

GHG sources and sinks in the baseline scenario are shown in Table 9 .

Table 9 GHG sources included or excluded within the limits of the project activities (VM0015 Methodology Table 4).

Source:	Gas	Included/Excluded	Justification/Explanation of Choices
Biomass Burning	CO_2	Excluded	Registered as changes in carbon stocks
	CH_4	Excluded	
	N_2O	Excluded	Considered insignificant, according to VCS Program updates, on May 24, 2010.
Cattle emissions	CO_2	Excluded	Not a significant source
	CH_4	Excluded	Not applicable to the project
	N_2O	Excluded	Not applicable to the project

4.5 Baseline Scenario (G2)

VM0015 Step 2- Background Analysis of Soil Use and Cover
Collection from proper data source

Data from software Digital PRODES were used for mapping land use and cover classes, available in vector format (shapefile). A total of 47 satellite images were used to map the classes Forest, Disturbed Vegetation (Deforestation), Hydrography, and Nonforest Vegetation. The images cover the historical reference period (2000 to 2010) and correspond to the following orbits/points of Landsat satellite: 231/66, 231/67, 232/65, 232/66 and 232/67 (Table). PRODES classification and evaluation was carried out using high spatial resolution images available on Google Earth.

Table 10 Satellite images used to map the soil area in the reference region (VM0015 methodology Table 5)

Image (Satellite or airplane)	Sensor	Resolution		Area	Acquisition date	Scene Identification	
		Spatial (m)	Spectral	(km^2)	(DD / MM / YY)	Path/ Latitude	Row/ Longitude
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/17/00	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/11/2001	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	06/11/2002	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/24/03	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/26/04	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	10/01/2005	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	09/02/2006	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/04/2007	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/06/2008	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/09/2009	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/27/10	231	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/16/00	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/19/01	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	06/11/2002	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/09/2003	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/26/04	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/14/05	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/16/06	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/04/2007	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/06/2008	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/09/2009	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/27/10	231	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/18/04	232	65
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/27/07	232	65
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/31/09	232	65
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/19/10	232	65
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/24/00	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/10/2001	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	06/18/02	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/15/03	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	06/15/04	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	06/09/2005	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/08/2006	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	11/8/2007	232	66

Image (Satellite or airplane)	Sensor	Resolution		Area	Acquisition date	Scene Identification	
		Spatial (m)	Spectral	(km^2)	(DD / MM / YY)	Path/ Latitude	Row/ Longitude
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/28/08	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/31/09	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/19/10	232	66
Satellite	Landsat	30	0.45 – 2.35 µm	34	10/8/2001	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	6/9/2002	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/31/03	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	2/8/2004	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/21/05	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/23/06	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/27/07	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/28/08	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	07/31/09	232	67
Satellite	Landsat	30	0.45 – 2.35 µm	34	08/19/10	232	67

Definition of land use and cover classes

The land use and cover classes used in this project are shown in Table 11 . The description of each class and the existing area before the Project start year are shown below:

Table 11 Land use and LAND cover classes existing in the Reference Region (VM0015 Table 6)

Class Identification		Carbon Stock Trend	Present in[1]	Base Line Activity[2]			Description
IDcl	Name			LG	FW	CP	
1	Disturbed vegetation in Balance	Constant	RR, LM.	Yes	Yes	No	Deforested areas due to clearcutting and with vegetation type different from Ombrophylous Forest.
2	Forest	Constant	RR, PA, LK	Yes	Yes	Yes	Remaining forest
3	Hydrography	Constant	RR	No	No	No	Water bodies
4	Nonforest Vegetation	Constant	RR	No	No	No	Nonforest vegetation natural coverage

[1] - RR: Reference Region; PA: Project Area; LK Leakage Belt; LM Leakage Management Areas

[2] - LG: Logging. FW = Fuel-wood collection; CP = Charcoal Production (yes/no)

- **Disturbed Vegetation in Balance** (228,542 ha): deforested Ombrophylous Forest areas converted to other land uses (mosaic of different types of vegetation including pastures, clearings, crops, and secondary vegetation).
- **Forest** (1,332,308 ha): remaining forest area belonging to different Ombrophylous Forest vegetation types.

- **Nonforest Vegetation No.** (4,857 ha): areas consisted of natural vegetation with different forest physiognomy, including Woody Savannah (Cerrado), Grassy-Woody Savannah (Campo Limpo de Cerrado), Campinarana, among others.
- **Hydrography** (46,774 ha): water bodies (rivers, lakes, streams, etc.).

Definition of land use and cover change categories

The project holds two categories of use and change of land use that are expected to take place within the project area and of the leakage belt: change of areas with forest to areas with anthropic vegetation in balance.

Table 12 Definition of land use and land use change categories (VM0015 methodology Table 7.b).

ID_{cl}	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
I1/F1	Forest	Constant	PA	No	No	No	Anthropic Vegetation	Constant	RR. LM	No	No	No
I1/F1	Forest	Constant	LK	Yes	Yes	No	Anthropic Vegetation	Constant	RR. LM	No	No	No

Analysis on the land use and land use change history (VM0015 Step 2.4)

Deforestation mapping data provided by PRODES were used to analyze the history of land use changes. The main methodological steps conducted by PRODES to map deforestation in the Brazilian Amazon are as follows:

- **Preprocessing:** according to Câmara et al. (2006) the main images preprocessing procedures carried out by PRODES consist of selection images with less cloud incidence, with the acquisition date closest to the dry season in the Amazon, and with proper radiometric quality; georeferencing of the images with a spatial resolution of 30 meters with topographic maps at 1: 100,000, and NASA orthorectified images in MrSID format.
- **Interpretation and** classification: the satellite images classification method used by PRODES follows four main steps. First it generates a spectral mixture model identifying t the vegetation components, soil, and shade in the images. This technique is known as spectral linear mixture models (SLMM), which attempts to estimate the percentage of vegetation, soil, and shade components for each cell (pixel) of the image. The second step is the application of the segmentation technique, which identifies, in the satellite image, spatially adjacent regions (segments) with similar spectral characteristics. After segmentation, the classification of segments take places individually, to identify the forest, nonforest vegetation, hydrography, and deforestation (anthropic vegetation) classes

Finally, the result of the classified segmentation is subjected to the editing process, or classification audit, performed by a specialist, ending with the creation of the state mosaics.

- **Post-processing:** The classification result is then subjected to an audit process conducted by a GIS analyst.
- **Map accuracy check:** The mapping check conducted by PRODES was carried out by comparing each class of the most recent land use and coverage map class (2010), with a set of 89 points randomly distributed on the reference region. The reference data used for this step came from visual interpretation of high spatial resolution images available on Google Earth. Using the reference points and the 2010 land use and land cover map, it was possible to check the mapping performance through the analysis of the confusion matrix (Table 13), according to Congalton (1999). The overall accuracy of the mapping for the different classes of land use and cover showed values greater than 80%. The overall accuracy of the forest cover reference map was of 97%.

Table 13 Confusion Matrix of PRODES 2012 data evaluation

		REFERENCE					
		Forest	**Veg. Anthropic**	**Water**	**Nonforest**	**Total**	**User Accuracy**
CLASSIFIED	**Forest**	38	2	2	2	44	86%
	Anthropic Veg	0	22	0	0	22	100%
	Water	0	0	12	0	12	100%
	Nonforest	1	1	0	9	11	82%
	Total	39	25	14	11	89	
	Producer Accuracy	97%	88%	86%	82%		

Analysis Results from the Use and Changes History in Land Use

The analysis results from deforestation history between 2000 and 2010 in the reference region are shown in Table 14 and Figure 9 Annual deforestation in the Reference Region between 2000 and 2010. A deforested area of approximately 126,696 hectares (about 9% of the existing forest in 2000) was observed between 2000 and 2010.

Table 14 LULC Change Matrix in the reference region between 2000 and 2010 (VM0015 Table 7)

ID_{cl}		Name	LU/LC Initial Class (2000)				Total (ha)
			Anthropic Veg	Forest	Hydrography	Nonforest Vegetation	
			I1	I2	I3	I4	
LU/LC Final Class (2012)	F1	Anthropic Veg	101,846	126,696			228,542
	F2	Forest		1,332,308			1,332,308
	F3	Hydrography			46,774		46,774
	F4	Nonforest Vegetation				4,857	4,857
Total (ha)			101,846	1,459,004	46,774	4,857	1,612,481

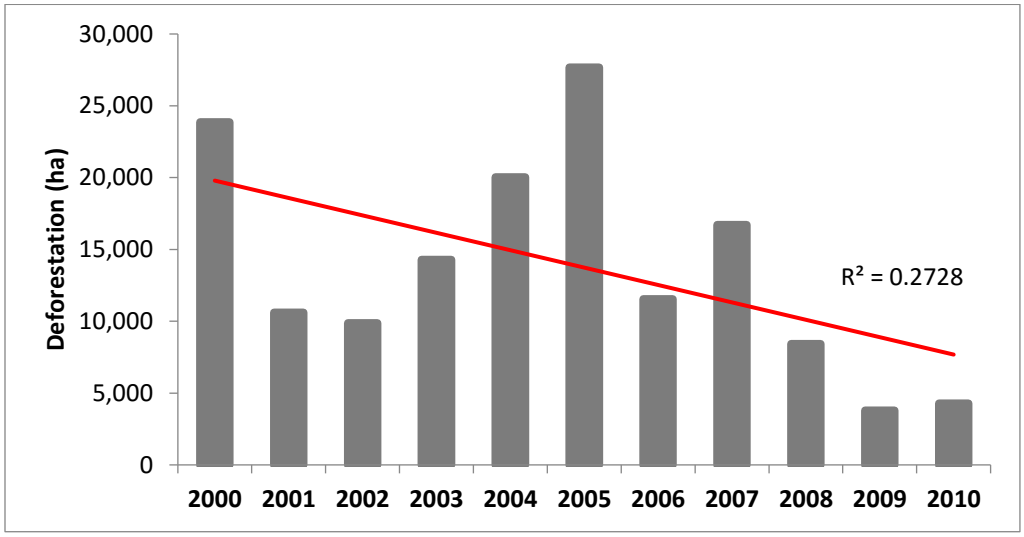

Figure 9 Annual deforestation in the Reference Region between 2000 and 2010

Preparation of the Methodology Attached to PD

Methodological procedures for the acquisition, preprocessing, classification, post-classification, and evaluation on the accuracy of remote sensing images for analysis of changes in land use and land cover during the Project duration.

a) **Data Acquisition:** satellite images from optical or radar sensors should be used. Optical images should have a spectral resolution between 0:45 and 2:35 μm. Radar images should be acquired in band X (cm 3) C (5 cm) or L (23 cm). Land use and land cover mapping should use images with spatial resolution equal to or greater than 30 meters. The images acquisition period should be during lower incidence of clouds and rainfall in the region, between the months of August and November. Concerning forest cover monitoring in the Project area and Leakage Belt, the satellite

image should cover the area corresponding to the following geographical coordinates: 8°36'58"S – 62°58'10"W and 9°25'27"S – 62°17'34"W.

b) **Preprocessing:** the images should be geometrically corrected through georeferencing in ArcGIS 10 or equivalent software, using topographic maps as reference in the scale 1:100,000 or USG-NASA orthorectified images in MrSID format. The georeferencing RMS should be lower than 1 pixel for optical images and approximately 1.5 piexel for radar image. All data should be in the UTM coordinate system, Zone 20S and Datum WGS 1984.

c) **Classification:** use the optical images to transform the digital numbers value in scene components (vegetation, soil, and shade) through the spectral mixture algorithm. Select images of the soil and shade component and apply the segmentation technique through the regions increasing algorithm, with threshold parameters of similarity equal to 8 and area threshold equal to 4. The classification is performed using ISOSEG unsupervised algorithm with 90% acceptance threshold for classes: forest, new deforestation, nonforest vegetation, hydrography, and clouds. These segmentation and classification algorithms may be applied using the image processing software such as SPRING 5 and TerraView 4. The mapped change of category is from forest class to deforestation class.

d) **Post-classification:** the classification result in *raster* format will be transformed in vector format for classification audit in ArcGIS 10. For analysis of areas with cloud cover, use the visual interpretation of radar image.

e) **Evaluation of classification accuracy:** performed by analyzing the overall accuracy and *kappa* index obtained from a confusion matrix (CONGALTON, 1999). At least 50 points randomly distributed derived from high spatial resolution satellite imagery (≤5 meters). The minimum accuracy of the classification mapping should be 80%.

VM0015 Step 3 - Agents Analysis, Drivers, and Underlying Causes of Deforestation and its Future Development

Identification of forestation agents:

a) **Deforestation agents in the reference region**: Group 1 - illegal loggers and squatters; Group 2 - squatters and small cattle raisers; Group 3 - medium and large farmers.

b) **Relative importance of the historical deforestation amount allocated to each agent or group**: These deforestation groups are responsible for 100% of the unplanned deforestation observed in the Reference Region.

c) **Brief description**: Group 1 - illegal loggers and squatters act motivated by the wood supply. This group acts by illegal logging that are "warmed" in sawmills found in the city of Cujubim, and others that move around the region (move according to the wood supply). Deforestation caused by this group takes place in road and extensions opening, earth roads, and timber yards. After or during wood removal, these

agents promote the illegal land allotment for agents that make up Group 2 - squatters and small farmers. Group 2 agents, in turn, start deforestation by making clearings and small areas for cattle pasture, to take ownership of the area. The squatters and small farmers often buy land lots through an off-the-record agreement without consulting the property ownership status in registry offices, INCRA, or SEDAM. Group 3 agents are composed of local farmers and medium and large scales rural producers high purchasing power. These agents cause deforestation by opening irregular access infrastructure (extensions, airstrips, ports), creating extensive cattle pastures, illegal logging, and cultivation of annual cycle crops. Over time, these agents carry out land concentration in the region through the acquisition of property from squatters and small farmers.

d) **Brief assessment of the most likely development of the population in the reference** region: according to IBGE's census data, the rural population in the reference region grew exponentially between 2000 and 2014. The growth average was 1,000 people per year in the city of Cujubim (ECOPORÉ, 2015).

Historical deforestation statistics allocated to each agent in the reference region: Based on the analysis of the land use type on the deforested areas up to 2010, conducted by TerraClass Project (EMBRAPA and INPE, 2011), it was identified that Squatters and Small Farmers are primarily responsible for unplanned deforestation in the reference region (Table 15).

Table 15 Relative contribution of deforestation observed per agent.

Agent	Deforestation (ha)	Contribution (%)
Loggers and squatters	14,673.	7%
Squatters and small cattle raisers	167,751.	79%
Medium and large-scale farmers	31,138.	15%
TOTAL	213,562.	100%

Identification of Deforestation Drivers:

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

Identification of deforestation drivers
Illegal logging and allotments

- **Brief** description: The illegal logging activities existing in the remaining forest of the region, in private or public areas, feeding the logging industries located in the reference region cities. The squatters start the invasion after the removal of higher profit woods, or often in parallel with loggers, by carrying out the allotment of forests degraded by illegal logging. Many time, the agent that extracts the wood is the same that carry outs the illegal allotment. According to a socioeconomic survey conducted by Ecoporé (2015), there are countless settlements throughout conservation unities territories and other areas previously predominated by forest, and people who occupy these

areas generally avoid commenting about the destination of the wood that existed in that location, others do not even live in the settlements as they just carry out cattle activities with few animal to demarcate the land ownership.

- **Impact on agent's behavior:** Illegal logging is usually the firs step for deforestation in the Amazon[3], as it usually causes progressive forest degradation due to the extraction of high profit wood. After removal of larger trees, the agents carry out quick burning and cutting activities of the forest, many times to limit illegally sold lots. Therefore, this region has become attractive for this agents in the option for deforestation, once there are no prevention measures carried out by the government agencies to avoid such actions. The occupation of new areas in the Amazon as a whole follows a cyclical pattern where the settlers (pioneers) who take possession of the land after (or together with) the logging action, leave these areas over time searching for new areas for farming or go to the cities, and the old allotments now belong to producers holding higher financial resources.
- **Development forecast:** Deforestation linked to illegal logging in the reference region tends to increase as it is still possible to remove profitable wood from the areas where access is unsupervised (Ecoporé, 2015). The real estate speculation context of in the area, associated to the lack of government commitment in monitoring and strengthening environmental matters, leads to a continuous degradation of forest remnants (with the removal of high-value wood) and subsequent occupation of these areas by squatters and small farmers who complete the area cleaning process. The increase and development of infrastructure (especially access roads) tends to grow in the future due to the demand exerted by large and medium-sized farmers; thus, providing greater access to groups 1 and 2 agents, feeding the cycle.
- **Measures to be implemented:** In addition to the annual monitoring on changes taking place in the forest area, the project intends, through the generated resources, to develop professional training and environmental education activities, aimed at the sustainable exploration of forest resources and biodiversity conservation. Other proposed activities are related to strengthening the region's rural associations actions, prioritizing job offer to the local community, prioritizing wood sales to local industries, and providing guidance and advice to social organizations. The project proponents' goal, through these activities and actions, is to offer new alternatives for the local population, as opposed to the existing conventional scenario.

Cattle raising and agricultural production

- **Brief description:** according to the socio-economic survey, cattle raising is the main activity in the reference area, even with the growth of new activities such as monocultures (rice, soybean)carried out after deforestation. The sector shows poor management techniques, and much of the pasture

[3] INPE (2008): Technical-scientific report - monitoring of Amazon forest area by satellites.

area produces little, resulting in abandonment and migration of these activities s to other locations (Ecoporé, 2015). Recently, the expansion of monocultures, especially soybeans, has been strongly incorporated to areas previously used for the management of lcattle raising and traditional agriculture.

- **Impact on agent's behavior:** cattle raising enables Group 2 agents (squatters and small farmers) and Group 3 (medium and large scale rural producers) to start the land ownership process and to capitalize quickly. Some squatters and small farmers, often under pressure or violence, end up selling their land to medium and large scale farmers, who expand their activities in the region. The lack of technical assistance and government investments for small producers reflects the abandonment of areas due to little production, this process feeds land speculation and lead to the opening of new forest areas in search for more productive areas.
- **Development forecast:** According to the study and data collected by the socio-economic report on the region (Ecoporé, 2015), the local economy is largely dependent on agricultural activities; thus, this sector tends to evolve due to the scarcity of wood and new government incentives. The region's agricultural dynamics tends to mechanized agriculture growth (monoculture), leading to replacement of pasture areas, which consequently demands new spaces, a factor that contributes to deforestation of new areas. From the socio-economic point of view, the population, due to the probable future lack of wood resources, tends to migrate to new exploration areas or to establish in agricultural settlements. The environmental initiatives taken by the government in the current context are weak and influenced by land interests, leading to a scenario of large scale properties and conversion of forest remaining areas into pastures.
- **Measures to be implemented:** the strategy addressed to these deforestation agents and drivers will be based on the same activities shown to Group 1 agents, previously presented.

b) **Variables to explain the location of deforestation:** four variables were analyzed to identify which one holds the greatest influence on the deforestation location (Figure 5). The method used to estimate the importance of the variables was the Weight of Evidence (Bonham-Carter, 1994). The results were values ranging from -3 to +3, which positive values have high influence and negative values represent low influence. According to the results shown in Figure 8, it was possible to verify that deforestation is more associated with the proximity from previous deforestation areas and roads, as well as settlement and private properties areas.

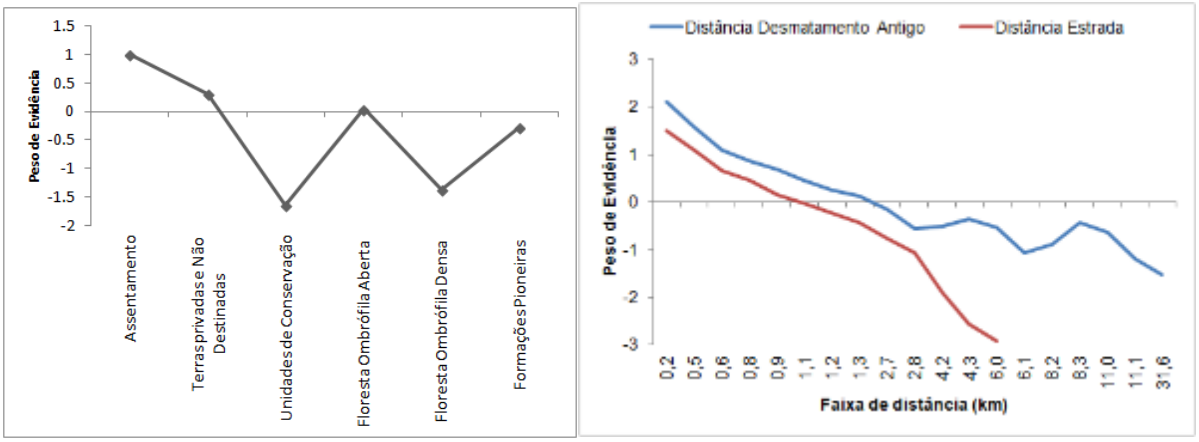

Figure 10 Weight of Evidence of spatial drivers associated with deforestation

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

- **Settlement:** forest areas within INCRA`s settlement projects are the ones with higher registration and risk of deforestation in the reference region.
- **Private land or not** intended: small, medium and large farms that conduct agricultural activities, forest or lots management under a land regularization process.
- **Conservation units:** protected areas act barriers to prevent deforestation in the reference region.
- **Vegetation** type: Open Ombrophilous Forests are more susceptible to risk and deforestation compared to other forest types.
- **Distance from previous** deforestation: areas that are influenced due to proximity to previously deforested areas.
- **Distance from roads:** forests near roads and road extensions are more accessible, becoming more susceptible to deforestation.

Deforestation underlying causes:

There are many studies that suggest the existence of several direct and indirect causes of deforestation in tropical forests, which are the result of a complex set of relations that contribute to forest reduction. Rivero et al. (2009) states that the underlying causes are related to the growth of markets and increasing demands for products that necessarily generate changes in land use. Population growth, cultural factors, integration of public policies for regional investment, land ownership insecurity, political factors, and impunity for environmental crimes are associated with such causes.

-
  - **Brief description:** there are many underlying causes for deforestation in the Manoa Project area, which are shared with other Amazon areas, such as opening roads, enabling access to still intact forest areas for the production of new farming activities and inducing real estate speculation

(Ecoporé, 2015). Real estate speculation holds strong influence on this context, due to direct or indirect incentive exercised by deforestation, inducing small farmers to deforest their areas, generating land appreciation and later acquired by large scale producers.

- **Development forecast:** Real estate speculation and expansion of large properties, low productivity and poor technical assistance offered to small farmers, in addition of th rapid revenue growth offer generated by logging, tends to lead the region into an unsustainable environmental context, leading to the domination of large scale properties, increasing marginalization of the population and land conflicts. This scenario implies the stabilization or reduction of the population, leading to a migration process in search of new job opportunities.
- **Measures to be implemented:** Regarding the hidden causes that converge to deforestation, the measures adopted by the project relate directly to what has been described for deforestation drivers. Other proposed activities are related to strengthening the region's rural associations actions, prioritizing job offer to the local community, prioritizing wood sales to local industries, and providing guidance and advice to social organizations. Thus, the project intends to work mainly on strengthening these associations and the local economy, offering new opportunities and alternative development for the local socioeconomic context.

Analysis of chain of events that leads to deforestation

- The chain of events that leads to deforestation in the reference region follows the complex and typical "arc of deforestation" pattern in the Brazilian Amazon. This chain starts with the entry of illegal loggers that corrupt local communities and/or small farms, either financially or with violence, to explore hardwoods. After the forest degradation cycle, which also includes the opening of roads, comes deforestation of the invaded area invaded for white crop and pasture production. These small producers, due lack of capital, sell their lands to medium and large scale producers, mainly associated to cattle raising. Cattle raising requires opening of new areas for consolidation of property limits. Over time, these areas are converted to implement mechanized farms, in this case cultivation of soybeans or rice. The cycle repeats for carrying out new logging and deforestation activities. Figure 11 shows the chain of events among the relationships identified between agents, drivers of the deforestation occurred in the reference area.

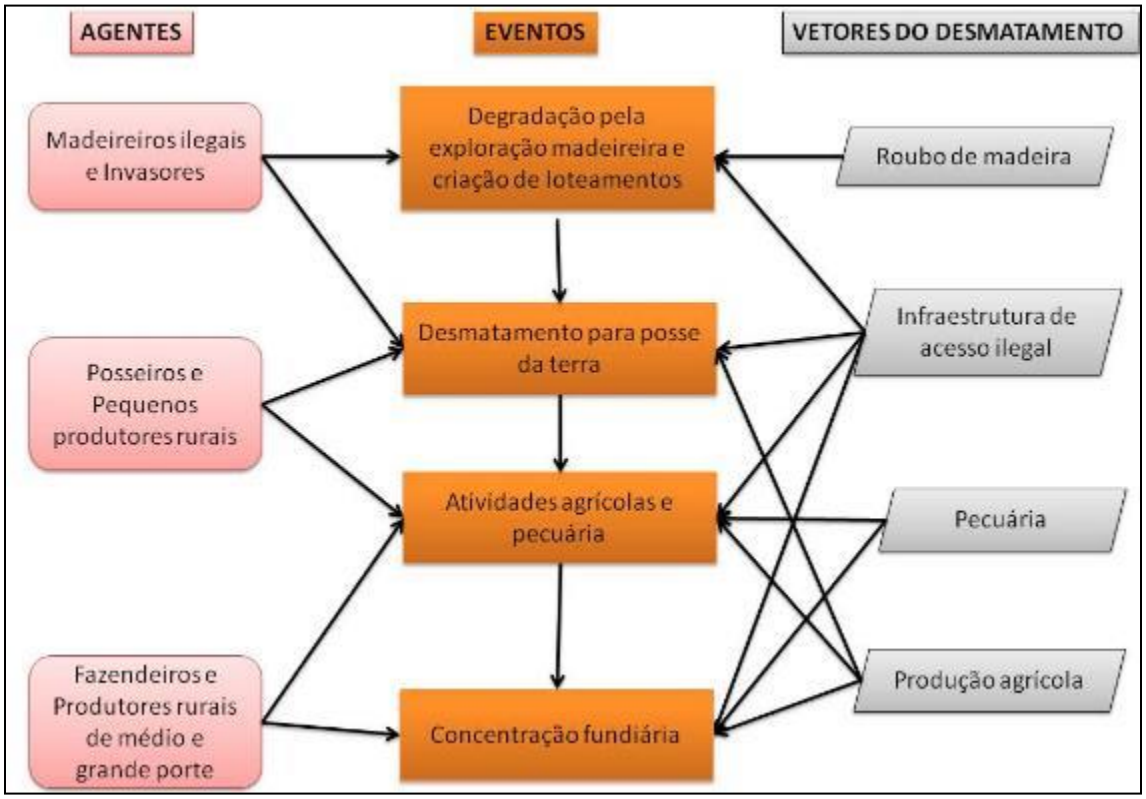

Figure 11 Analysis of chain of events that leads to deforestation

Conclusion

Based on data and information presented in the study conducted by ECOPORÉ (2015), deforestation data (PRODES and TerraClass) and local experts consulting, it was possible to find conclusive evidence to explain the relationship among agents, drivers, underlying causes, and deforestation history occurred in the reference area. Therefore, the hypothesis presented is that the relationships among demographic variations, forest degradation due to inefficient management plans, possible advancement of agriculture and cattle raising activities, increased monoculture activities by landowners, and land invasions with support from local and state politicians suggests that the baseline general trend for the period after the Project start will be maintenance on historical deforestation rates, observed in the reference region, as long as there is wood supply protected areas, private properties, or other land contexts with fragile governance or low economic income.

VM0015 Step 4 - Future Deforestation Projection

Future Deforestation Quantity Projection (Step 4.1)

The reference region does not hold stratified limits, as agents, drivers, and causes of deforestation were considered equal throughout the area.

Selection of Baseline Approach

Despite of conclusive evidence concerning analysis of agents and drivers, deforestation rates observed in different sub-periods in the reference region did not show a clear increasing, maintenance, or reduction trend, according to Figure 9 chart. The observed rate showed an increase in the first years (2000-2005), reduction between 2005 and 2009, and a new increasing trend from 2009 on (Figure 9). The land use changes dynamics in the region is complex and influenced by many variables, so even with conclusive evidence of activities conducted by agents and drivers in the region, it was not possible to establish a clear trend towards annual deforestation rates continuity in the future. This finding is reinforced by the low correlation between the deforestation annual rates, as evidenced by Figure 9 .trend line.

The conclusive evidences obtained from field studies and secondary data (ECOPORÉ, 2015) indicate the possibility of increasing deforestation rate in the reference region; however, none of the variables analyzed was adequate to serve as a basis for future deforestation modeling (Figure 12 and Figure 13). Thus, approach "a" (historical average) was selected to project the future deforestation amount.

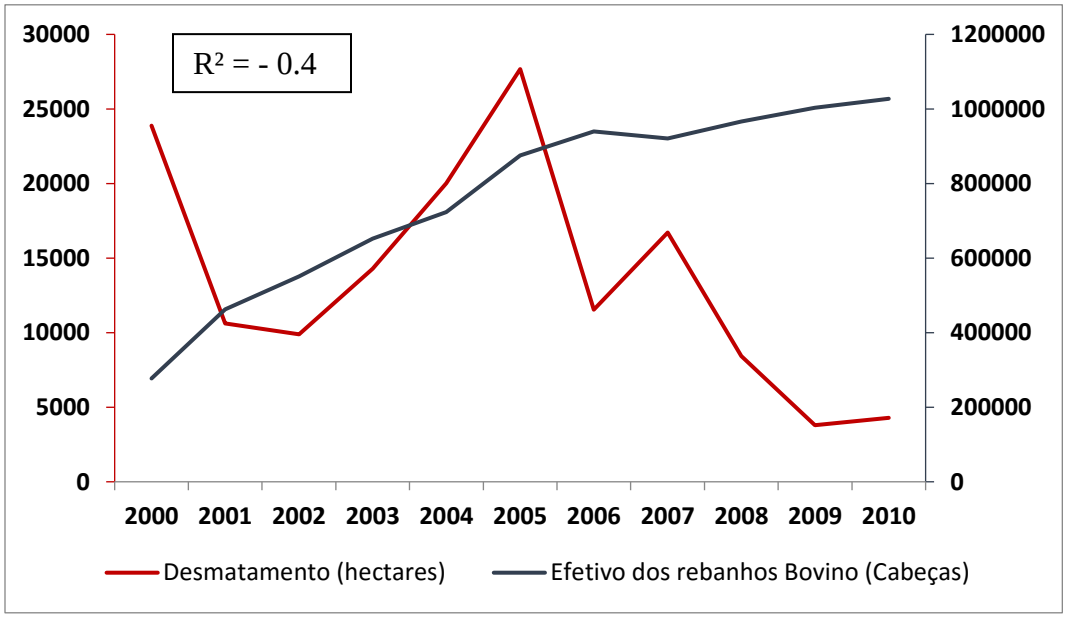

Figure 12 Correlation between variables "Deforestation" and "Bovine Cattle".

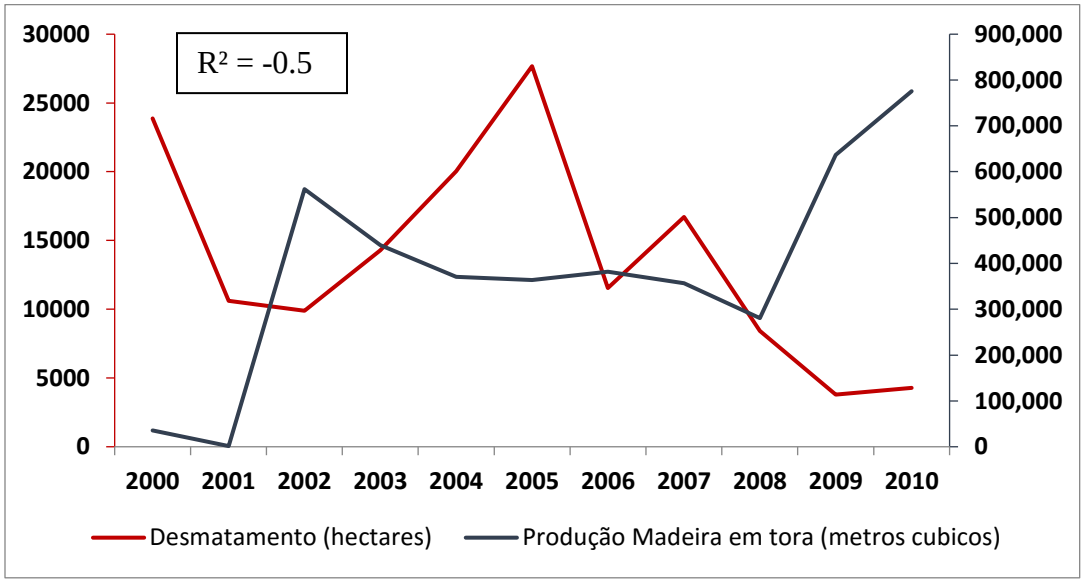

Figure 13 Correlation between variables "Deforestation" and "Wood production".

Annual projection of baseline deforestation areas in the reference region

The annual baseline deforestation in year *t* for the reference region was calculated as indicated in equation 04, according to Puyravaud (2003):

$$ABSLRR_{i,t} = Atn\text{-}Atn * e^{rt}$$

Once:

$ABSLRR_{i,t}$: Annual deforestation baseline in stratum *i* inside the reference region in year t; (ha/yr $^{-1)}$;

Atn: Area with forest cover in stratum *i* inside the reference region in year t; (ha);

r: Deforestation rate applied in stratum *i* inside the reference region in year t; (%);

t: Time interval.

Thus, the deforestation rate observed between 2000 and 2010 was calculated according to equation 07 indicated by Puyravaud (2003) and the value obtained was 0.91%. The deforestation amount projected for the 30-year period (2011-2040) in the reference region is shown in Table 16.

Projection of annual baseline deforestation in the project area and leakage belt

The baseline deforestation for the project area and leakage belt was spatially projected for the entire reference region, according to recommendation of Methodology VM0015 step 4.2.4.

Summary of deforestation quantitative projection

This section presents future deforestation values projected for 2012-2041 in the reference area (Table 16), in the project area (Table 17), and in the leakage belt (Table 18)

Table 16 Annual and accumulated deforestation for the Reference Region (VM0015 Table 9a).

Project Year *t*	Stratum *i* in Reference Region	Total	
	1. $ABSLRR_{i,t}$ ha	Annual $ABSLRR_t$ ha	cumulative ABSLRR ha
2012	11,938	11,938	11,938
2013	11,830	11,830	23,768
2014	11,723	11,723	35,491
2015	11,617	11,617	47,108
2016	11,512	11,512	58,620
2017	11,408	11,408	70,028
2018	11,305	11,305	81,333
2019	11,203	11,203	92,536
2020	11,101	11,101	103,637
2021	11,001	11,001	114,638
2022	10,901	10,901	125,539
2023	10,803	10,803	136,342
2024	10,705	10,705	147,047
2025	10,608	10,608	157,655
2026	10,512	10,512	168,167
2027	10,417	10,417	178,584
2028	10,323	10,323	188,907
2029	10,230	10,230	199,137
2030	10,137	10,137	209,274
2031	10,046	10,046	219,320
2032	9,955	9,955	229,275
2033	9,865	9,865	239,140
2034	9,776	9,776	248,916
2035	9,687	9,687	258,603
2036	9,600	9,600	268,203
2037	9,513	9,513	277,716
2038	9,427	9,427	287,143
2039	9,341	9,341	296,484
2040	9,257	9,257	305,741

Table 17 Annual and accumulated deforestation in the project area by 2040 (VM0015 Methodology Step 9b).

Project Year *t*	Stratum *i* of Reference Region in the Project Area 1. $ABSLPA_{i,t}$ ha	Total	
		Annual $ABSLPA_t$ ha	cumulative ABSLPA ha
2012	113	113	113
2013	49	49	162
2014	175	175	337
2015	182	182	519
2016	45	45	564
2017	182	182	746
2018	192	192	938
2019	233	233	1,171
2020	44	44	1,215
2021	192	192	1,407
2022	239	239	1,646
2023	474	474	2,120
2024	263	263	2,383
2025	183	183	2,566
2026	285	285	2,851
2027	257	257	3,108
2028	516	516	3,624
2029	632	632	4,256
2030	737	737	4,993
2031	580	580	5,573
2032	303	303	5,876
2033	576	576	6,452
2034	395	395	6,847
2035	780	780	7,627
2036	776	776	8,403
2037	659	659	9,062
2038	753	753	9,815
2039	806	806	10,621
2040	1,111	1,111	11,732

Table 18 Annual and accumulated deforestation for leakage belt 2040 (VM0015 Methodology 9c table).

Ano do Projeto *t*	Stratum *i* of Reference Region in the Leakage Belt 1 $ABSLLK_{i,t}$ ha	Total	
		Annual $ABSLLK_t$ ha	cumulative ABSLLK ha
2012	249	249	249
2013	350	350	599
2014	145	145	744
2015	232	232	976
2016	160	160	1,136
2017	216	216	1,352
2018	292	292	1,644
2019	295	295	1,939
2020	406	406	2,345
2021	355	355	2,700
2022	301	301	3,001
2023	411	411	3,412
2024	479	479	3,891
2025	424	424	4,315
2026	472	472	4,787
2027	239	239	5,026
2028	786	786	5,812
2029	645	645	6,457
2030	713	713	7,170
2031	712	712	7,882
2032	857	857	8,739
2033	633	633	9,372
2034	550	550	9,922
2035	723	723	10,645
2036	588	588	11,233
2037	927	927	12,160
2038	847	847	13,007
2039	872	872	13,879
2040	1,033	1,033	14,912

Projection of Future Deforestation Location (Step 4.2)

Future deforestation location projection was found through Dinamica-EGO software version 2.0.10. This software is indicated by VM0015 methodology (p. 51) as an appropriate model for REDD+ projects baseline modeling. The selection for Dinamica-EGO was made the following reasons: a) it is a model available in the scientific publications of Soares-Filho et al. (2006), Yanai et al. (2012) and Vitel et al (2013); b) it holds transparent process for input and output of data and parameters processed with user-friendly graphical interface; c) it incorporates the use of appropriate data to explain the location of deforestation; d) it holds proper tools to evaluate uncertainties (Hagen, 2003).

The main steps conducted with Dinamica-EGO at this stage was: (i) organization of maps on land use and land cover, and maps with deforestation explanatory factors; (ii) model calibration by determining the weight of evidence and analyzing correlations between variables; (iii) assessment of model accuracy; (Iv) development of deforestation baseline scenarios. Dinamica-EGO used spatial data with 100 x 100 m pixel size, GeoTIFF format, 1714 rows by 1446 columns dimension.

Preparation of factors maps

This step was carried out applying the empirical approach to the create factors maps found in Table 19. Studies on deforestation in the Amazon (IMAZON, 2011) show that maps of landscape distances and spatial attributes (roads distance, previous deforestation distance, vegetation type, etc.) have high correlation with the location of new deforestation. Dinamica EGO, to draw the map and calibrate the model, requires independent input spatial variables. Thus, four independent spatial variables were used to produce the deforestation risk map (Table 19 List of maps, variables, and factors maps (VM0015 Table 10).

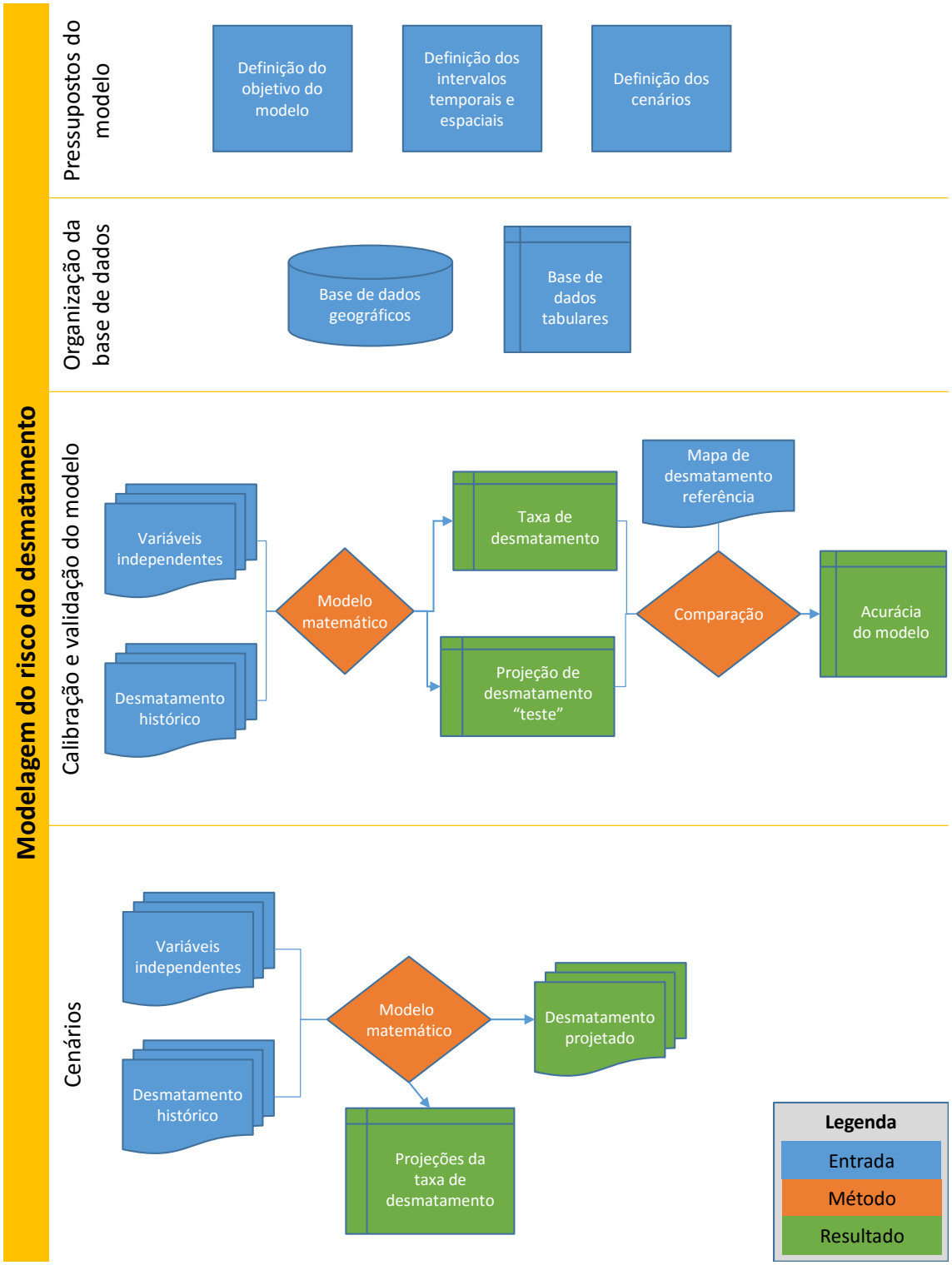

Figure 14 Flowchart of deforestation projection model.

Table 19 List of maps, variables, and factors maps (VM0015 Table 10).

Factors Maps		Source	Represented variable		Meaning of categories or pixel value.		Other variables and maps used to create the factors maps		Algorithm or equation used
ID	File name		Unit	Description	Variation	Meaning	ID	File name	
1	distance_to_1	INPE	Meters	Continuous data	0-31600	Former deforestation distance.	1	lulc2000.tif	Euclidean Distance (Dinamica Ego 2.0.10)
2	d_estrada	DSG	Meters	Continuous data	0-27100	Roads and extensions distance.	2	Estradas_RR.shp	Euclidean Distance (ArcGIS 10.1)
3	legal_status	Category	Category	Land status Categories	1 to 3	1 = Settlements. 2 = Private properties and non-designated areas. 3 = Conservation Units	3	Status_Land.shp	-
4	veget	Category	Category	Categories of large groups of vegetation	1 to 4	1 = Open Ombrophilous Forest. 2 = Dense Ombrophilous Forest. 3 = Pioneer Formations. 4 = Savannah.	4	vegetacao.shp	-

Development of deforestation risk maps

Deforestation risk maps show the regions with the highest (risk = 1) or lower conditions for possible deforestation (risk = 0). This project risk map was produced by the Weight of Evidence (Bonham- Carter, 1994), available from Dynamic EGO, which calculates the probability of transition from forest to deforested area in each pixel of the reference region. This probability is calculated based on the sum of all weights of evidence that overlap over a certain pixel, and depend on combinations of all static and dynamic map (Soares-Filho et al 2006).

The result of applying the weights of evidence method in Dinamica EGO is a deforestation risk map. This map (Figure 15) identifies areas with higher and lower conditions for the occurrence of

deforestation. The deforestation risk map, together with other spatial variables shown in Table 19 , is the starting point for the generation of future deforestation baseline scenarios.

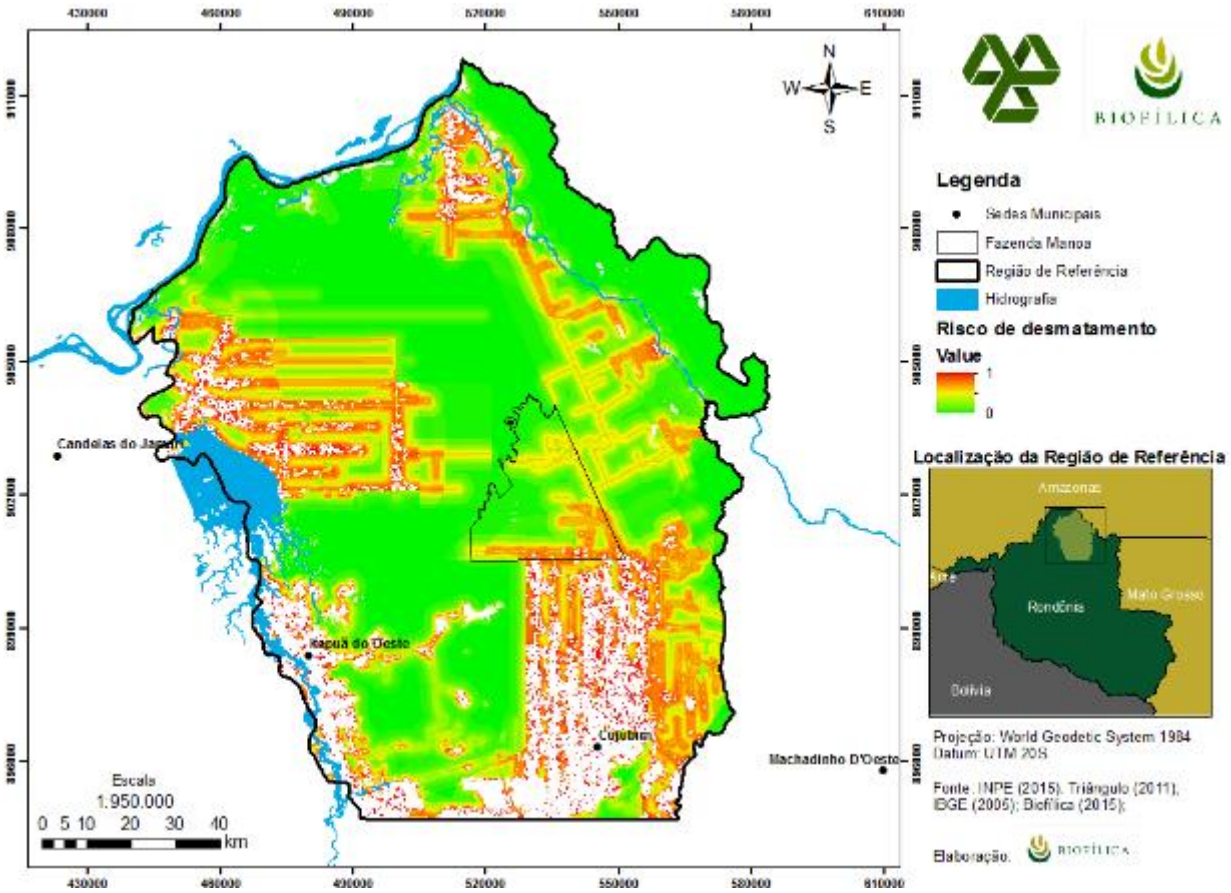

Figure 15 Transition potential map for occurrences of deforestation in the reference region.

Selection of risk map to the most accurate deforestation

The assessment on the quality of the generated model was conducted applying option A - calibration and confirmation using two historical subperiods - available in VM0015 methodology version 1.1 (page 53). Deforestation data, occurred between 2000 and 2007, were used to calibrate the model, while the deforestation map occurred by 2010 was used for the confirmation process. In this process, a deforestation map for 2010 was simulated from the data observed in the years 2000-2007.

The FOM technique *(Figure of Merit)* was applied to evaluate the accuracy of the map simulated in 2010. The FOM is the reason of the intersection of observed changes (changes between reference map at time 1 and time 2), and simulated changes (changes between the reference map at time 1 and the reference map at time 2), to gather the observed change and the expected variation, according to VM0015 equation 9.

This method points out that the minimum threshold for the best adjustment measured by FOM must be defined by the net change observed in the reference region for model calibration period. The net change observed must be calculated as the total area of change being modeled in the reference area during the calibration period, as a percentage of the total area of the reference area, and the FOM value should be the minimum equivalent to this amount. If the FOM value is below this threshold, the project proponent must demonstrate that at least three models were tested (resulting in at least three risk maps), and the one with the best FOM was used.

The threshold of net changes observed in the reference region was 0.07, and the FOM value obtained by applying VM0015 equation 9 was 0.49; thus, as the FOM for the first produced risk map is above the minimum threshold, it was not necessary create other two models to perform the allocation of the future deforestation (VM0015 Step 4.2.4). Thus, the deforestation risk map developed at this stage showed acceptable accuracy to project land use changes by 2040 at Manoa Farm REDD+ Project reference region.

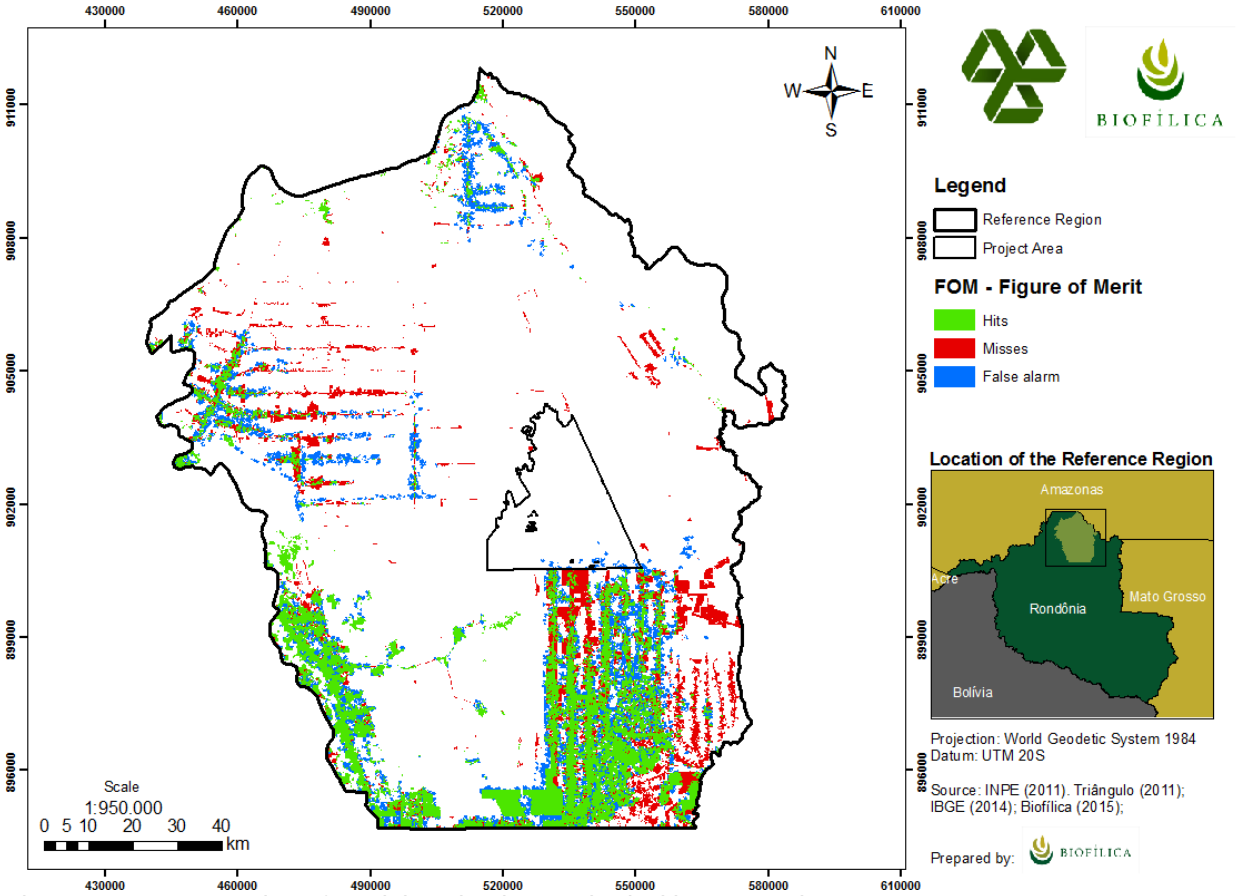

Figure 16 Demonstration of model evaluation method with FOM tool.

Mapping of future deforestation location

The procedure of selecting pixels with higher risk of deforestation, based on deforestation rate defined in step 4.1, and of developing deforestation baseline maps, was automatically carried out by

Dinamica EGO for the 30-year period, from 2011 on. The result is shown in Figure 17 and Figure 18, along with the Reference Region deforestation expected by 2040, and in the Project Area for the first baseline fixed period (2020).

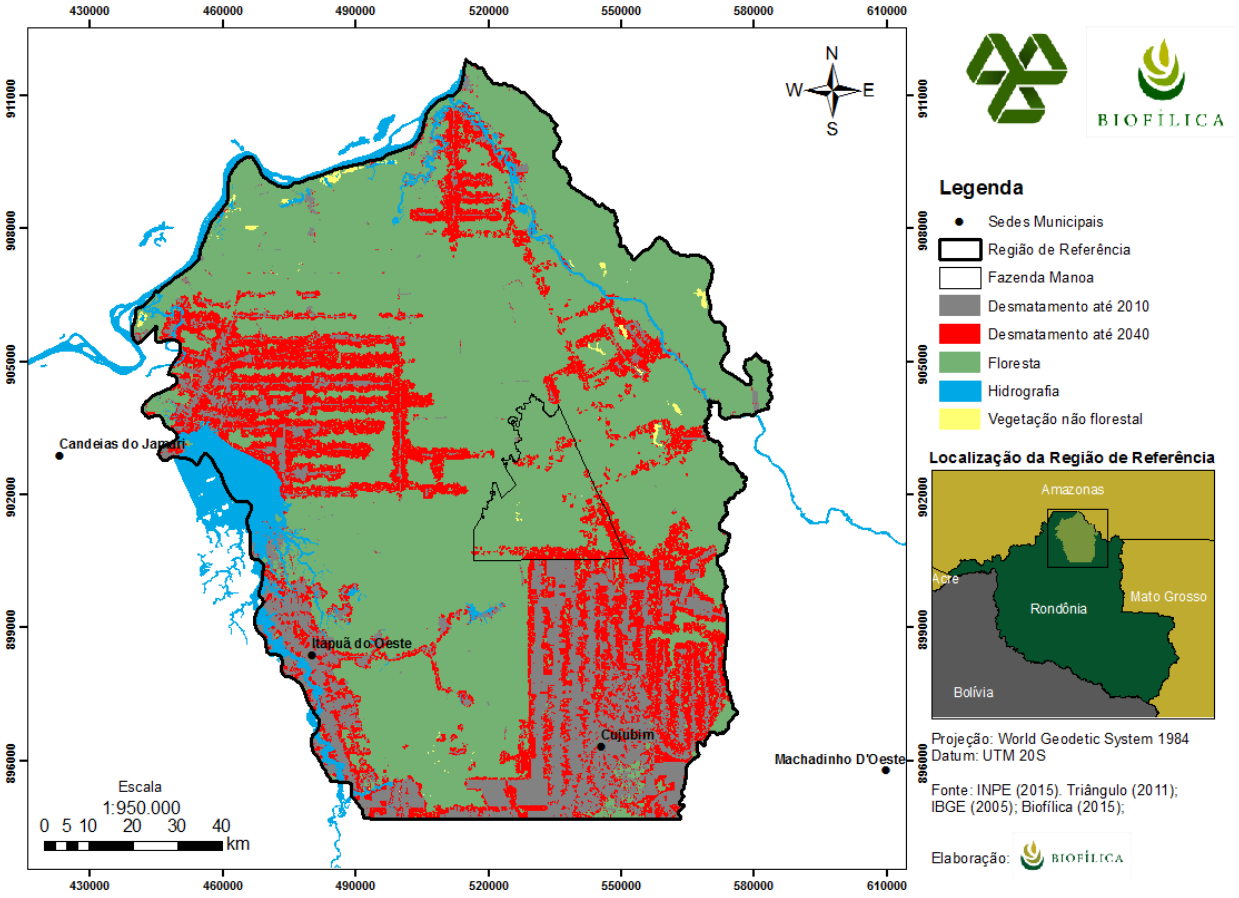

Figure 17 Baseline deforestation in the Reference Region for 2040.

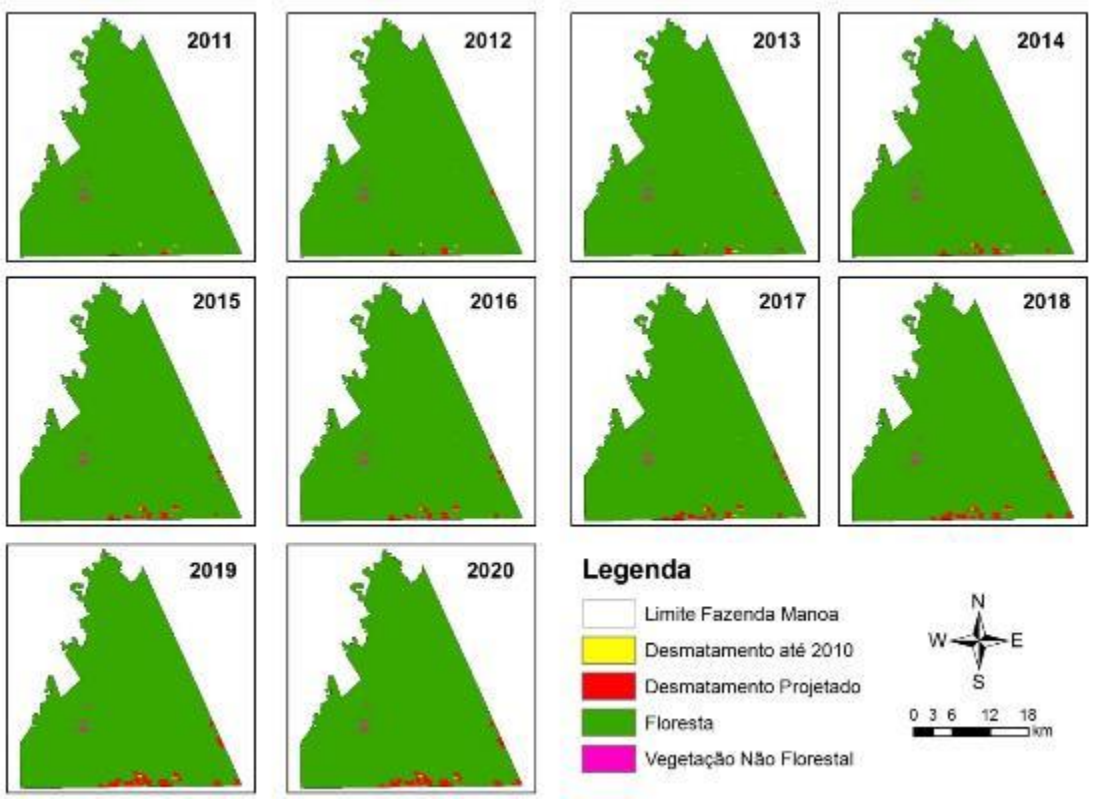

Figure 18 Deforestation projection for the first 10 years of the project.

4.6 Additionality (G2)

The additionality of the project was analyzed according to the tool approved by VCS "VT0001 - Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities", version 3.0, of February 1, 2012.

The tool's applicability conditions are met because:

• The AFOLU activities are equal or similar to the design of the proposed activities within their respective limits or registered as Project VCS AFOLU, and do not lead to a breach of any applicable law even if this law is not applied; and

• The 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 estimation of GHG Emissions Reductions" of VM0015).

Step 1. Identification of alternative scenarios of land uses proposed by the VCS AFOLU project activity

Sub-step 1a. - Identify alternative scenarios credible land use to the VCS AFOLU project activities proposed

Among the alternative scenarios for the use of realistic and credible soil that occur within the project boundary in the absence of activity AFOLU Project registered in the VCS, they were considered:

i) Continued use of the previous ground the project (baseline scenario): deforestation caused madeireios illegal and invaders by squatters and small livestock and farmers and medium / large. Between 2000 and 2010 126,696 hectares were deforested in the Project reference region for installation of these activities. For the next 20 years, it is projected a loss of 219,320 hectares in this scenario, of which 5,573 hectares are expected to be cleared in the Project area. In this scenario there is a great social burden in the region in the project because the chain of deforestation events ends up creating and enhancing a number of social problems related to unemployment and migration, for example. And as biodiversity, deforestation in the project area would represent a major loss in the landscape context of the reference region.

ii) project activity without registration as a VCS AFOLU Project: driving sustainable forest management FSC certified, complementary activities for containment and monitoring of deforestation caused by the setting of the agents (i) and social activities, as described in Section 2.2. For effectiveness of the project in relation to the containment and monitoring of deforestation present in the region and local socioeconomic development, are needed specific investments for these activities (professionals, satellite imagery acquisition, technical studies specific to REDD, intensified surveillance and property security, social activities of environmental education with the families of the environment, enhancement of biodiversity monitoring). These are not necessary investments and generally not performed by certified forest management and tend to fail to be practiced over time, reducing the positive net impacts in the region. Thus, the economic viability of management is reduced without the aggregation of additional revenue resulting from the sale of assets recorded in the VCS.

iii) Only without the addition of activities Sustainable Forest REDD Management +: driving FSC certified forest management activities without complementary activities aimed at reducing deforestation, such as but not limited to professionals, satellite imagery acquisition, specific technical studies to REDD , intensified surveillance and property security, social activities of environmental education with families located in the vicinity, and activity aimed at more intensive monitoring of biodiversity.

Sustainable forest management, notably the certificate is recognized by many experts as a forest conservation tool, maintenance of forest carbon stocks and reduction of deforestation rates (Porter-Bolland et al, 2012;. UNCED, 1992; Verissimo et al ., 1992; Silva et al., 1997; Uhl et al., 1997; Barreto et al, 1998;. HOLMES et al, 2002 cited SABOGAL et al, 2006;.. PUTZ et al, 2008;. SPATHELF et al. , 2004). This is mainly due to the application of low-impact logging techniques, monitoring continuously the forest and the social and environmental impacts of the operation, physical presence, land organization and generating economic value for forest areas.

However, the complexity and scale of the operation, combined with factors such as bureaucratic barriers and fluctuation in the value of the wood due to crises of buyers and exchange rate markets may

make excessively costly activity and high risk. Thus, investment in some additional practices when required by law and by the certification body are compromised or become secondary to the operation needs. Among these, they would be some complementary activities to the specific operation and to contain and effectively monitor deforestation in the areas of forest management, as well as a broader social activities, such as those listed in the scenario (ii).

Thus, despite the certified forest management contribute to the conservation of forest and carbon stocks, the forest is subject to the occurrence of illegal deforestation and loss of carbon stock caused by external agents, even in smaller quantities and in a more timely fashion in relation to areas without management. Moreover, failure to halt deforestation can stimulate the action of squatters and illegal loggers face a shortage of wood in the region.

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

The proposed scenarios, scenarios (ii) and (ii) are in compliance with all legal and regulatory requirements applicable and only constant practice in scenario (i) are not in accordance with the rules and mandatory regulations.

This occurs as illegal logging, or unauthorized, is a systematic and widespread in Amazonia and especially in the project area, located in the "Arc of Deforestation". Following Higuchi, et al (2009) 1997-2003 authorized the deforestation rate was 19%, ie 81% of the identified deforestation were not authorized by public bodies.

A study by the Institute of Man and Environment in the Amazon (Imazon, 2013) reported that for the years 2011-2012, 78% of logging was not allowed and that 78% of these the majority (67%) situava- in private areas, vacant or under dispute. This finding corroborates previous studies of the same institute identified the categories of land "private, unused and unclaimed" main stages of illegal / unauthorized deforestation.

Sub-step 1c. Selection of the baseline scenario

Described in Section 4 - Methodology Application, item 4.5 Baseline Scenario.

Step 2. Investment analysis

Sub-step 2a. Determine appropriate analysis method

As the project generates financial benefits beyond the income related to loans recorded in the VCS through the marketing of tropical timber, a comparative investment analysis (Option II) of alternative scenarios to determine the project's additionality was applied. We analyzed the scenarios (i) and (ii).

Sub-step 2b. Option II Application of comparative investment analysis

The Net Present Value (NPV) was selected as a financial indicator for investment comparison analysis of alternative scenarios. The VPL is one of the methods used by companies to assess projects

and has the following advantages over other indicators: (i) take into account the value of money over time; (Ii) the NPVs can be added; and (iii) depend only on cash flows and cost of capital (LEMES JR, 2005).

Sub-step 2c. Calculation and comparison of financial indicators

The summary of the sources of revenue and expenditure considered in the analysis are presented in Table 20. See Section 2.2 - Description of Project Activities detailed description of the proposed activities (i and ii scenarios) to contain / monitor unplanned deforestation and generate net benefits to the climate, communities and biodiversity.

Table 20. Summary of the sources of revenue and expenditure

Cenário	Revenue	Expenses
(I) Sustainable Forest Management without complementary activities to contain / monitor unplanned deforestation and no additional activities to benefit the climate, community and biodiversity.	Sale of tropical timber from sustainable forest management.	sustainable forest management.
(Ii) Sustainable Forest Management, with complementary activities to contain / monitor unplanned deforestation and additional activities to benefit the climate, community and biodiversity.	Sale of tropical timber from sustainable forest management.	SFM + Additional activities to contain / monitor unplanned deforestation and climate, community and biodiversity

The free cash flow scenarios and comparative analysis of NPV took into account the revenue fotes and expenses described in Table 20,and also a discount rate of 25%. This discount rate reflects the critical parameter management of Biofílica Environmental investments to determine the continuation with a new project / investment.

A conservative analysis by the year 2040 revealed a NPV of R$ 4,515,406 to the scenario (i), an NPV of R$ 3,868,374 to the scenario (ii). Thus, it is clear that the additional activities to forest management to contain / monitor deforestation and generate positive benefits net climate, community and biodiversity decrease the financial viability of the project, if there is no aggregation of additional revenue, such as that resulting from the commercialization of credits recorded in the VCS.

It follows, therefore, that the scenario (i) provides a better financial indicator and the VCS Project AFOLU without the financial benefit of the credits recorded in the VCS is not considered the most financially attractive scenario.

Sub-step 2d. - Sensitivity Analysis

Table 20 presents the Critics assumptions of the scenarios (i) and (ii) and its variations, considered reasonable, used in the sensitivity analysis. In Panorama 1 were considered pessimistic variances and 2 optimistic. The basic values are those considered for comparative analysis of the NPV in Sub-step 2c.

Table 21. Critical assumptions for the scenarios (i) and (ii) used and variations in the sensitivity analysis.

Cenário	Premise	Panorama	
		1 – pessimistic	2 – optimistic
(I) Sustainable Forest Management without complementary activities to contain / monitor unplanned deforestation and no additional activities to benefit the climate, community and biodiversity.	*a. Preço da madeira*	*80% do valor base*	*120% do valor base*
(Ii) Sustainable Forest Management, with complementary activities to contain / monitor unplanned deforestation and additional activities to benefit the climate, community and biodiversity.	*b. Preço da madeira*	*80% do valor base*	*120% do valor base*
	c. Custos REDD+	*120% do valor base*	*80% do valor base*

Panorama 1 had lower NPV, and the scenario (i) presented a NPV of R$ 3,613,444 and the scenario (ii) R$2,751,003. In Panorama 2 scenario (i) showed a positive NPV of R$ 5,420,166 and the scenario (ii) R$ 4,845,205. In both Panoramas 1 (pessimistic) and 2 (optimistic) variation of the critical assumptions scenario (i) presents the best financial indicators.

The sensitivity analysis strengthens the conclusion that the REDD+ Manoa Project without registration as VCS AFOLU project and the credits sales revenue derived can not be considered the most financially attractive scenario, even with reasonable variations in the critical assumptions.

5 QUANTIFICATION OF REDUCED GHG EMISSIONS AND REMOVALS (CLIMATE)

5.1 Project scale and GHG reduced emissions estimate or removals

Table 22 Project scale

Project	x
Megaproject	

Table 23. Estimated reduced emissions and GHG removals

year t	Estimated removals and GHG emission reductions (tCO2e)
2012	30,757
2013	5,843
2014	56,988
2015	60,849
2016	5,202
2017	61,163
2018	65,496
2019	82,490
2020	5,697
2021	67,848
2022	87,545
2023	185,739
2024	213,284
2025	65,016
2026	107,715
2027	96,193
2028	204,211
2029	252,949
2030	297,535
2031	232,884
2032	117,940
2033	231,458
2034	156,478
2035	317,208

year t	Estimated removals and GHG emission reductions (tCO2e)
2036	316,242
2037	268,222
2038	307,595
2039	329,851
2040	457,043
Total	4,687,440
Total years in crediting period	30
Emission Reduction - Annual Average	156,248

5.2 Leakage management (CL2)

The description of the leakage management activities to be developed in areas already opened in the communities is described in Item 2.2. Description of project activities.

5.3 Emissions at baseline (G2)

VM0015 Step 5 - Definition of the Changes Component in the Baseline Land Use and Land Cover Baseline activity data calculation per forest class

The results of the baseline projections pointed out approximately 5,573 hectares of deforestation in the project area between 2012 and 2031 (Table 24), and 7,882 hectares in the leakage belt (Table 25); Table 24. Annual deforested area per forest icl inside the project area in the baseline case (VM0015 Table 11b).

Deforested area per forest class *icl* forest inside the project area		Total baseline deforestation in the project area	
ID *icl>*	icl1	$ABSLPA_t$	ABSLPA
Name>	Forest	Annual	Cumulative
Year t	ha	ha	ha
2012	113	113	113
2013	49	49	162
2014	175	175	337
2015	182	182	519
2016	45	45	564

Deforested area per forest class *icl* forest inside the project area		Total baseline deforestation in the project area	
ID *icl>*	icl1	$ABSLPA_t$	ABSLPA
Name>	Forest	Annual	Cumulative
Year t	ha	ha	ha
2017	182	182	746
2018	192	192	938
2019	233	233	1,171
2020	44	44	1,215
2021	192	192	1,407
2022	239	239	1,646
2023	474	474	2,120
2024	263	263	2,383
2025	183	183	2,566
2026	285	285	2,851
2027	257	257	3,108
2028	516	516	3,624
2029	632	632	4,256
2030	737	737	4,993
2031	580	580	5,573
2032	303	303	5,876
2033	576	576	6,452
2034	395	395	6,847
2035	780	780	7,627
2036	776	776	8,403
2037	659	659	9,062
2038	753	753	9,815
2039	806	806	10,621
2040	1,111	1,111	11,732

Table 25 Annual deforested area per forest class icl inside the leakage belt in the baseline case (VM0015 table 11c).

Deforested area per forest class *icl* inside the leakage belt		Total deforestation baseline in the leakage belt	
ID *icl>*	icl1	$ABSLPA_t$	ABSLPA
Name>	Forest	Annual	cumulative
Year t	ha	ha	ha
2012	249	249	249
2013	350	350	599
2014	145	145	744
2015	232	232	976
2016	160	160	1,136
2017	216	216	1,352
2018	292	292	1,644
2019	295	295	1,939
2020	406	406	2,345
2021	355	355	2,700
2022	301	301	3,001
2023	411	411	3,412
2024	479	479	3,891
2025	424	424	4,315
2026	472	472	4,787
2027	239	239	5,026
2028	786	786	5,812
2029	645	645	6,457
2030	713	713	7,170
2031	712	712	7,882
2032	857	857	8,739
2033	633	633	9,372
2034	550	550	9,922
2035	723	723	10,645
2036	588	588	11,233
2037	927	927	12,160
2038	847	847	13,007
2039	872	872	13,879
2040	1,033	1,033	14,912

Baseline activity data calculation per post-deforestation

Method 1 available in VM0015 Methodology was used to define the class that will replace the forest cover in the project baseline (called Anthropic Vegetation in Balance). **Erro! Fonte de referência não encontrada.** shows the zone 1 area, which includes the project area, leakage belt, and leakage management areas, and the corresponding area of each class of use and cover after deforestation.

Table 26 Reference region zones covering different combinations of potential post-deforestation classes.

Zone		Name	Total all other LU / LC classes present in the zone		Total area of each zone	
		Zone 1				
		ID_{fcl}	1			
IDz	Name	Area ha	% Of Zone %	Area ha	% Of Zone %	Area ha	% Of Zone %
1	Zone 1	171,818	100	26,966	15.69%	171,818	100
Total area in each *fcl class*		171,818	100	26,966	15.69%	171,818	100

Table 27 Annual deforested area in each zone within the project area in the baseline scenario (VM0015 Table 13b).

Area established after deforestation per Zone within the project area		Total deforestation baseline in the project area IDz>	
IDz>	1		
Name>	Zone 1	$ABSLPA_t$	ABSLPA
Year t	ha	ha	ha
2012	113	113	113
2013	49	49	162
2014	175	175	337
2015	182	182	519
2016	45	45	564
2017	182	182	746
2018	192	192	938
2019	233	233	1,171
2020	44	44	1,215
2021	192	192	1,407
2022	239	239	1,646
2023	474	474	2,120
2024	263	263	2,383
2025	183	183	2,566

Area established after deforestation per Zone within the project area		Total deforestation baseline in the project area IDz>	
IDz>	1		
Name>	Zone 1	$ABSLPA_t$	ABSLPA
Year t	ha	ha	ha
2026	285	285	2,851
2027	257	257	3,108
2028	516	516	3,624
2029	632	632	4,256
2030	737	737	4,993
2031	580	580	5,573
2032	303	303	5,876
2033	576	576	6,452
2034	395	395	6,847
2035	780	780	7,627
2036	776	776	8,403
2037	659	659	9,062
2038	753	753	9,815
2039	806	806	10,621
2040	1,111	1,111	11,732

Table 28 Annual deforested area in each zone within the leakage belt in the baseline scenario (VM0015 Table 13c).

Area established after deforestation per Zone within the leakage belt		Total deforestation baseline in the leakage belt IDz>	
IDz>	1		
Name>	Zone 1	$ABSLLK_t$	ABSLLK
Year t	ha	ha	ha
2012	249	249	249
2013	350	350	599
2014	145	145	744
2015	232	232	976
2016	160	160	1,136
2017	216	216	1,352
2018	292	292	1,644
2019	295	295	1,939
2020	406	406	2,345
2021	355	355	2,700

Area established after deforestation per Zone within the leakage belt		Total deforestation baseline in the leakage belt IDz>	
IDz>	1		
Name>	Zone 1	$ABSLLK_t$	ABSLLK
Year t	ha	ha	ha
2022	301	301	3,001
2023	411	411	3,412
2024	479	479	3,891
2025	424	424	4,315
2026	472	472	4,787
2027	239	239	5,026
2028	786	786	5,812
2029	645	645	6,457
2030	713	713	7,170
2031	712	712	7,882
2032	857	857	8,739
2033	633	633	9,372
2034	550	550	9,922
2035	723	723	10,645
2036	588	588	11,233
2037	927	927	12,160
2038	847	847	13,007
2039	872	872	13,879
2040	1,033	1,033	14,912

Calculation of activity data by change category in land use and land cover

Not applicable.

VM0015 Step 6 - Estimate in Carbon Stock and non-CO2 Emissions Changes in the Baseline

The estimate of carbon stock for Forest class was obtained through a primary forest inventory conducted in 2015 by Florestal-Planejamento, Paisagismo e Consultoria Ltda. technical staff, in partnership with Biofílica Investimentos Ambientais. The main results obtained in this study are described below. Further information can be found in the the Carbon Stock Final Report (Florestal-Planejamento, Paisagismo e Consultoria Ltda, 2015).

Estimate of carbon average stock by class of use and change in land cover

The forest inventory in Manoa Farm was conducting applying the sampling technique, which uses concepts or statistical theory to estimate the uncertainties (errors) of a population that presents normal

distribution. Thus, a Cluster sampling was applied, due to the simplicity of planning, costs, and administration, including data to estimate biomass carbon stock above and below ground.

The Clusters were arranged in Maltese cross shape, consisting of four rectangular sub-units (10 x 250 m) oriented toward the cardinal points, and numbered from 1 to 4, 50 meters apart from the cluster center (Figure 19). The sampling was conducted in the two most representative forest extracts in the area (Lowland Open Ombrophilous Forest and Submontane Ppen Ombrophilous Forest), and these were divided between explored and unexplored area. Data from live plant with Diameter at Breast Height (DBH) greater than 10 cm or Circumference at Breast Height (CBH) greater than 31 cm.

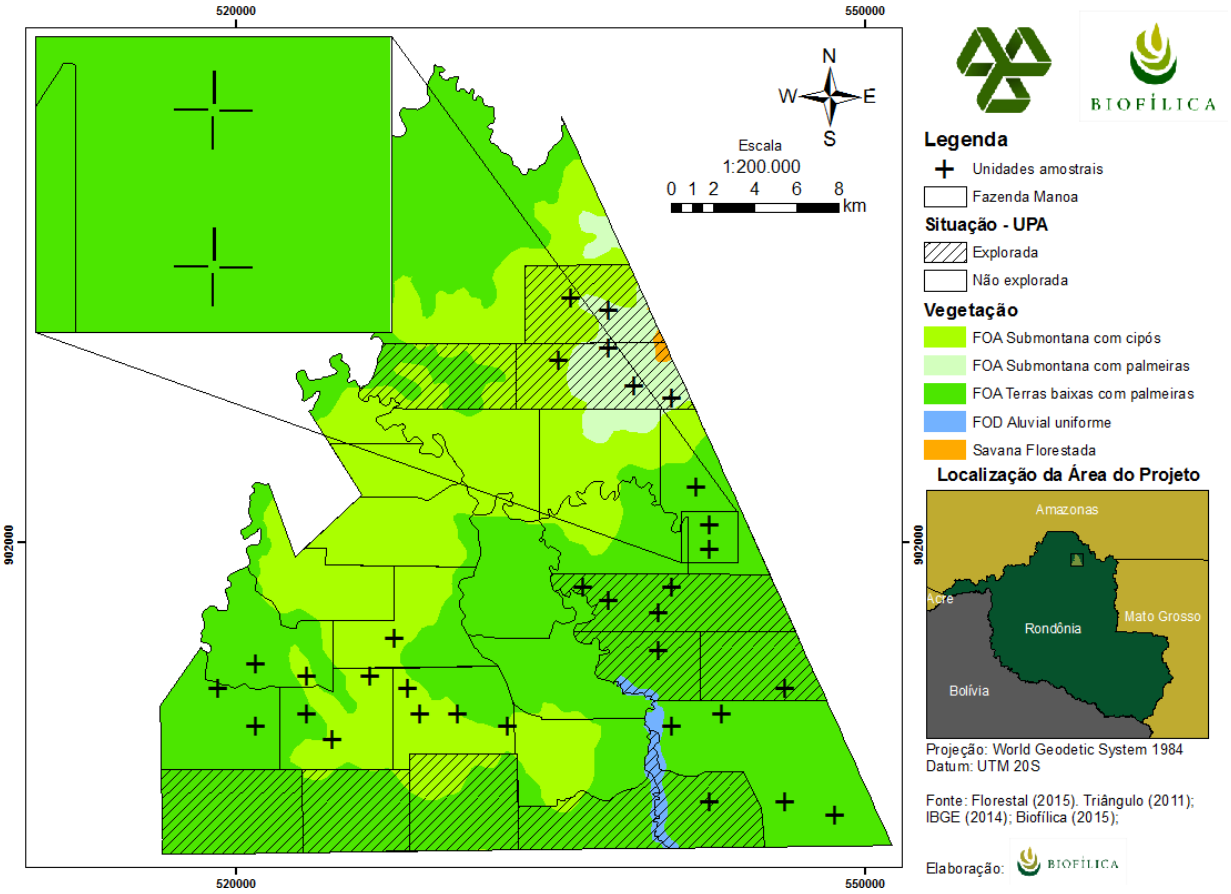

Figure 19 Allocation of forest inventory ample units in the project area.

Estimated variables

Number of Individuals

The number of individuals per hectare was estimated by extrapolating the number of individuals measured in the parcel (trees, palm trees, and vines) through the relation below:

$$N = n \times 1/a$$

Once:

N = Number of individuals per hectare;

n = Number of individuals in the sample;

a = Plot area (0.25 ha)

Basal Area

The basal area is a population density measurement, and reflects the individuals occupation degree within a certain forest area. This is a forest population density measure, which makes it a very important estimate in the decision-making.

Biomass and Carbon

- **Above-ground biomass**

Concerning trees, the data input unit was DBH, used to determine the biomass and carbon storage. Data from palm trees and vines were not used in the carbon stock calculation, only for phytosociological analysis. The biomass contained in the trees were quantified applying the allometric equation described by Nogueira (2008), which was more suitable for the study area. Below is the description of the equation:

$$DW_{abg} = EXP\ (-1{,}716 + 2{,}413 \times ln\ (DBH))$$

Once:

DWabg = Dry weight above ground estimated for each individual;

DBH = diameter at breast height or just above the buttresses;

- **Bellow-ground biomass (roots)**

The tree roots biomass was estimated applying an equation proposed by Silva (2007), adjusted based on data collected in the field, which is the only one data available in literature for the Amazon Rainforest. Below is the description of the equation:

$$FW_{Root} = 0{,}0469 \times DBH^{2{,}4754}$$

Once:

FW_{root} = Root Fresh Weight estimated for each individual

DHB = diameter at Breast Height

In this equation, the diameter is related to fresh mass, so a conversion factor was used to obtain the Dry Weight considering the average moisture content of thick and thin roots (46.7%), described by Smith (2007). Thus, the Dry Weight is calculated by the following equation:

$$FW_{Root} = FW_{Root} \times 0{,}533$$

Once:

FW_{root} = Fresh Weight of root estimated for each individual.

FW_{root} = Root Dry Weight estimated for each individual

- **Carbon Content**

The estimated carbon stocks will be obtained through the carbon content determined by Silva (2007), who showed that the carbon content is 48.5% of the dry weight found for each individual. Therefore, the following equation is used:

$$C_{AS} = DW\ (abg + blg) \times 0.485$$

as:

C = Carbon $_{AS}$ Above Ground;

DW = estimated Dry Weight for each individual (above and below ground).

Sampling

32 clusters were installed, distributed in 4 strata defined at Manoa Farm area. Each cluster contains 4 sampling units, totaling 128 samples. A total of 17354 individuals were inventoried, of which 16342 were trees (94.1%), 339 vine (2.0%), and 673 palm trees (3.9%).

Out of the 16342 inventoried trees, 12 individuals showed DBH higher than 124 cm, which were lowered to 124cm for biomass calculations, as conservative measure. The application range of the equation proposed by Nogueira (2008), described above, ranges from 5 to 124 cm DBH.

Carbon Stock

The carbon estimate calculated for stock above and below ground, considering the mean values calculated for managed forest and primary forest, was 117.98 tC ha for the reservoir above ground and 20.7 tC/ha to the reservoir below soil, considering 2.48% and 2.54% CI, respectively, for each reservoir. The area presented 138.68 tC/ha with a 2.49% CI, in total.

The carbon content values found in this study (unmanaged area) are consistent with very conservative estimates found in Open Forests in Rondônia, by Nogueira (2008), which were 153.75 tC/ha. It is also very close to the value found in the inventory held at Sete de Setembro Indian village, territory of Paiter-Suruí indigenous tribe, which was 125.97 tC/ha, compared to above-ground biomass.

Emission Reduction Calculation

The reduced emissions were calculated multiplying the inventory estimated stock by 3.6667, as 1 kg of C is equal to 3.66667 kg of CO2 (CO2 mass = 44 and C mass = 12; 44/12 = 3.66667). Table 29 shows the average carbon values per hectare for each initial class of land use and land cover considered for the baseline scenario present in the project area and leakage belt.

Table 29 Carbon stocks per hectare for *icl* initial class existing in the project area and leakage belt (VM0015 Table 15a).

Class of initial forest *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 $tCO_2e\ ha^{-1}$
432.6	10.7	75.9	1.9	-	-	508.5	12.7

Once:

Cab $_{icl}$ = average equivalent carbon stock per hectare for biomass reservoir above ground for the forest initial class;

Cbb $_{icl}$ = stock average carbon equivalent per hectare for the biomass reservoir below ground biomass for the forest initial class;

Cdw_{icl} = stock average carbon equivalent per hectare for the dead biomass reservoir biomass for the forest initial class;

Ctot $_{icl}$ = average equivalent carbon stock per hectare for total biomass reservoir for the forest initial class;

Post-deforestation classes projected for the project area and leakage belt in the baseline scenario and existing non-forest classes in the leakage management area:

The VM0015 Methodology allows the use of estimates based on local studies; thus, an amount of 61.2 tCO2e ha-1 was taken as a reference for the carbon stock of the anthropic vegetation in balance class, which is the class projected to exist in the project area and leakage belt in the project scenario. This carbon stock estimate was obtained from (Fearnside, 1996), through a long-term study on the landscape and vegetation average composition in deforested areas of the Brazilian Amazon, which consists of a matrix composed of pastures, small-scale agriculture, and crops (permanent and temporary), usually found in a post-deforestation scenario in the Amazon. This amount is conservative, as it represents an average estimate of the composition of a landscape in balance, with a 30% increase over the amount reported by the author.

Fearnside (1996) is a reviewed scientific literature, and it represents the only study conducted on the Brazilian Amazon concerning carbon stock in deforested areas, complying with section 4.5.6 of the VCS Standards:

The data were not collected directly from primary sources;

The data were collected from secondary sources, by INPA (renowned research institute for the topic in Brazil), published by an international and renowned scientific journal (Forest Ecology and Management);

The data are from a period that accurately defines the current practices available for determination of carbon stock, recently accepted in other international scientific publications as reference(Yanavi et al, 2012; Fearnside et al, 2009);

No sample was applied on these data;

The data is available to the public through the website: http://philip.inpa.gov.br/publ_livres/LISTAS%20POR%20ASSUNTO-L.htm. Accessed on December 12, 2013;

Available for independent evaluation of VCSA and VVB;

The data are appropriate for VM0015 geographic scope;

The expert analysis was not necessary; and

The data are not only kept in one central repository storage only.

Calculation of change factors in carbon stock

The project baseline scenario considers the changes in carbon stock of a replaced by a type of vegetation that can be pasture areas, small-scale crops, or temporary and permanent crops. AFOLU VCS requests to account the decay of carbon stocks in organic soil carbon reservoirs, of below-ground biomass, dead wood, and wood products.

The decay is calculated through VM0015 version 1.1, which applies a linear function to account the initial carbon stock decay initial carbon to the initial for the initial forest class (icl), and a carbon stock increase in the class after deforestation (fcl). Table 20a (Table 30) And Table 20b (Table 31 in the document) show how the carbon stock change factor was calculated.

Table 30 Carbon stock change factor for the initial forest class icl (Method 1) (VM0015 Table 20b).

Year after deforestation		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$	$\Delta Cdw_{icl,t}$	$\Delta Ctot_{cl,t}$
1	t *	432.6	7.6	0.0	440.2
2	t*+1	0	7.6	0.0	7.6
3	t*+2	0	7.6	0.0	7.6
4	t*+3	0	7.6	0.0	7.6
5	t*+4	0	7.6	0.0	7.6
6	t*+5	0	7.6	0.0	7.6

7	t*+6	0	7.6	0.0	7.6
8	t*+7	0	7.6	0.0	7.6
9	t*+8	0	7.6	0.0	7.6
10	t*+9	0	7.6	0.0	7.6
11	t*+10				
12	t*+11				
13	t*+12				
14	t*+13				
15	t*+14				
16	t*+15				
17	t*+16				
18	t*+17				
19	t*+18				
20	t*+19				
21-T	t*+20...				

Table 31 Carbon stock change factor for fcl class or z zones (Method 1) (VM0015 Table 20b).

Year after deforestation		$\Delta Ctot_{fcl,t}$
1	t *	6.1
2	t*+1	6.1
3	t*+2	6.1
4	t*+3	6.1
5	t*+4	6.1
6	t*+5	6.1
7	t*+6	6.1
8	t*+7	6.1
9	t*+8	6.1
10	t*+9	6.1
11	t*+10	0
12	t*+11	0
13	t*+12	0
14	t*+13	0
15	t*+14	0
16	t*+15	0
17	t*+16	0
18	t*+17	0
19	t*+18	0
20	t*+19	0

21-T	t*+20...	

Baseline calculation of changes in carbon stock

VM0015 version 1.1 Method 1 *(activity data are available for classes)* was used to calculate the carbon stock change baseline in the project area (Table 32), and in the leakage belt (Table 33) for year t, according to equation 10, page 72 of VM0015 version 1.1.

Table 32 Carbon stock changes baseline in the project area.

Changes in carbon stock per initial forest class *icl*		Total change in carbon stock of initial forest class in the project area		Changes in post-deforestation carbon stock per zone z		Total changes in post-deforestation carbon stock per zone in the project area		Total net changes in carbon stock in the project area	
ID_{icl}>	1	$\Delta CBSLPA_{icl,t}$	$\Delta CBSLPA_{icl}$	ID_{iz}>	ID_{icl}>	1	$\Delta CBSLPA_{icl,t}$	$\Delta CBSLPA_{icl}$	ID_{iz}>
Name>	Forest	Annual	accumulated	Name>	Name>	Forest	Annual	accumulated	Name>
year t	tCO_2-e	tCO_2-e	tCO_2-e	Year	year t	tCO_2-e	tCO_2-e	tCO_2-e	Year
2012	49,740.6	49,740.6	49,740.6	2012	691.2	691.2	691.2	49,049.4	49,049.4
2013	22,426.7	22,426.7	72,167.3	2013	990.9	990.9	1,682.2	21,435.8	70,485.1
2014	78,261.6	78,261.6	150,428.9	2014	2,061.4	2,061.4	3,743.6	76,200.2	146,685.4
2015	82,671.3	82,671.3	233,100.2	2015	3,174.7	3,174.7	6,918.2	79,496.7	226,182.0
2016	23,748.0	23,748.0	256,848.2	2016	3,449.9	3,449.9	10,368.2	20,298.0	246,480.0
2017	84,394.5	84,394.5	341,242.7	2017	4,563.2	4,563.2	14,931.4	79,831.3	326,311.3
2018	90,177.9	90,177.9	431,420.6	2018	5,737.7	5,737.7	20,669.1	84,440.2	410,751.6
2019	109,682.9	109,682.9	541,103.5	2019	7,162.9	7,162.9	27,832.0	102,519.9	513,271.5
2020	28,257.2	28,257.2	569,360.6	2020	7,432.1	7,432.1	35,264.0	20,825.1	534,096.6
2021	93,738.1	93,738.1	663,098.8	2021	8,606.5	8,606.5	43,870.5	85,131.6	619,228.2
2022	115,026.4	115,026.4	778,125.1	2022	9,377.2	9,377.2	53,247.8	105,649.1	724,877.4
2023	219,911.5	219,911.5	998,036.6	2023	11,976.9	11,976.9	65,224.7	207,934.5	932,811.9
2024	129,302.8	129,302.8	1,127,339.4	2024	12,515.2	12,515.2	77,739.9	116,787.6	1,049,599.5
2025	94,703.1	94,703.1	1,222,042.5	2025	12,521.3	12,521.3	90,261.2	82,181.8	1,131,781.2
2026	140,649.2	140,649.2	1,362,691.7	2026	13,989.4	13,989.4	104,250.6	126,659.8	1,258,441.0
2027	129,106.0	129,106.0	1,491,797.7	2027	14,448.2	14,448.2	118,698.8	114,657.8	1,373,098.9
2028	243,606.6	243,606.6	1,735,404.3	2028	16,430.0	16,430.0	135,128.8	227,176.6	1,600,275.4
2029	296,816.0	296,816.0	2,032,220.3	2029	18,870.7	18,870.7	153,999.5	277,945.3	1,878,220.7
2030	347,498.7	347,498.7	2,379,718.9	2030	23,109.7	23,109.7	177,109.2	324,388.9	2,202,609.7
2031	282,527.2	282,527.2	2,662,246.1	2031	25,483.1	25,483.1	202,592.3	257,044.1	2,459,653.8

Changes in carbon stock per initial forest class *icl*		Total change in carbon stock of initial forest class in the project area		Changes in post-deforestation carbon stock per zone z		Total changes in post-deforestation carbon stock per zone in the project area		Total net changes in carbon stock in the project area	
ID_{icl}>	1	$\Delta CBSLPA_{icl,t}$	$\Delta CBSLPA_{icl}$	ID_{iz}>	ID_{icl}>	1	$\Delta CBSLPA_{icl,t}$	$\Delta CBSLPA_{icl}$	ID_{iz}>
Name>	Forest	Annual	accumulated	Name>	Name>	Forest	Annual	accumulated	Name>
year t	tCO_2-e	tCO_2-e	tCO_2-e	Year	year t	tCO_2-e	tCO_2-e	tCO_2-e	Year
2032	163,185.3	163,185.3	2,825,431.5	2032	25,874.6	25,874.6	228,466.9	49,049.4	49,049.4
2033	282,057.0	282,057.0	3,107,488.4	2033	26,498.5	26,498.5	254,965.4	21,435.8	70,485.1
2034	204,760.0	204,760.0	3,312,248.4	2034	27,305.9	27,305.9	282,271.3	76,200.2	146,685.4
2035	375,839.4	375,839.4	3,688,087.9	2035	30,957.7	30,957.7	313,229.0	79,496.7	226,182.0
2036	377,836.3	377,836.3	4,065,924.1	2036	33,961.1	33,961.1	347,190.1	20,298.0	246,480.0
2037	330,274.7	330,274.7	4,396,198.9	2037	36,420.1	36,420.1	383,610.3	79,831.3	326,311.3
2038	372,737.4	372,737.4	4,768,936.3	2038	37,869.8	37,869.8	421,480.1	84,440.2	410,751.6
2039	396,985.6	396,985.6	5,165,921.8	2039	38,934.2	38,934.2	460,414.3	102,519.9	513,271.5
2040	531,764.9	531,764.9	5,697,686.7	2040	41,221.9	41,221.9	501,636.2	20,825.1	534,096.6

Table 33 Carbon stock changes baseline in the leakage belt.

Changes in carbon stock per initial forest class *icl*		Total change in carbon stock of initial forest class in the leakage belt area		Ppost-deforestation carbon stock change per zone z		Total change in post-deforestation carbon stock in the leakage belt area		Total net changes in carbon stock in leakage belt	
ID_{icl}>	1	$\Delta CBSLLK_{icl,t}$	$\Delta CBSLLK_{icl}$	ID_{iz}>	ID_{icl}>	1	$\Delta CBSLLK_{icl,t}$	$\Delta CBSLLK_{icl}$	ID_{iz}>
Name>	Forest	Annual	accumulated	Name>	Name>	Forest	Annual	accumulated	Name>
Year t	tCO_2-e	tCO_2-e	tCO_2-e	Year	Year t	tCO_2-e	tCO_2-e	tCO_2-e	Year
2012	109,605.3	109,605.3	109,605.3	2012	1,523.1	1,523.1	1,523.1	108,082.2	108,082.2
2013	155,953.9	155,953.9	265,559.3	2013	3,664.0	3,664.0	5,187.1	152,289.9	260,372.1
2014	68,373.5	68,373.5	333,932.7	2014	4,551.0	4,551.0	9,738.1	63,822.5	324,194.6
2015	107,770.0	107,770.0	441,702.7	2015	5,970.1	5,970.1	15,708.2	101,799.9	425,994.5
2016	77,838.0	77,838.0	519,540.7	2016	6,948.8	6,948.8	22,657.1	70,889.2	496,883.7
2017	103,702.8	103,702.8	623,243.5	2017	8,270.1	8,270.1	30,927.1	95,432.7	592,316.4
2018	138,796.3	138,796.3	762,039.8	2018	10,056.2	10,056.2	40,983.4	128,740.1	721,056.5
2019	142,333.4	142,333.4	904,373.3	2019	11,860.7	11,860.7	52,844.1	130,472.7	851,529.2
2020	193,433.0	193,433.0	1,097,806.3	2020	14,344.2	14,344.2	67,188.2	179,088.9	1,030,618.1
2021	174,065.7	174,065.7	1,271,872.0	2021	16,515.7	16,515.7	83,703.9	157,550.0	1,188,168.1
2022	151,100.5	151,100.5	1,422,972.6	2022	16,833.8	16,833.8	100,537.7	134,266.8	1,322,434.9
2023	199,148.6	199,148.6	1,622,121.2	2023	17,206.9	17,206.9	117,744.6	181,941.7	1,504,376.6
2024	231,100.2	231,100.2	1,853,221.4	2024	19,249.9	19,249.9	136,994.5	211,850.3	1,716,226.9
2025	208,765.2	208,765.2	2,061,986.6	2025	20,424.4	20,424.4	157,418.9	188,340.8	1,904,567.7
2026	231,898.0	231,898.0	2,293,884.5	2026	22,332.9	22,332.9	179,751.8	209,565.1	2,114,132.8
2027	131,278.9	131,278.9	2,425,163.4	2027	22,473.6	22,473.6	202,225.3	108,805.3	2,222,938.1
2028	371,656.1	371,656.1	2,796,819.5	2028	25,495.3	25,495.3	227,720.6	346,160.8	2,569,098.9
2029	313,317.7	313,317.7	3,110,137.2	2029	27,636.2	27,636.2	255,356.9	285,681.4	2,854,780.4
2030	345,064.3	345,064.3	3,455,201.5	2030	29,514.1	29,514.1	284,871.0	315,550.2	3,170,330.6

Changes in carbon stock per initial forest class *icl*		Total change in carbon stock of initial forest class in the leakage belt area		Ppost-deforestation carbon stock change per zone z		Total change in post-deforestation carbon stock in the leakage belt area		Total net changes in carbon stock in leakage belt	
ID_{icl}>	1	$\Delta CBSLLK_{icl,t}$	$\Delta CBSLLK_{icl}$	ID_{iz}>	ID_{icl}>	1	$\Delta CBSLLK_{icl,t}$	$\Delta CBSLLK_{icl}$	ID_{iz}>
Name>	Forest	Annual	accumulated	Name>	Name>	Forest	Annual	accumulated	Name>
Year t	tCO_2-e	tCO_2-e	tCO_2-e	Year	Year t	tCO_2-e	tCO_2-e	tCO_2-e	Year
2031	347,341.8	347,341.8	3,802,543.3	2031	31,697.9	31,697.9	316,568.9	315,643.9	3,485,974.4
2032	414,288.1	414,288.1	4,216,831.4	2032	35,098.9	35,098.9	351,667.7	379,189.2	3,865,163.7
2033	319,072.9	319,072.9	4,535,904.3	2033	36,456.8	36,456.8	388,124.6	282,616.1	4,147,779.7
2034	283,706.8	283,706.8	4,819,611.1	2034	36,891.1	36,891.1	425,015.7	246,815.7	4,394,595.4
2035	360,814.8	360,814.8	5,180,425.9	2035	38,720.1	38,720.1	463,735.8	322,094.7	4,716,690.2
2036	303,295.6	303,295.6	5,483,721.5	2036	39,429.7	39,429.7	503,165.4	263,865.9	4,980,556.1
2037	455,166.6	455,166.6	5,938,888.1	2037	43,638.1	43,638.1	546,803.5	411,528.5	5,392,084.6
2038	421,022.4	421,022.4	6,359,910.5	2038	44,011.2	44,011.2	590,814.8	377,011.1	5,769,095.8
2039	433,560.3	433,560.3	6,793,470.8	2039	45,399.8	45,399.8	636,214.5	388,160.6	6,157,256.3
2040	505,636.6	505,636.6	7,299,107.5	2040	47,357.2	47,357.2	683,571.7	458,279.4	6,615,535.8

Non-CO2 emissions baseline per forest fires

Non-CO2 emissions were not considered and accounted for the project

5.4 Project emissions (CL1)

(VM0015 Step 7) Ex-ante Estimate of Real Changes in Carbon Stock and Non-CO2 Emissions in the Project Area

Non-CO2 emissions were not considered and accounted for the project

(VM0015 Step 7) Ex-ante estimate of real changes in carbon stock

(VM0015 Step 7) Ex-ante estimate of real changes in carbon stock due to planned activities

Low impact logging activities are expected to take place in the Project area, developed by the logging company Indústria de Madeiras Manoa Ltda, which follows FSC principles and criteria, not leaving large clearings in the forest. As observed by Holmes et al. (2002), in forest exploration systems of reduced impact, such as FSC Management, less than 10% of dragging trails can cause exposure of the soil and, consequently, clearings in the forest canopy. However, a carbon stock reduction was estimated concerning deforestation for implementation of infrastructure, for example, new roads, dragging trails, or forest patios in each annual production unity (UPA) within the project area. Table 34 shows the planned deforestation estimated area and the impact on carbon stocks in the project area. Figure 20 shows the location of each UPA in the Manoa REDD+ Project.

Table 34 *Ex-ante* estimate on stock reduction due to planed deforestation in the Project Area (VM0015 Methodology Table 25a).

Year *t*	Planned deforested areas X Carbon stock changes (decrease) in the project area		Total decrease in carbon stock due to planned deforestation	
	ID_{cl} =	1	annual	ID_{cl} =
	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CPDdPA_t$	$APDPA_{icl,t}$
	ha	$tCO_2e\ ha^{-1}$	tCO_2e	Ha
2012	27	508.5	13,878.3	13,878.3
2013	27	508.5	13,878.3	27,756.5
2014	27	508.5	13,878.3	41,634.8
2015	27	508.5	13,878.3	55,513.1
2016	27	508.5	13,878.3	69,391.4
2017	27	508.5	13,878.3	83,269.6
2018	27	508.5	13,878.3	97,147.9

Year *t*	Planned deforested areas X Carbon stock changes (decrease) in the project area		Total decrease in carbon stock due to planned deforestation	
	ID_{cl} =	1	annual	ID_{cl} =
	$APDPA_{icl,t}$	$Ctot_{icl,t}$	$\Delta CPDdPA_t$	$APDPA_{icl,t}$
	ha	$tCO_2e\ ha^{-1}$	tCO_2e	Ha
2019	27	508.5	13,878.3	111,026.2
2020	27	508.5	13,878.3	124,904.5
2021	27	508.5	13,878.3	138,782.7
2022	27	508.5	13,878.3	152,661.0
2023	27	508.5	13,878.3	166,539.3
2024	27	508.5	13,878.3	180,417.6
2025	27	508.5	13,878.3	194,295.8
2026	27	508.5	13,878.3	208,174.1
2027	27	508.5	13,878.3	222,052.4
2028	27	508.5	13,878.3	235,930.7
2029	27	508.5	13,878.3	249,808.9
2030	27	508.5	13,878.3	263,687.2
2031	27	508.5	13,878.3	277,565.5
2032	27	508.5	13,878.3	291,443.8
2033	27	508.5	13,878.3	305,322.0
2034	27	508.5	13,878.3	319,200.3
2035	27	508.5	13,878.3	333,078.6
2036	27	508.5	13,878.3	346,956.9
2037	27	508.5	13,878.3	360,835.1
2038	27	508.5	13,878.3	374,713.4
2039	27	508.5	13,878.3	388,591.7
2040	27	508.5	13,878.3	402,470.0

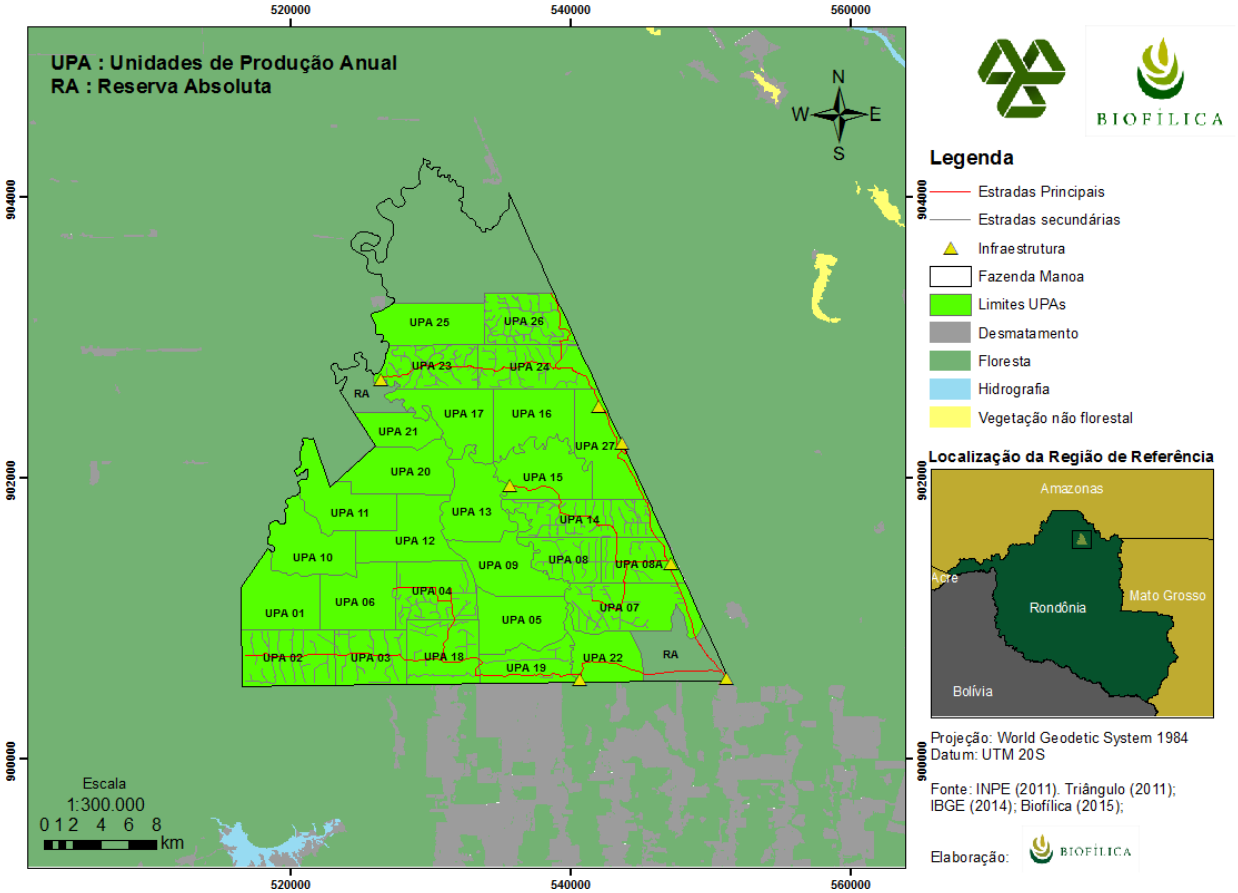

Figure 20 Location of areas subject to planned deforestation to implement FSC management infrastructure.

Wood Extraction

The forest management activities planned by Indústria de Madeiras Manoa Ltda. will be monitored and reported on each project verification event, this monitoring will be based on Post-exploring Reports. In case of reduction in carbon stock due to logging, VM0015 Table 25b will be filled ex-post.

The construction of infrastructure for forest management activities, such as patios and roads, will be considered as planned deforestation in the project area. Moreover, according to VM0015 footnote number 85, carbon stock from forest management products with the purpose to constitute durable wooden goods may be conservatively ignored in the project scenario.

Production of charcoal and firewood collection

The production of charcoal or firewood collection is not expected. This type of use was not identified among families during the social diagnosis. In case of carbon stock reduction in the forest due to this activity, Table 25c of VM0015 will be presented ex post.

Table 35 shows ex ante estimate of carbon stock reduction due to activities planned by the project.

Table 35 Ex-ante estimate on stock reduction due to planed deforestation in the Project Area (VM0015 Methodology Table 25a).

Year t	Total decrease in carbon stock due to planned deforestation		Total decrease in carbon stock due to planned harvest activities		Total decrease in carbon stock due to firewood collection and charcoal production		Year t	
	annual $\Delta CPDdPA_t$ tCO_2e	accumulated $\Delta CPDdPA$ tCO_2e	annual $\Delta CPLdPA_t$ tCO_2e	accumulated $\Delta CPLdPA$ tCO_2e	annual $\Delta CPDdPA_t$ tCO_2e	accumulated $\Delta CPDdPA$ tCO_2e	Annual $\Delta CPLdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e
2012	13,878.3	13,878.3	0.0	0.0	0.0	0.0	13,878.3	13,878.3
2013	13,878.3	27,756.5	0.0	0.0	0.0	0.0	13,878.3	27,756.5
2014	13,878.3	41,634.8	0.0	0.0	0.0	0.0	13,878.3	41,634.8
2015	13,878.3	55,513.1	0.0	0.0	0.0	0.0	13,878.3	55,513.1
2016	13,878.3	69,391.4	0.0	0.0	0.0	0.0	13,878.3	69,391.4
2017	13,878.3	83,269.6	0.0	0.0	0.0	0.0	13,878.3	83,269.6
2018	13,878.3	97,147.9	0.0	0.0	0.0	0.0	13,878.3	97,147.9
2019	13,878.3	111,026.2	0.0	0.0	0.0	0.0	13,878.3	111,026.2
2020	13,878.3	124,904.5	0.0	0.0	0.0	0.0	13,878.3	124,904.5
2021	13,878.3	138,782.7	0.0	0.0	0.0	0.0	13,878.3	138,782.7
2022	13,878.3	152,661.0	0.0	0.0	0.0	0.0	13,878.3	152,661.0
2023	13,878.3	166,539.3	0.0	0.0	0.0	0.0	13,878.3	166,539.3
2024	13,878.3	180,417.6	0.0	0.0	0.0	0.0	13,878.3	180,417.6
2025	13,878.3	194,295.8	0.0	0.0	0.0	0.0	13,878.3	194,295.8
2026	13,878.3	208,174.1	0.0	0.0	0.0	0.0	13,878.3	208,174.1
2027	13,878.3	222,052.4	0.0	0.0	0.0	0.0	13,878.3	222,052.4
2028	13,878.3	235,930.7	0.0	0.0	0.0	0.0	13,878.3	235,930.7
2029	13,878.3	249,808.9	0.0	0.0	0.0	0.0	13,878.3	249,808.9
2030	13,878.3	263,687.2	0.0	0.0	0.0	0.0	13,878.3	263,687.2
2031	13,878.3	277,565.5	0.0	0.0	0.0	0.0	13,878.3	277,565.5
2032	13,878.3	291,443.8	0.0	0.0	0.0	0.0	13,878.3	291,443.8

Year t	Total decrease in carbon stock due to planned deforestation		Total decrease in carbon stock due to planned harvest activities		Total decrease in carbon stock due to firewood collection and charcoal production		Year t	
	annual $\Delta CPDdPA_t$ tCO_2e	accumulated $\Delta CPDdPA$ tCO_2e	annual $\Delta CPLdPA_t$ tCO_2e	accumulated $\Delta CPLdPA$ tCO_2e	annual $\Delta CPDdPA_t$ tCO_2e	accumulated $\Delta CPDdPA$ tCO_2e	Annual $\Delta CPLdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e
2033	13,878.3	305,322.0	0.0	0.0	0.0	0.0	13,878.3	305,322.0
2034	13,878.3	319,200.3	0.0	0.0	0.0	0.0	13,878.3	319,200.3
2035	13,878.3	333,078.6	0.0	0.0	0.0	0.0	13,878.3	333,078.6
2036	13,878.3	346,956.9	0.0	0.0	0.0	0.0	13,878.3	346,956.9
2037	13,878.3	360,835.1	0.0	0.0	0.0	0.0	13,878.3	360,835.1
2038	13,878.3	374,713.4	0.0	0.0	0.0	0.0	13,878.3	374,713.4
2039	13,878.3	388,591.7	0.0	0.0	0.0	0.0	13,878.3	388,591.7
2040	13,878.3	402,470.0	0.0	0.0	0.0	0.0	13,878.3	402,470.0

Optional counting of carbon stocks increase

The ex-ante estimate of carbon stock increase due to regeneration after management activities was not considered for conservative measure.

Ex-ante estimate of carbon stock changes due to inevitable unplanned deforestation in the project area

The project activities can reduce about 95% of baseline emissions in the first year of the project and, after the first few years of implementation it may reach 99%. After this period, considering an effective monitoring of the forest cover and continuity of the strong governance carried out in the area by the management, strengthened by the activities of the project, it is expected that the project Effectiveness Index remains close to 100% in all foreseen years of reduced emissions accounting (20 years after 2011).

Ex-ante estimate of net real changes in carbon stock in the project area

Table 36 shows the carbon stock changes related to planned activities and the project effectiveness.

Table 36 Ex-ante estimates of net carbon reduction in the project area on the project scenario (VM0015 Table 27).

Year t	Total decrease in carbon stock due to planned activities		Total increase in carbon stock due to planned activities		Total decrease in carbon stock due to inevitable unplanned deforestation		Total carbon stock change in the project scenario	
	annual $\Delta CPAdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	accumulated $\Delta CPAiPA$ tCO_2e	annual $\Delta CUDdPA_t$ tCO_2e	annual $\Delta CPAdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e
2012	13,878.3	13,878.3	0.0	0.0	1,962.0	1,962.0	15,840.2	15,840.2
2013	13,878.3	27,756.5	0.0	0.0	643.1	2,605.0	14,521.3	30,361.6
2014	13,878.3	41,634.8	0.0	0.0	1,524.0	4,129.1	15,402.3	45,763.9
2015	13,878.3	55,513.1	0.0	0.0	795.0	4,924.0	14,673.2	60,437.1
2016	13,878.3	69,391.4	0.0	0.0	203.0	5,127.0	14,081.3	74,518.4
2017	13,878.3	83,269.6	0.0	0.0	798.3	5,925.3	14,676.6	89,195.0
2018	13,878.3	97,147.9	0.0	0.0	844.4	6,769.7	14,722.7	103,917.6
2019	13,878.3	111,026.2	0.0	0.0	1,025.2	7,794.9	14,903.5	118,821.1
2020	13,878.3	124,904.5	0.0	0.0	208.3	8,003.2	14,086.5	132,907.6
2021	13,878.3	138,782.7	0.0	0.0	851.3	8,854.5	14,729.6	147,637.2
2022	13,878.3	152,661.0	0.0	0.0	1,056.5	9,911.0	14,934.8	162,572.0
2023	13,878.3	166,539.3	0.0	0.0	2,079.3	11,990.3	15,957.6	178,529.6
2024	13,878.3	180,417.6	0.0	0.0	1,167.9	13,158.2	15,046.1	193,575.8
2025	13,878.3	194,295.8	0.0	0.0	821.8	13,980.0	14,700.1	208,275.8
2026	13,878.3	208,174.1	0.0	0.0	1,266.6	15,246.6	15,144.9	223,420.7
2027	13,878.3	222,052.4	0.0	0.0	1,146.6	16,393.2	15,024.9	238,445.6
2028	13,878.3	235,930.7	0.0	0.0	2,271.8	18,665.0	16,150.0	254,595.6
2029	13,878.3	249,808.9	0.0	0.0	2,779.5	21,444.4	16,657.7	271,253.3
2030	13,878.3	263,687.2	0.0	0.0	3,243.9	24,688.3	17,122.2	288,375.5
2031	13,878.3	277,565.5	0.0	0.0	2,570.4	27,258.7	16,448.7	304,824.2
2032	13,878.3	291,443.8	0.0	0.0	1,373.1	28,631.8	15,251.4	320,075.6

Year t	Total decrease in carbon stock due to planned activities		Total increase in carbon stock due to planned activities		Total decrease in carbon stock due to inevitable unplanned deforestation		Total carbon stock change in the project scenario	
	annual $\Delta CPAdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	accumulated $\Delta CPAiPA$ tCO_2e	annual $\Delta CUDdPA_t$ tCO_2e	annual $\Delta CPAdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e
2033	13,878.3	305,322.0	0.0	0.0	2,555.6	31,187.4	16,433.9	336,509.5
2034	13,878.3	319,200.3	0.0	0.0	1,774.5	32,962.0	15,652.8	352,162.3
2035	13,878.3	333,078.6	0.0	0.0	3,448.8	36,410.8	17,327.1	369,489.4
2036	13,878.3	346,956.9	0.0	0.0	3,438.8	39,849.5	17,317.0	386,806.4
2037	13,878.3	360,835.1	0.0	0.0	2,938.5	42,788.1	16,816.8	403,623.2
2038	13,878.3	374,713.4	0.0	0.0	3,348.7	46,136.8	17,226.9	420,850.2
2039	13,878.3	388,591.7	0.0	0.0	3,580.5	49,717.3	17,458.8	438,309.0
2040	13,878.3	402,470.0	0.0	0.0	4,905.4	54,622.7	18,783.7	457,092.7

Ex-ante estimate of non-CO_2 emissions due to forest fire

Non-CO2 emissions from forest fire were not accounted for the baseline scenario.

Table 37 shows expected net change and non-CO2 emissions in the project area. Emissions that occur during the development of the project activities will be monitored and reported, in case of increase in projected emissions in relation to the scenario with the project.

Table 37 Total ex-ante estimate of net real changes in carbon stock and non-CO2 emissions in the project area

Year t	Total ex-ante decrease in carbon stock due to planned activities		Total ex-ante increase in carbon stock due to planned activities		Total ex-ante decrease in carbon stock due to inevitable unplanned activities		Total ex-ante net carbon stock change		Total ex ante estimate of non-CO2 forest fires in the project area	
	annual $\Delta CPAdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	accumulated $\Delta CPAiPA$ tCO_2e	annual $\Delta CUDdPA_t$ tCO_2e	accumulated $\Delta CUDdPA$ tCO_2e	annual $\Delta CPAdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	accumulated $\Delta CPAiPA$ tCO_2e
2012	13,878.3	13,878.3	0.0	0.0	1,962.0	1,962.0	15,840.2	15,840.2	0.0	0.0
2013	13,878.3	27,756.5	0.0	0.0	643.1	2,605.0	14,521.3	30,361.6	0.0	0.0
2014	13,878.3	41,634.8	0.0	0.0	1,524.0	4,129.1	15,402.3	45,763.9	0.0	0.0
2015	13,878.3	55,513.1	0.0	0.0	795.0	4,924.0	14,673.2	60,437.1	0.0	0.0
2016	13,878.3	69,391.4	0.0	0.0	203.0	5,127.0	14,081.3	74,518.4	0.0	0.0
2017	13,878.3	83,269.6	0.0	0.0	798.3	5,925.3	14,676.6	89,195.0	0.0	0.0
2018	13,878.3	97,147.9	0.0	0.0	844.4	6,769.7	14,722.7	103,917.6	0.0	0.0
2019	13,878.3	111,026.2	0.0	0.0	1,025.2	7,794.9	14,903.5	118,821.1	0.0	0.0
2020	13,878.3	124,904.5	0.0	0.0	208.3	8,003.2	14,086.5	132,907.6	0.0	0.0
2021	13,878.3	138,782.7	0.0	0.0	851.3	8,854.5	14,729.6	147,637.2	0.0	0.0
2022	13,878.3	152,661.0	0.0	0.0	1,056.5	9,911.0	14,934.8	162,572.0	0.0	0.0
2023	13,878.3	166,539.3	0.0	0.0	2,079.3	11,990.3	15,957.6	178,529.6	0.0	0.0
2024	13,878.3	180,417.6	0.0	0.0	1,167.9	13,158.2	15,046.1	193,575.8	0.0	0.0
2025	13,878.3	194,295.8	0.0	0.0	821.8	13,980.0	14,700.1	208,275.8	0.0	0.0
2026	13,878.3	208,174.1	0.0	0.0	1,266.6	15,246.6	15,144.9	223,420.7	0.0	0.0
2027	13,878.3	222,052.4	0.0	0.0	1,146.6	16,393.2	15,024.9	238,445.6	0.0	0.0
2028	13,878.3	235,930.7	0.0	0.0	2,271.8	18,665.0	16,150.0	254,595.6	0.0	0.0
2029	13,878.3	249,808.9	0.0	0.0	2,779.5	21,444.4	16,657.7	271,253.3	0.0	0.0
2030	13,878.3	263,687.2	0.0	0.0	3,243.9	24,688.3	17,122.2	288,375.5	0.0	0.0
2031	13,878.3	277,565.5	0.0	0.0	2,570.4	27,258.7	16,448.7	304,824.2	0.0	0.0

Year t	Total ex-ante decrease in carbon stock due to planned activities		Total ex-ante increase in carbon stock due to planned activities		Total ex-ante decrease in carbon stock due to inevitable unplanned activities		Total ex-ante net carbon stock change		Total ex ante estimate of non-CO2 forest fires in the project area	
	annual $\Delta CPAdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	accumulated $\Delta CPAiPA$ tCO_2e	annual $\Delta CUDdPA_t$ tCO_2e	accumulated $\Delta CUDdPA$ tCO_2e	annual $\Delta CPAdPA_t$ tCO_2e	accumulated $\Delta CPAdPA$ tCO_2e	annual $\Delta CPAiPA_t$ tCO_2e	accumulated $\Delta CPAiPA$ tCO_2e
2032	13,878.3	291,443.8	0.0	0.0	1,373.1	28,631.8	15,251.4	320,075.6	0.0	0.0
2033	13,878.3	305,322.0	0.0	0.0	2,555.6	31,187.4	16,433.9	336,509.5	0.0	0.0
2034	13,878.3	319,200.3	0.0	0.0	1,774.5	32,962.0	15,652.8	352,162.3	0.0	0.0
2035	13,878.3	333,078.6	0.0	0.0	3,448.8	36,410.8	17,327.1	369,489.4	0.0	0.0
2036	13,878.3	346,956.9	0.0	0.0	3,438.8	39,849.5	17,317.0	386,806.4	0.0	0.0
2037	13,878.3	360,835.1	0.0	0.0	2,938.5	42,788.1	16,816.8	403,623.2	0.0	0.0
2038	13,878.3	374,713.4	0.0	0.0	3,348.7	46,136.8	17,226.9	420,850.2	0.0	0.0
2039	13,878.3	388,591.7	0.0	0.0	3,580.5	49,717.3	17,458.8	438,309.0	0.0	0.0
2040	13,878.3	402,470.0	0.0	0.0	4,905.4	54,622.7	18,783.7	457,092.7	0.0	0.0

5.5 Leakage (CL2)

Ex-ante estimate of carbon stocks reduction and increased GHG emissions due to leakage prevention measures.

The leakage prevention measures are intended to be carried out within the limits of Manoa Farm, starting with courses and training related to sustainable forest management, conservation, and environmental awareness. These initiatives will be target not only to the professional training of workers in the region but also to raise awareness of the population on environmental issues and forest preservation.

According to Section 2, item 2.2 of this document, the development of activities that may reduce carbon stocks or increase GHG emissions is not expected, in comparison with the baseline scenario. However, in case these activities are implemented and result in significant changes in carbon stock, they will be monitored, registered and reported.

Changes in carbon stocks due to implementation of activities in leakage management areas

Table 30c of VM0015 (Step 8.1.1) is not applicable, as reduction due to implementation of activities is not expected.

CH_4 and N_2O ex-ante emissions estimate due to pasture activities

As previously stated, activities resulting in a significant increase in CH4 and N2O emissions are not expected. Therefore, VM0015 Tables 31 and 32 were not applied.

Ex-ante estimate of carbon stocks changes and increased GHG emissions due to leakage prevention measures.

VM0015 Table 33 does not apply.

Ex-ante estimate of carbon stocks reduction and increased GHG emissions due leakage displacement.

According to Step 3, deforestation agents are external to Manoa Farm area and most part of their activities are found in an illegality and criminally context. Thus, a 5% displacement factor was considered for the first ten years, as existing forest management in the area has properly held deforestation in the farm even prior to the project implementation. A 3% reduction factor was considered after the first ten years of the project, already considering the project influence on this context. Thus, the leakage displacement factor tends to remain constant for the project remaining crediting period.

Table 38 shows the ex-ante leakage estimate due to activity displacement for the first baseline fixed period and Table 39 shows the ex-ante leakage total.

Table 38 ex-ante leakage estimate due to activity displacement (VM0015 Table 34).

Year	Total ex ante estimated decrease in carbon stock due to the displacement of deforestation Ex ante leakage GHG emissions		Total ex ante estimated increase in GHG emissions due to displacement of forest fires	
	annual $\Delta CADLK_t$ tCO_2e	accumulated $\Delta CADLK$ tCO_2e	annual $EADLK_t$ tCO_2e	Annual $\Delta CADLK_t$ tCO_2e
2012	2,452.5	2,452.5	0.0	0.0
2013	1,071.8	3,524.3	0.0	0.0
2014	3,810.0	7,334.3	0.0	0.0
2015	3,974.8	11,309.1	0.0	0.0
2016	1,014.9	12,324.0	0.0	0.0
2017	3,991.6	16,315.6	0.0	0.0
2018	4,222.0	20,537.6	0.0	0.0
2019	5,126.0	25,663.6	0.0	0.0
2020	1,041.3	26,704.8	0.0	0.0
2021	2,553.9	29,258.8	0.0	0.0
2022	3,169.5	32,428.3	0.0	0.0
2023	6,238.0	38,666.3	0.0	0.0
2024	3,503.6	42,169.9	0.0	0.0
2025	2,465.5	44,635.4	0.0	0.0
2026	3,799.8	48,435.2	0.0	0.0
2027	3,439.7	51,874.9	0.0	0.0
2028	6,815.3	58,690.2	0.0	0.0
2029	8,338.4	67,028.6	0.0	0.0
2030	9,731.7	76,760.2	0.0	0.0
2031	7,711.3	84,471.5	0.0	0.0
2032	4,119.3	88,590.9	0.0	0.0
2033	7,666.8	96,257.6	0.0	0.0
2034	5,323.6	101,581.2	0.0	0.0
2035	10,346.5	111,927.7	0.0	0.0
2036	10,316.3	122,244.0	0.0	0.0
2037	8,815.6	131,059.6	0.0	0.0
2038	10,046.0	141,105.6	0.0	0.0
2039	10,741.5	151,847.2	0.0	0.0
2040	14,716.3	166,563.4	0.0	0.0

Table 39 Ex-ante total leakage (VM0015 Table 35).

Year t	Ex-ante total GHG emissions due to increased cattle raising.		Ex-ante total increase in GHG emissions due to the forest fires displacement		Ex-ante total decrease in carbon stock due to deforestation displacement		Decrease in carbon stock due to leakage prevention activities		Total net changes in carbon stock due to leakage		Total net increase in emissions due to leakage	
	annual $EgLK_t$ tCO_2e	accumulated EgLK tCO_2e	annual $EADLK_t$ tCO_2e	accumulated EADLK tCO_2e	annual $\Delta CADLK_t$ tCO_2e	accumulated $\Delta CADLK$ tCO_2e	annual $\Delta CLPMLK_t$ tCO_2e	annual $EgLK_t$ tCO_2e	accumulated EgLK tCO_2e	annual $EADLK_t$ tCO_2e	accumulated EADLK tCO_2e	Annual $\Delta CADLK_t$ tCO_2e
2012	0.0	0.0	0.0	0.0	2,452.5	2,452.5	0.0	0.0	2,452.5	2,452.5	0.0	0.0
2013	0.0	0.0	0.0	0.0	1,071.8	3,524.3	0.0	0.0	1,071.8	3,524.3	0.0	0.0
2014	0.0	0.0	0.0	0.0	3,810.0	7,334.3	0.0	0.0	3,810.0	7,334.3	0.0	0.0
2015	0.0	0.0	0.0	0.0	3,974.8	11,309.1	0.0	0.0	3,974.8	11,309.1	0.0	0.0
2016	0.0	0.0	0.0	0.0	1,014.9	12,324.0	0.0	0.0	1,014.9	12,324.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	3,991.6	16,315.6	0.0	0.0	3,991.6	16,315.6	0.0	0.0
2018	0.0	0.0	0.0	0.0	4,222.0	20,537.6	0.0	0.0	4,222.0	20,537.6	0.0	0.0
2019	0.0	0.0	0.0	0.0	5,126.0	25,663.6	0.0	0.0	5,126.0	25,663.6	0.0	0.0
2020	0.0	0.0	0.0	0.0	1,041.3	26,704.8	0.0	0.0	1,041.3	26,704.8	0.0	0.0
2021	0.0	0.0	0.0	0.0	2,553.9	29,258.8	0.0	0.0	2,553.9	29,258.8	0.0	0.0
2022	0.0	0.0	0.0	0.0	3,169.5	32,428.3	0.0	0.0	3,169.5	32,428.3	0.0	0.0
2023	0.0	0.0	0.0	0.0	6,238.0	38,666.3	0.0	0.0	6,238.0	38,666.3	0.0	0.0
2024	0.0	0.0	0.0	0.0	3,503.6	42,169.9	0.0	0.0	3,503.6	42,169.9	0.0	0.0
2025	0.0	0.0	0.0	0.0	2,465.5	44,635.4	0.0	0.0	2,465.5	44,635.4	0.0	0.0
2026	0.0	0.0	0.0	0.0	3,799.8	48,435.2	0.0	0.0	3,799.8	48,435.2	0.0	0.0
2027	0.0	0.0	0.0	0.0	3,439.7	51,874.9	0.0	0.0	3,439.7	51,874.9	0.0	0.0

Year t	Ex-ante total GHG emissions due to increased cattle raising.		Ex-ante total increase in GHG emissions due to the forest fires displacement		Ex-ante total decrease in carbon stock due to deforestation displacement		Decrease in carbon stock due to leakage prevention activities		Total net changes in carbon stock due to leakage		Total net increase in emissions due to leakage	
	annual $EgLK_t$ tCO_2e	accumulated EgLK tCO_2e	annual $EADLK_t$ tCO_2e	accumulated EADLK tCO_2e	annual $\Delta CADLK_t$ tCO_2e	accumulated ΔCADLK tCO_2e	annual $\Delta CLPMLK_t$ tCO_2e	annual $EgLK_t$ tCO_2e	accumulated EgLK tCO_2e	annual $EADLK_t$ tCO_2e	accumulated EADLK tCO_2e	Annual $\Delta CADLK_t$ tCO_2e
2028	0.0	0.0	0.0	0.0	6,815.3	58,690.2	0.0	0.0	6,815.3	58,690.2	0.0	0.0
2029	0.0	0.0	0.0	0.0	8,338.4	67,028.6	0.0	0.0	8,338.4	67,028.6	0.0	0.0
2030	0.0	0.0	0.0	0.0	9,731.7	76,760.2	0.0	0.0	9,731.7	76,760.2	0.0	0.0
2031	0.0	0.0	0.0	0.0	7,711.3	84,471.5	0.0	0.0	7,711.3	84,471.5	0.0	0.0
2032	0.0	0.0	0.0	0.0	4,119.3	88,590.9	0.0	0.0	4,119.3	88,590.9	0.0	0.0
2033	0.0	0.0	0.0	0.0	7,666.8	96,257.6	0.0	0.0	7,666.8	96,257.6	0.0	0.0
2034	0.0	0.0	0.0	0.0	5,323.6	101,581.2	0.0	0.0	5,323.6	101,581.2	0.0	0.0
2035	0.0	0.0	0.0	0.0	10,346.5	111,927.7	0.0	0.0	10,346.5	111,927.7	0.0	0.0
2036	0.0	0.0	0.0	0.0	10,316.3	122,244.0	0.0	0.0	10,316.3	122,244.0	0.0	0.0
2037	0.0	0.0	0.0	0.0	8,815.6	131,059.6	0.0	0.0	8,815.6	131,059.6	0.0	0.0
2038	0.0	0.0	0.0	0.0	10,046.0	141,105.6	0.0	0.0	10,046.0	141,105.6	0.0	0.0
2039	0.0	0.0	0.0	0.0	10,741.5	151,847.2	0.0	0.0	10,741.5	151,847.2	0.0	0.0
2040	0.0	0.0	0.0	0.0	14,716.3	166,563.4	0.0	0.0	14,716.3	166,563.4	0.0	0.0

5.6 Summary of reduced or removed GHG emissions (CL1 & CL2)

Ex-ante total net reduction of GHG anthropogenic Emissions

Significance Assessment

Based on the document *"EB-CDM approved" "Tool for testing significance of GHG emissions in A/R CDM Project activities",* we could verify that the above-ground biomass will contribute with 85% of the expected emissions in the baseline scenario. On the other side, below-ground biomass will contribute with 15%.

Ex-ante estimate calculation of GHG emissions total net reduction

VM0015 Equation 19 has been used to calculate the ex-ante estimate of the project emission reduction.

Ex-ante calculation of Verified Carbon Units (VCUs)

VM0015 Equation 20 was applied to estimate the number of VCUs. The project Risk Factor parameter was estimated using the *VCS AFOLU Non-Permanence Risk Too*l, resulting in 10%.

Table 40. Ex-ante estimate of net anthropogenic emission reductions (DREDD) and Verified Carbon Units (VM0015 Table 36).

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
	$\Delta CBSLPA_t$	$\Delta CBSLPA$	$\Delta EBBBSLPA_t$	$\Delta EBBBSLPA$	$\Delta CPSPA_t$	$\Delta CPSPA$	$EBBPSPA_t$	$EBBPSPA$	ΔCLK_t	ΔCLK	ELK_t	ELK	$\Delta REDD_t$	$\Delta REDD$	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
2012	49,049	49,049	0	0	15,840	15,840	0	0	2,452	2,452	0	0	30,757	30,757	27,436	27,436	3,321	3,321
2013	21,436	70,485	0	0	14,521	30,362	0	0	1,072	3,524	0	0	5,843	36,599	5,151	32,587	691	4,012
2014	76,200	146,685	0	0	15,402	45,764	0	0	3,810	7,334	0	0	56,988	93,587	50,908	83,495	6,080	10,092
2015	79,497	226,182	0	0	14,673	60,437	0	0	3,975	11,309	0	0	60,849	154,436	54,366	137,861	6,482	16,574
2016	20,298	246,480	0	0	14,081	74,518	0	0	1,015	12,324	0	0	5,202	159,638	4,580	142,441	622	17,196
2017	79,831	326,311	0	0	14,677	89,195	0	0	3,992	16,316	0	0	61,163	220,801	54,648	197,089	6,515	23,712
2018	84,440	410,752	0	0	14,723	103,918	0	0	4,222	20,538	0	0	65,496	286,296	58,524	255,613	6,972	30,683
2019	102,520	513,271	0	0	14,903	118,821	0	0	5,126	25,664	0	0	82,490	368,787	73,729	329,342	8,762	39,445
2020	20,825	534,097	0	0	14,087	132,908	0	0	1,041	26,705	0	0	5,697	374,484	5,023	334,365	674	40,119
2021	85,132	619,228	0	0	14,730	147,637	0	0	2,554	29,259	0	0	67,848	442,332	60,808	395,173	7,040	47,159
2022	105,649	724,877	0	0	14,935	162,572	0	0	3,169	32,428	0	0	87,545	529,877	78,473	473,647	9,071	56,231
2023	207,935	932,812	0	0	15,958	178,530	0	0	6,238	38,666	0	0	185,739	715,616	166,541	640,188	19,198	75,428
2024	116,788	1,049,599	0	0	15,046	193,576	0	0	3,504	42,170	0	0	98,238	813,854	88,064	728,251	10,174	85,602
2025	82,182	1,131,781	0	0	14,700	208,276	0	0	2,465	44,635	0	0	65,016	878,870	58,268	786,519	6,748	92,351
2026	126,660	1,258,441	0	0	15,145	223,421	0	0	3,800	48,435	0	0	107,715	986,585	96,564	883,083	11,151	103,502
2027	114,658	1,373,099	0	0	15,025	238,446	0	0	3,440	51,875	0	0	96,193	1,082,778	86,230	969,313	9,963	113,465
2028	227,177	1,600,275	0	0	16,150	254,596	0	0	6,815	58,690	0	0	204,211	1,286,990	183,109	1,152,422	21,103	134,568
2029	277,945	1,878,221	0	0	16,658	271,253	0	0	8,338	67,029	0	0	252,949	1,539,939	226,820	1,379,242	26,129	160,697
2030	324,389	2,202,610	0	0	17,122	288,376	0	0	9,732	76,760	0	0	297,535	1,837,474	266,808	1,646,051	30,727	191,423

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
2031	257,044	2,459,654	0	0	16,449	304,824	0	0	7,711	84,472	0	0	232,884	2,070,358	208,825	1,854,875	24,060	215,483
2032	137,310.8	2,596,964.6	0.0	0.0	15,251.4	205,029.5	0.0	0.0	4,119.3	88,590.9	0.0	0.0	117,940	2,303,344.3	105,734	2,064,150.7	12,205.9	239,193.5
2033	255,558.5	2,852,523.1	0.0	0.0	16,433.9	221,463.3	0.0	0.0	7,666.8	96,257.6	0.0	0.0	231,458	2,534,802.1	207,545	2,271,696.1	23,912.5	263,106.0
2034	177,454.1	3,029,977.1	0.0	0.0	15,652.8	237,116.1	0.0	0.0	5,323.6	101,581.2	0.0	0.0	156,478	2,691,279.8	140,298	2,411,993.7	16,180.1	279,286.1
2035	344,881.7	3,374,858.8	0.0	0.0	17,327.1	254,443.2	0.0	0.0	10,346.5	111,927.7	0.0	0.0	317,208	3,008,487.9	284,453	2,696,446.4	32,755.5	312,041.6
2036	343,875.1	3,718,734.0	0.0	0.0	17,317.0	271,760.2	0.0	0.0	10,316.3	122,244.0	0.0	0.0	316,242	3,324,729.8	283,586	2,980,032.4	32,655.8	344,697.4
2037	293,854.6	4,012,588.6	0.0	0.0	16,816.8	288,577.1	0.0	0.0	8,815.6	131,059.6	0.0	0.0	268,222	3,592,951.9	240,518	3,220,550.8	27,703.8	372,401.2
2038	334,867.5	4,347,456.1	0.0	0.0	17,226.9	305,804.0	0.0	0.0	10,046.0	141,105.6	0.0	0.0	307,595	3,900,546.5	275,831	3,496,381.3	31,764.1	404,165.2
2039	358,051.4	4,705,507.5	0.0	0.0	17,458.8	323,262.8	0.0	0.0	10,741.5	151,847.2	0.0	0.0	329,851	4,230,397.6	295,792	3,792,173.1	34,059.3	438,224.5
2040	490,543.0	5,196,050.5	0.0	0.0	18,783.7	342,046.5	0.0	0.0	14,716.3	166,563.4	0.0	0.0	457,043	4,687,440.5	409,867	4,202,040.1	47,175.9	485,400.4

6 COMMUNITIES

6.1 Scenario of the communities in the absence of the project (CM1)

6.1.1 Characteristics of the communities surrounding the project

For the social and economic study of the project area, the reference area of the municipality of Cujubim was taken as a sample, plus portions of the municipalities Itapuã do Oeste, Candeias do Jamari, and Porto Velho. However, the primary data were obtained only in Cujubim, and the secondary data were obtained in the other three municipalities. This choice was made because there is a social and economic relationship between Manoa Farm and the municipality of Cujubim, due to access to the area, the creation of jobs and the destination of raw material (wood), and the fact that the activities of the deforestation agents mainly occur based in the Cujubim region.

In addition to the aforementioned relationships, it is also noteworthy that: a) access to the area is via Cujubim; b) the area is contiguous to protected areas, known as Conservation Units, along several segments of its boundaries; c) the settlements for agrarian reform (considered vectors of deforestation) are located in the section between Cujubim and Manoa Farm; d) all other areas are forested, privately held, and used for management plans; e) the areas called “títulos antigos dos soldados da borracha” [literally: “old titles of the rubber soldiers”] are located in the municipality of Cujubim, being used for Forest Management.

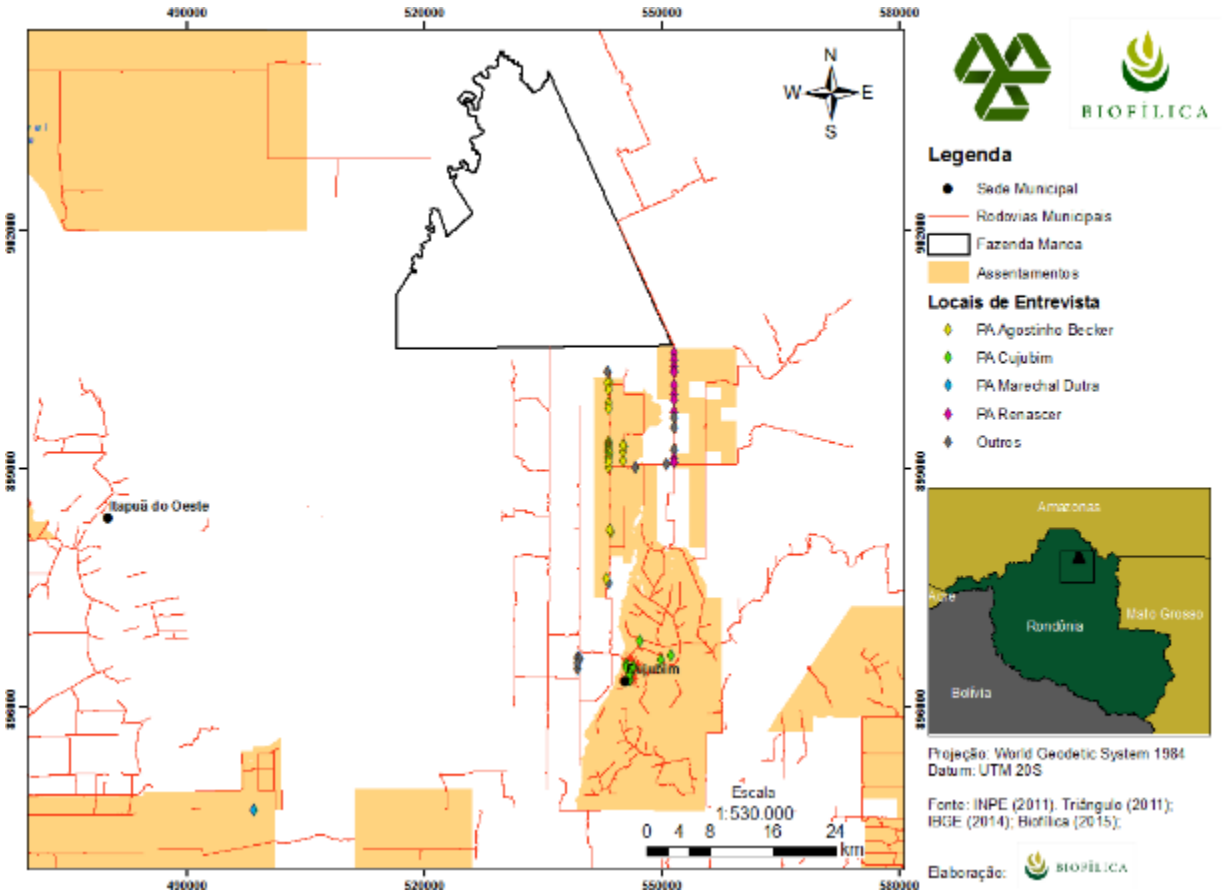

Figure 21 Location of the sites of the interviews conducted for the socioeconomic study.

The choice of methodology for the social and economic analysis of the REDD+ Manoa Project Reference Region took into account the need to combine the data obtained from municipal authorities and government departments, with the information obtained through the field work conducted in the municipality of Cujubim and secondary data.

Accordingly, we used questionnaires administered to three groups of the study's target population: rural area, urban area, and Manoa Farm workers, which served as a basis for subsequent analyses. Through the questions contained in these questionnaires, we sought to meet the characteristics listed in the study's Term of Reference and, consequently, the specificities in the standards of the validators of REDD projects. The questionnaires were formulated containing closed-ended as well as open-ended questions, because this model allows researchers to observe certain subjective aspects of the respondents that might be hidden in a later stage of data tabulation and analysis.

The questionnaires were applied in field work conducted October 08–17, 2014. The number of questionnaires referred to the sampling effort obtained in the time allotted for the field survey. This procedure was chosen in the field stage, as the following activities were carried out in this period: Interviews with residents of the urban and rural areas of Cujubim and the workers at Manoa Farm. Additionally, researchers' perceptions were obtained during this period regarding the situation of the municipality. The

researchers also contacted staff members of municipal government departments, with whom open interviews were conducted and saved on audio recordings, with the permission of the interviewees.

Secondary data were obtained through public information contained on official websites and requested through ex-officio letters to state agencies in various socioeconomic areas; few of these were answered.

We emphasize the difficulties in obtaining official information during the data collection period, due to the electoral process, whereby much information was unavailable in compliance with current legislation.

6.1.2 Future scenarios in the absence of the project

The analysis we conducted on the region focuses on three basic issues discussed extensively throughout the report: a) decrease in wood extraction; b) conversion of forest into pasture; c) increase of agricultural mechanization.

The decline in the timber potential is a matter of time, in light of the fact that no municipality in Rondônia ever managed to exceed 15 to 20 years of intense exploration; considering that since 2000 the timber industry grew rapidly in the region, there are 5 to 10 years for the activity to decline. This fact stems from a number of factors, including the lack of effective action by the State in overseeing and licensing the activity; and the lack of commitment to social and environmental and sustainability issues by many of the sector's business leaders, as such issues are seen as "obstacles to development." This scenario of decline will cause economic damage to the municipality of Cujubim and loss of its capacity to invest in public services, which are already deficient.

The downturn of the timber industry inevitably entails converting forest into pasture, since from a capital viewpoint, the forests that once served to leverage the region's economic environment are no longer of importance, due to the absence of tree species with economic value. Thus, people turn to cattle raising, planting pastures of African origin in these areas, which will cause imbalance in the mostly polymorphic soil structure (low natural fertility). For cattle raising, there is a complete framework provided by the State to support the activity, as well as guaranteed marketing of production. Initially, the activity encompasses those farmers who, over the years, ended up leasing or selling their lands to small business owners in the area, because they were not able to obtain the capital to invest in improving pastures, which become deteriorated due to soil depletion, leading to low productivity levels per hectare.

As an alternative to the weakening of the soil, agricultural mechanization and monoculture, especially soy, begin to appear, which finds deforested areas, with low cost of mechanization, cheap and depleted lands. These facts are attractive to those who have technology and knowledge to invest in the activity. If this scenario is confirmed, it will, in turn, involve the incorporation of areas that are currently used for livestock and agriculture management, which will result in real estate marketing and speculation, with a

consequent rural exodus, or removal of family farmers to new areas of cultivation and/or livestock and may result in pressure on the remaining forest areas, including the Conservation Units.

In this context, one must consider that the municipalities in the reference area are located in the region known as the "Arc of Deforestation," because of the actions related to illegal logging as well as the advancement of agriculture and livestock; notably it has been observed statewide that the Conservation Units and Indigenous Lands are areas with better conservation and preservation, and yet have suffered the most diverse types of pressure (encroachment, illegal timber extraction, loss of biomass and biodiversity, among others) and the many different communities are beset by constant threats, including to their physical integrity.

It was also observed that the state agencies and representatives of the executive, legislative and judiciary branches, whether through a series of structural difficulties or even omission, have not satisfactorily fulfilled their role of regional oversight and planning, which favors the action of various social actors – many of which are repeat offenders; therefore, these Conservation Units, to a greater or lesser extent, suffer some kind of pressure.

In an optimistic scenario, it may occur that by realizing the social and economic and environmental benefits that forest maintenance generates for population and brings to the residents of urban and rural areas, they become important contributors to defend and fight for conservation and preservation of the region's innumerable natural resources.

At best, the situation of the forests in the region is that the status quo will continue, depending on the goodwill of the State and specific projects.

In a catastrophic scenario, it is possible that the situation in the region will worsen the indicators of deterioration, considering that there is noticeable low self-esteem among the population, which at the moment is practically abandoned in the following categories: a) social (education, healthcare, housing, communication, housing conditions, leisure and cultural areas, and other infrastructure); b) economic (employment, income, agriculture and alternatives to promote diversification and vertical integration of production); c) environmental (potentiation of invasions and illegal extraction of natural resources; d) political–associative (with the weakening or disintegration of their representative entities.

The consequences of the condition presented in this scenario may include rural exodus and migration of the residents to the cities, where almost certainly they be marginalized in every way, or proceeding to other rural areas (big and small farms, to work only to survive, with no dignity) in such a way that they will be deterritorialized and have no reference to their place of origin.

6.2 Net positive impacts for the communities (CM2)

With the project, it is possible that the social, economic, environmental and governance conditions will be strengthened, especially in Cujubim, because it is believed that several actions can be triggered, thereby improving the self-esteem of the population. Among the actions, activities, programs, projects should be considered as an ongoing process of training and educating residents, hence with the expectation that they acquired experience and technical knowledge to contribute to the region's development.

The support that the project may offer the foregoing proposals represents important tools to change the scenario of the region. The REDD + Project appears as an important opportunity, whereby the residents may generate business with a sustainable bases and mostly maintain the integrity of the forest, so that they can thus obtain better quality of life for current and future generations in a healthy environment. However, it is essential to stress that many challenges and forces will likely be faced by the residents, who must first articulate in their political bases in order to be partners of the Project and together achieve common goals.

6.3 Impacts on other actors (GL2)

No impacts on other actors are expected.

6.4 Exceptional benefits for the communities

This section does not apply to the project.

7 BIODIVERSITY

The state of Rondônia has much of its territory located in the "Rondônia Endemism Center," considered one of the most important bird endemism areas of in South America (CRACRAFT, 1985), and the region is classified as one of the few global IBAs (Important Bird and Biodiversity Areas). The area has extreme ecological complexity due to the fact that almost all the rivers of the interfluvial system flow into the Madeira river (WILLIS, 1969).

The project area is located in the region of the Madeira river basin, southwest of the Amazon biome, a region that is seen as great potential for biodiversity; however, the area historically has few studies (WHITTAKER, 2008) and has suffered from increased anthropogenic pressure in recent decades (PY-DANIEL et al., 2007). The region is composed of a mosaic of protected areas – called Conservation Units (Figure 22) – such as National Forests, Sustainable-Yield State Forests, Extractive Reserve and Ecological Station, and comprises one of the state's main foci for biodiversity conservation.

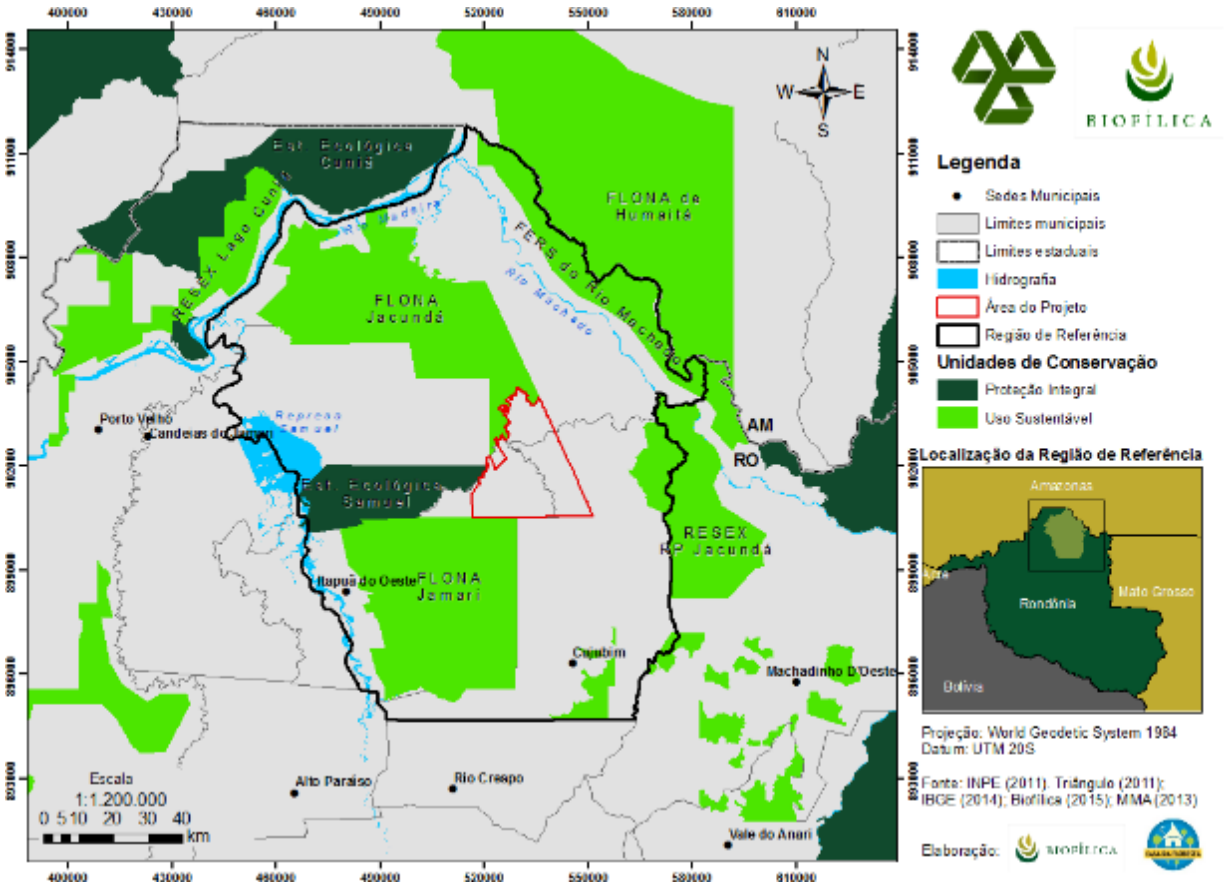

Figure 22 Location of the Project Area and Conservation Units in the surrounding area

Reduced-impact management, which is carried out in the project area, can be considered as an alternative to biodiversity conservation, in such a way that generates financial resources and provides for forest maintenance compared to the current scenario in the region, which is characterized by land conflicts as well as forest degradation and deforestation.

7.1.1 Flora

For a description of the structure and composition of the existing forest cover in the project area, we adopted the methodology used for the carbon inventory assessment. The sampling of vegetation was carried out in clusters in the shape of a Maltese cross, with four sampling subunits measuring 10 m x 250 m (Figure 19). For the phytosociological assessment, the four sub-plots existing in each cluster were considered so as to correspond to a single sampling unit, with total area of 1 hectare.

The distribution of the plots was ordered by stratifying the Project Area according to criteria of the forest types mapped in the IBGE database and the existence or absence of exploitation in a reduced-impact forest management arrangement. According to the approach of the vegetation types presented by the IBGE

(2014), there are four predominant types of formations, and only two types with the greater scope and spatial representation for the area of interest were considered: open rainforest lowlands with palm trees ("FOATB") and open submontane rainforest with lianas ("FOAS").

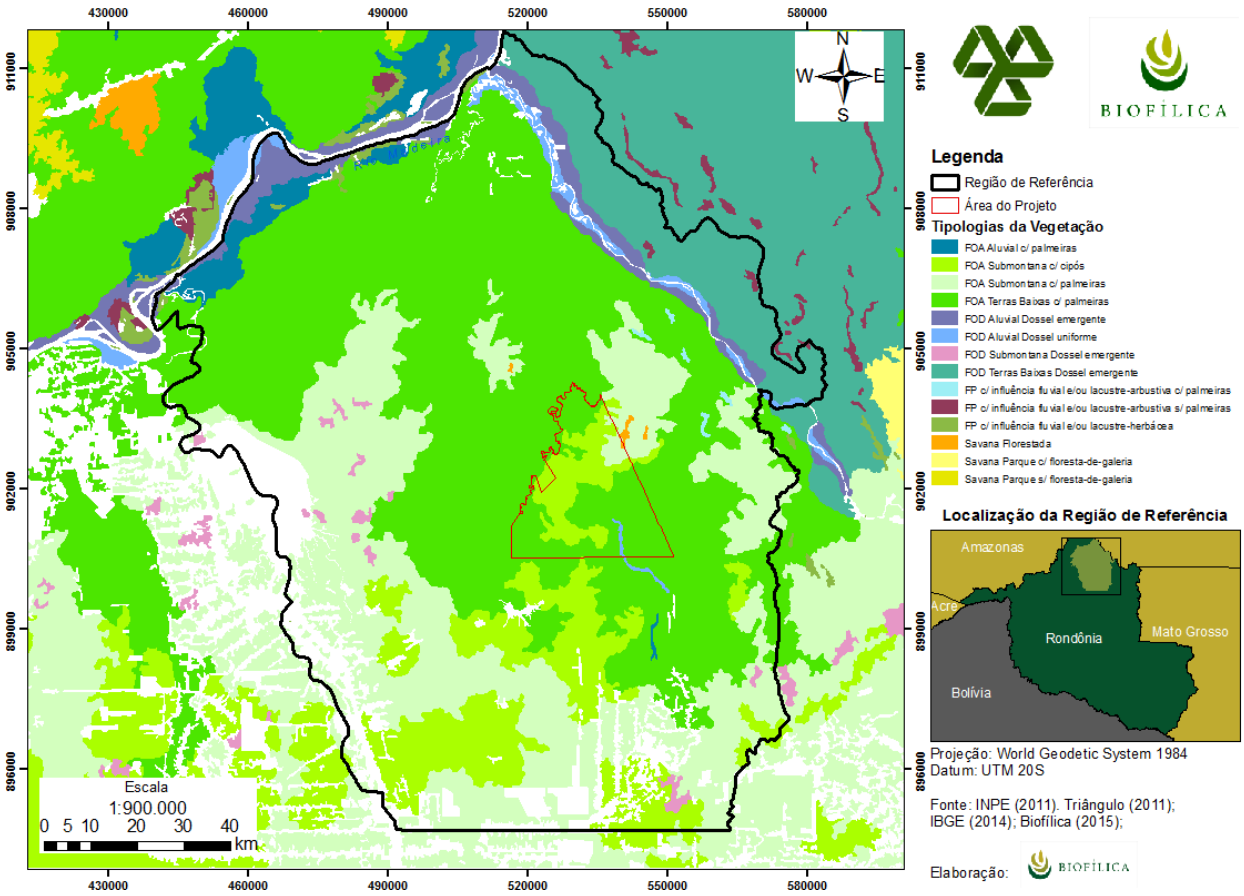

Figure 23 Forest formations present in the Project Zone

In each sampling unit, the diameter at breast height (DBH) ≥ 10 cm was measured, so that only individuals that have reached the minimum diameter were identified. The identification of inventoried individuals was carried out based on the contribution of woodsmen experienced in recognizing the common names of the species, and subsequently correlated with the scientific names of identification reports conducted at Manoa Farm.

All of the scientific names were updated following the nomenclature available in the database of the List of Species Flora in Brazil and verified with regard to the degree of threat to national and international lists of the Ministry of the Environment (MMA) and the International Union for Conservation Nature (IUCN).

Phytosociology

The survey conducted at Manoa Farm, considering the thirty sample units of one hectare each, totaled a record of 16,021 individuals distributed among 177 tree species belonging to 45 botanical families. The analysis was performed by comparing the composition of species in the two formations defined by the IBGE mapping. In the lowland open rainforest, the number of species identified was 155, distributed among 42 families. As for the submontane open rainforest, 159 species were recorded, among 45 families; of these, 140 are present in both formations, 15 are exclusive to lowland open rainforest, and 19 are exclusive in the plots allocated in submontane open rainforest.

Virtually all the exclusive species sampled in both phytophysiognomies showed low natural density in the forest, and for most of them only a single individual was recorded. Among the species sampled exclusively in each phytophysiognomy, we highlight *Cedrela odorata* (known locally as “cedro-vermelho”) in the submontane forest, a species previously very commonly found almost throughout Brazil, and due to the high commercial value of the wood, is now currently restricted to certain areas, being cited as vulnerable on the list of endangered species (IUCN, 2015). The palm species *Mauritia flexuosa* (“buriti”) was found exclusively in the areas lowland open rainforest, and this species can be considered exclusive of low-lying areas, always occurring near rivers and variable tributary zones.

The two main forest types present in the area show great similarity in the tree layer, so that the occurrence of unique species are mainly explained by the low density of these species. Accordingly, a single forest type was considered for the farm, stratifying the data only into exploited and non-exploited (i.e., logged and non-logged) areas. The aim of this evaluation was to diagnose whether reduced-impact logging brings about significant variations in the natural patterns of species.

The analysis of the phytosociology of the exploited and non-exploited areas was based on the Importance Value Index (IVI), which is determined based on the sum of the density, frequency and relative dominance of a species, expressed in percentages. The number of individuals identified in areas that have not been managed on Manoa Farm was 8,164, belonging to 155 species. However, for the managed areas, 7,857 individuals and 162 species were recorded. In terms of diversity of plant families, the number identified in non-exploited areas was 42 families, and 45 in exploited areas. Figure 24 shows the species with higher IVI values within the fifteen plots located in areas where logging occurs.

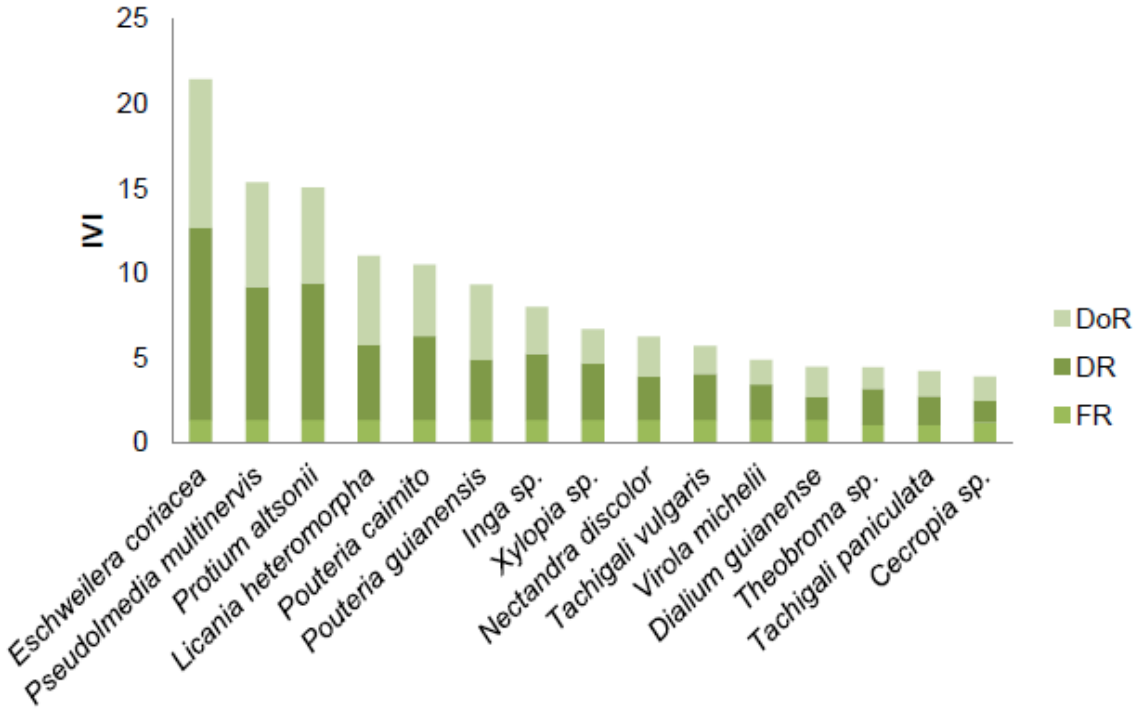

Figure 24 Importance Value Index (%) of the fifteen main species sampled in the logged areas of Manoa Farm. Source: Casa da Floresta (2015).

The same survey was conducted in non-exploited areas (Figure 25), where some species, such as *Pouteria caimito* (known locally as “abiu”) and *Tachigali paniculata* (“taxi”) were found in smaller IVI values in the exploited area. On the other hand, the species *Peltogyne lecointei* (“roxinho”), *Copaifera guyanensis* (“copaíba”) and *Dendrobangia boliviana* (“caferana”) present among the first 15 species of higher values of importance in the non-exploited areas, are among the top 25 of the exploited areas.

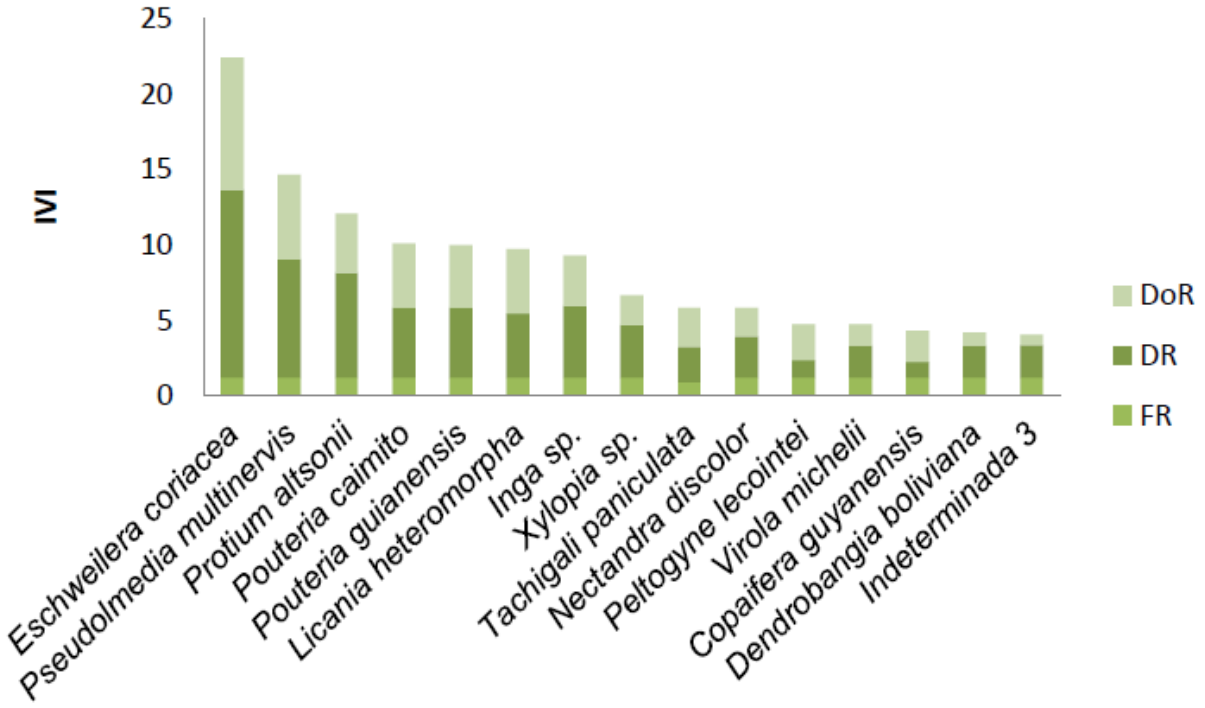

Figure 25 Importance Value Index (%) of the fifteen main species sampled in non-exploited areas of Manoa Farm. Source: Casa da Floresta (2015).

The assessment of phytosociological parameters and the comparison between the exploited and non-exploited areas showed that the forest on Manoa Farm, despite management intervention, maintains its natural characteristics of structure and composition.

The differentiation in the composition of flora observed between the two categories of sampled areas can be attributed to the “Intermediate Disturbance” hypothesis (Connel *apud* Ribeiro Neto, 2009), caused by factors of disturbance that interfere with the dynamics of species establishment. It was observed that among the species that were identified exclusively in managed areas, 45% are pioneer species, a fact that indicates favoring the colonization of open areas by individuals with a tolerance to light, contributing to the increase of the wealth of species in the area subjected to disturbances when compared to areas where there was no exploitation.

The fact that there are differences in the wealth of species between the two categories can thus be attributed to the disturbance caused by forest management. However, it is noteworthy that because this is an area of Open Rainforest, the project area does not necessarily show changes in the composition of flora within the two categories due strictly to disturbance factors. Of course, the regional phytophysiognomy corresponds to formations with spaced individuals, resulting in discontinuity in the canopy formed by the climactic tree layer.

Based on the data surveyed, it is possible to assert that the application of good management practices has maintained the integrity of the forest at Manoa Farm, assuring the maintenance thereof, which is of the utmost importance in the regional landscape, where it forms a large forest massif with other adjacent Protected Areas.

Regarding endangered species, the lists formulated by IBAMA and IUCN are also instruments of control of exploitation of species at risk. The result of the survey of species that occur in the Project Area resulted in eight species included on the lists of endangered species with some degree of threat.

Table 41 List of endangered species that occur in the Project Area (with respect to the degree of threat of the species listed in the table: EN = Endangered, VU = Vulnerable, CR = Critically endangered

Family	Species	Vernacular name	Level of threat	
			IUCN	IBAMA
Fabaceae	*Apuleia leiocarpa*	garapeira		VU
Fabaceae	*Vouacapoua americana*	angelim-de-folha-larga	CR	EN
Lauraceae	*Mezilaurus itauba*	ataúba	VU	VU
Lecythidaceae	*Bertholletia excelsa*	castanheira (Brazil nut tree)	VU	
Lecythidaceae	*Couratari guianensis*	tauari	VU	VU
Meliaceae	*Cedrela odorata*	cedro-rosa	VU	VU
Rutaceae	*Esenbeckia leiocarpa*	guarantã	VU	
Sapotaceae	*Manilkara elata*	maçaranduba	EN	

Source: Adapted, Casa da Floresta (2015).

Among the species which should be assigned greater attention when managing, it is important to highlight *Hevea brasiliensis* (rubber tree), which shows high potential in the generation of non-timber forest products (latex), and *Bertholletia excelsa* (Brazil nut tree), which in addition to presenting the possibility of non-timber management, is restricted to exploitation (included on the list of endangered species).

7.1.2 Fauna

The survey of wildlife based on primary field data within the project area was aimed at contextualizing and understanding the importance of the forest on the Farm in relation to the regional scenario. Thus, secondary data were also collected for the municipalities of Porto Velho, Candeias do Jamari, Itapuã do Oeste, and Cujubim, which are located in the Reference Region of the project.

For primary data collection, carried out in November 2014, four sampling areas were selected, so that the sampling could serve as a comparison between different stages of management. Of these, three are called Annual Production Units (UPAs), i.e., they constitute areas earmarked for management, one of which

is newly managed, with logging between 2013/2014 (UPA 07), one was logged in 2011 (UPA 14), and another with logging planned for 2015/2016 (UPA 27). The other location selected was the Absolute Reserve (RA), because it is an area that will not undergo management intervention and is therefore considered in the evaluation as the "control area."

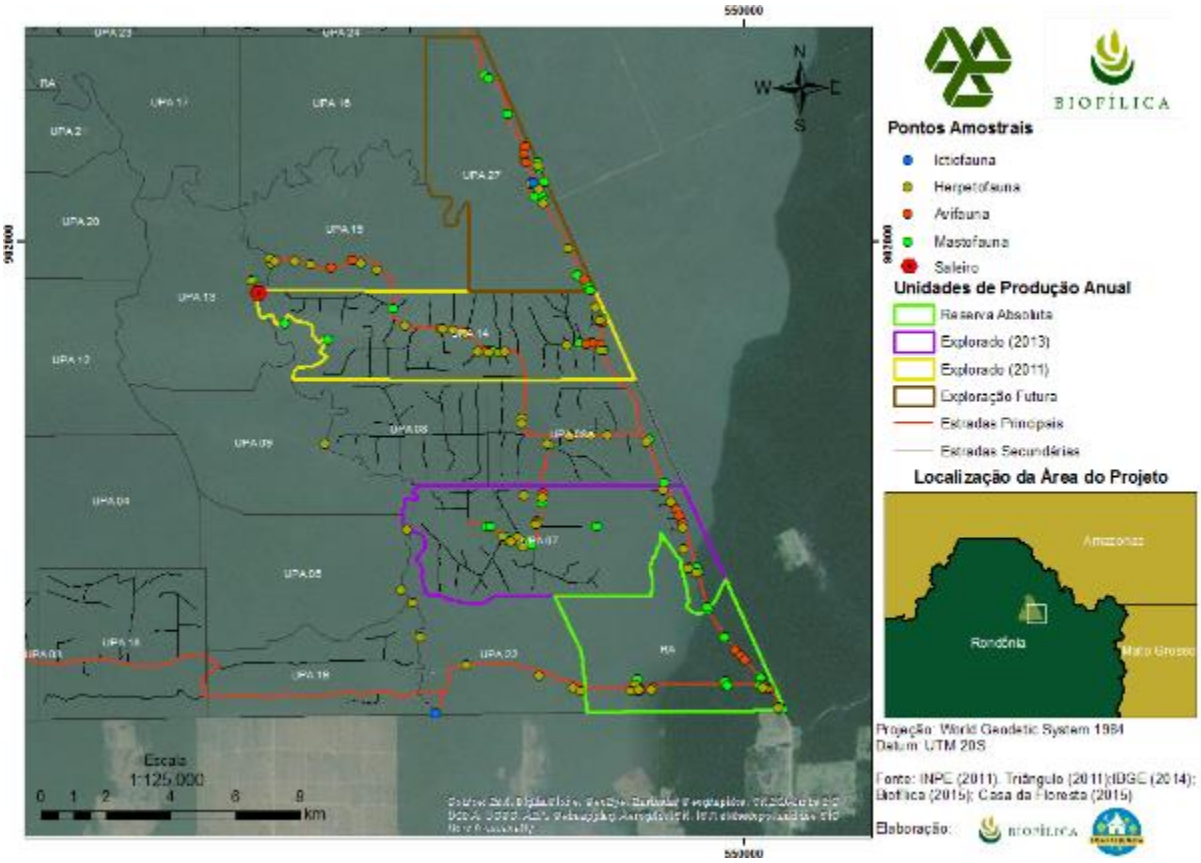

Figure 26 Location of the areas selected for wildlife sampling and sample points

Herpetofauna

In all, we compiled – through secondary data – 235 species of herpetofauna (amphibians and reptiles) with possible occurrences for the Project Zone. Amphibians correspond to 84 species, belonging to 11 families. The 151 species of reptiles identified are represented by six species of turtle distributed in three families; four amphisbaenians (worm lizards) from one family; snakes account for the majority of the records: 100 species distributed among eight families.

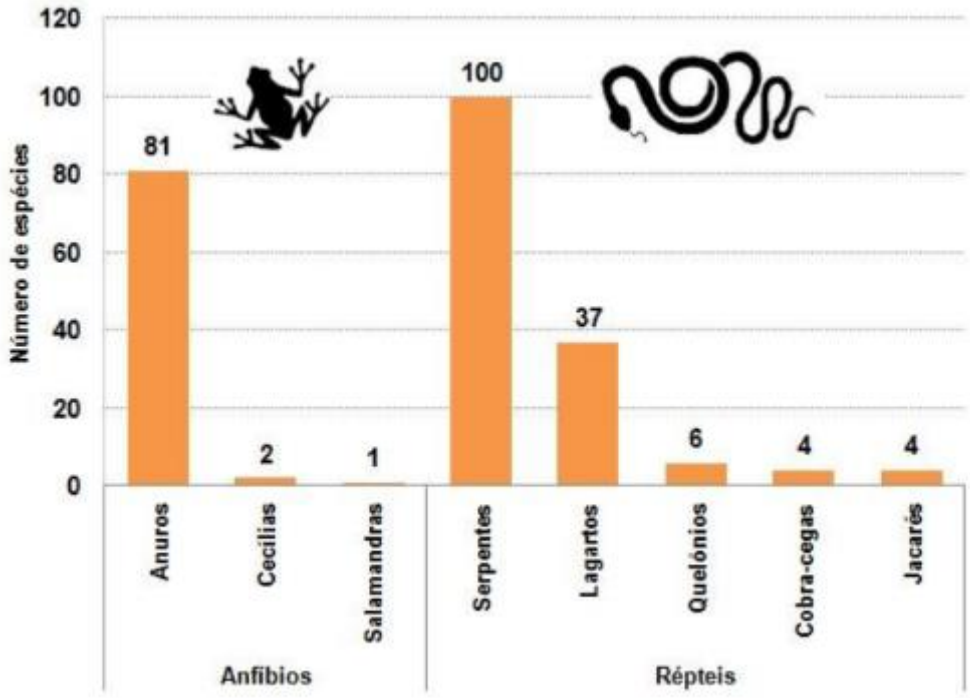

Figure 27 Number of species related to amphibians and reptiles obtained through secondary data for the project area. Source: Casa da Floresta (2015).

Among the species listed as endangered, only *Allobates brunneus* (known locally as “sapo-flecha’) is classified as a critically endangered species (CR) on the Brazilian list of endangered species (ICMBIO, 2014); with regard to lizards and snakes, no species identified is classified under any degree of threat. According to IUCN criteria, two turtle species (*Podocnemis unifilis* and *Chelonoides denticulata*) and one caiman species (*Caiman crocodilos*) are considered vulnerable (VU), a fact that is related to exploratory hunting, habitat loss and degradation, and the low density with which these animals occur in nature.

At Manoa Farm, 44 species of herpetofauna were recorded in the field, among which 30 are amphibians and 14 are reptiles. Considering the low number of sampling days (ten), high local diversity was observed, and the greater the number of sampling days, the more the number of data collected tends to increase. In the case of some amphibian species, such as frogs/toads, the distribution can be temporal as well as spatial, i.e., accompanying the seasons and weather throughout the year.

Among the 84 amphibians of probable occurrence in the project area, 24 are common species with the data presented; this means there is a chance that more than 60 different species inhabit the site, and six species were unique to the project area, not being found in the secondary data consulted (*Dendropsophus rhodopeplus, D. sarayacuensis, Phyllomedusa camba, Scinax* cf. *nebulosus, Trachycephalus resinifictrix*, and *Chiasmocleis avilapiresae*). In contrast, all the reptiles sampled directly

were present in the secondary data, which indicates the possible occurrence of over 137 species in the study area.

The 30 species of amphibians recorded are distributed in seven families, and the 14 species of reptiles are divided into four groups: amphisbaenians, caimans, lizards, and snakes. The record of the list of species encountered is attached to this document.

All four sample units visited had very similar wealth of species, and the area with the greatest number of amphibian and reptile species was the Absolute Reserve (RA), with 25 species, followed by UPA 07, with 24 species; UPA 14, with 22 species; and UPA 27, with 15 species. The area considered as "absolute reserve" (where no forest management intervention is planned) showed a greater wealth of species, and may eventually serve as the control area of the Farm. The list showing the presence of amphibian/reptile species detected in each sampled UPA is attached to this document.

Ichthyofauna

Because of the difficulty to acquire authorization to capture, collect and transport native wildlife specimens, it was not possible for the assessment to be made through primary data, thus the ichthyofauna (fish life) inventory was made only through the collection of secondary data. The data collected were a compilation of information available in the literature, such as journal articles, books, theses and dissertations, and also in digital databases. In this case the data for the municipalities of Porto Velho, Candeias do Jamari, Itapuã do Oeste, and Cujubim were considered, which are part of the Project's Reference Region.

In all, 234 species were compiled for the Project's Reference Region, present in the drainage of the Jamari river and the section of the Madeira river located within the Porto Velho municipal limits. This quantity of species is distributed among nine orders and 38 families. The composition of species reflects the pattern observed for the neotropical basins, in which there is a predominance of the orders Characiformes and Siluciformes (LOWE-MCCONNELL, 1999) and the highest representativeness of families Cichlidae and Loricariidae.

Through the secondary data collected, it was possible to observe that the region has the potential occurrence of a considerable number of species that make trophic and/or reproductive migrations (local names shown in parentheses): [*Leporinus* spp. ("piaus"), *Brycon* spp.("matrinchã"), *Prochilodus* spp. ("curimbas/curimbatás"), *Rhaphiodon vulpinus* e *hydrolicus* spp. ("peixes-cachorro"), *Brachyplatystoma vailantii* ("bagres"), *Zungaro zungaro* ("jaú"), among others]. It is worth noting that many of these species hold considerable commercial relevance to fishing communities on the Madeira river, a fact that highlights the importance of the project's reference region as local breeding/food potential for these fish in particular, and contribution toward maintaining inventories. Regarding the commercial importance, high-value species

are identified, but that do not necessarily make great migrations, such as *Pseudoplatystoma fasciatum* ("surubim"), *Pirinampus pirinampu* ("barba-chata"), and *Sorubim lima* ("bico-de-pato").

The survey also indicates the potential occurrence of several species of small fish typical of smaller streams. These fish are noteworthy because of the greater sensitivity of the environments in which they occur, since smaller streams and the ecosystems present therein are more sensitive vis-à-vis human activity carried out in the riparian areas of these streams (HELFMAN, 2007).

The data collected were supplemented by interviews with workers of the Manoa Farm, whereby 37 species were mentioned (all of which were large sized species), which in a way underestimates the wealth of species, aside from not providing precise taxonomic information. However, the results of the interviews are shown to be valid by reinforcing the potential occurrence of species with commercial value, as well as species that make trophic/reproductive migrations. The list of species identified through interviews is attached to this document.

Finally, it is important to highlight that the data collected show that the streams present in the project area are in excellent condition and represent tremendous importance for harboring part of the migratory fish populations of the Madeira river. Thus, it is reasonable to infer that the project area has a high diversity of fish species, including representatives with high ecological importance, such as fruit/seed dispersers, foraging species and predatory species, as well as species with high economic significance.

Bird life

Data on bird life were surveyed from a compilation of secondary data inventories carried out in the surrounding Conservation Units (National Forests and Ecological Stations), plus a diagnosis performed in the Project Area through primary data collection. Based on the data collected in the Project Area, it was possible to determine a species abundance index, the Point Index of Abundance ("IPA"), which is the quotient of the total number of contacts and the number of sample points (VIELLIARD et al., 2010).

During the ten days of sampling, 273 bird species were recorded, belonging to 22 orders and 53 families (attached hereto). Despite the large number, it is believed that new species might be recorded based on a larger sampling.

Compared to the secondary data collected, this total is considered representative, because it corresponds to 32% of those listed for the entire state of Rondônia (LEPAGE, 2015). Moreover, values of

wealth are higher than the units listed in the protected areas in the immediate surroundings (DE LUCA et al., 2009; YAMASHITA et al., 2005; ICMBIO, 2010; FRANÇA et al., 2011).

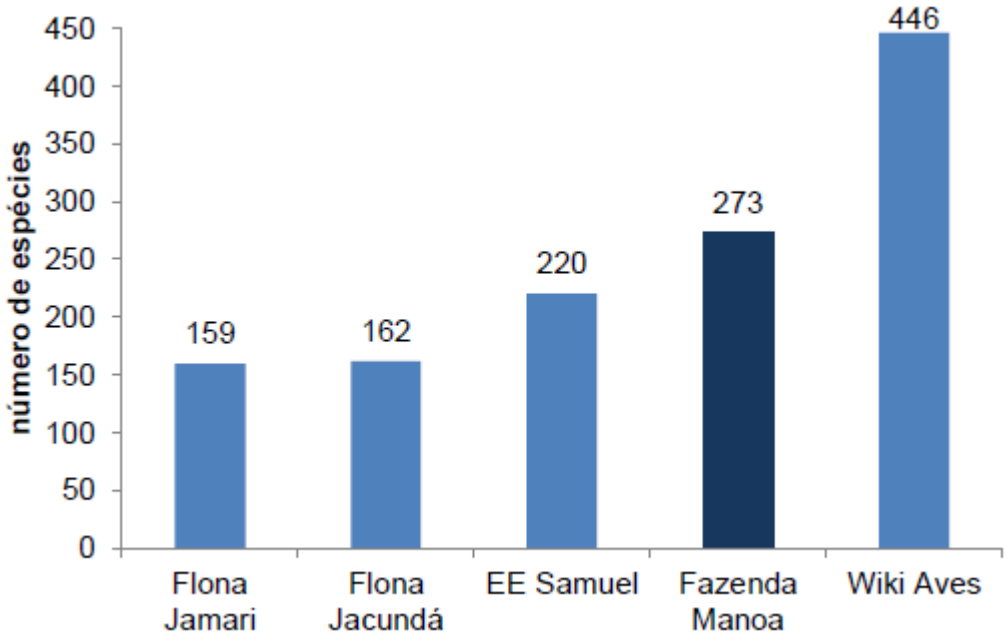

Figure 28 Wealth of bird life recorded in Estação Ecológica de Samuel (DE LUCA et al., 2009); Flona Jacundá (ICMBIO, 2010); Flona Jamari (YAMASHITA, 2005; FRANÇA et al., 2011), Project Area and records by observers in Cujubim, Candeias do Jamari, Itapuã do Oeste and Porto Velho (WIKIAVES, 2014).

Few forest species recorded in the National Forests and Ecological Station were not detected during the observation period. They consist chiefly of high-mobility and extensive home range birds, and are less populous. In all and considering all the secondary data found (save for the Project area), 472 species were recorded. This great wealth detected is attributed to the extensive remaining forest area in the Project Zone and to the fact that the municipality of Porto Velho is cut by the Madeira river, which besides giving rise to unique environments is also a dividing line for a number of taxons. The lowland bio-geographical division created by Amazon region rivers gives rise to endemism areas, with the Project Area located in the region known as “Rondônia.” Among the species restricted to this division, the Project Area is the home of *Hypocnemis ochrogyna* (cantador-ocráceo), *Amazilia rondoniae* (beija-flor-de-cabeça-azul), *Rhegmatorhina hoffmannsi* (mãe-de-taoca-papuda) and *Lepidocolaptes fuscicapillus* (arapaçu-de-rondônia);

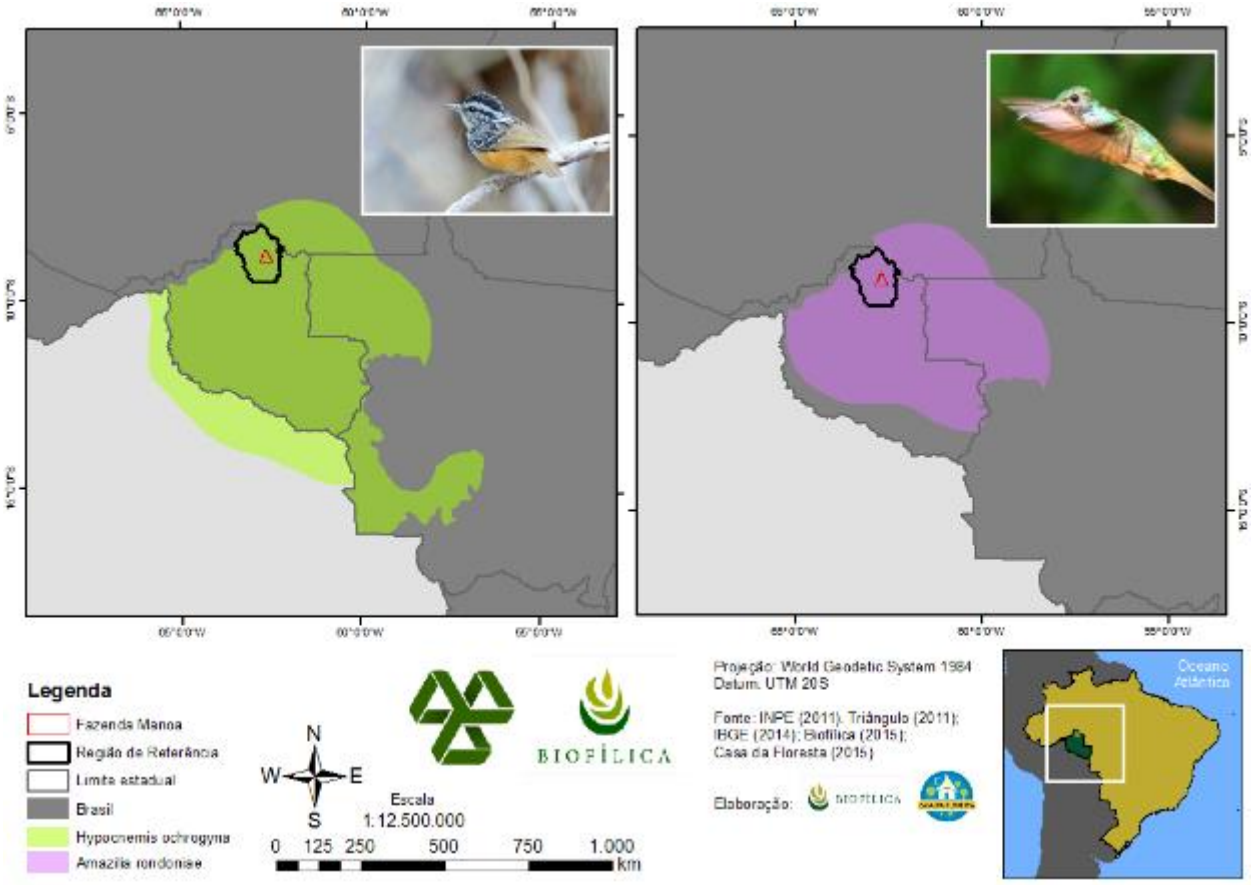

Figure 29 Map of restricted distribution species recorded in the Project Area.

Regarding bird life, the Amazon region's endemism rating is divided into two zoo-geographic regions (South and North). Twenty species recorded were considered endemic in the Project Area's South Amazon region, all strictly forest areas. Despite this area being almost entirely located in an IBA (Important Bird Area), the Project Area itself displays features for being rated as such, as according to De Luca et al. (2009), at least 19 South Amazon region endemic species are required for inclusion in this category.

A Table 42 lists the nine species considered as endangered at a countrywide and/or global level, all in the Vulnerable (VU) class. Their chief threat is deforestation and the ensuing loss of the habitat's features, as being forest-dwellers that cannot withstand forest fragmentation. Moreover, many species are restricted in distribution and face the Amazon region's progressive deforestation, chiefly in the state of Rondônia, as is the case of the *Hypocnemis ochrogyna* (cantador-ocráceo), which in this case was highly abundant in almost all the UPAs surveyed. Besides being sensitive to fragmentation, the *Tinamus tao* (azulona) is restricted mainly to primary vegetation and is considered a target for hunters, which makes their populations fragile in the presence of human occupation (ICMBio, 2014). Parrot-like birds in turn are also vulnerable, as they are often hunted to serve unlawfully as pets due to their exuberant colors and their voice.

Table 42 Endangered bird species recorded in the Project Area.

Species (by Family)	Vernacular name	Endangered in Brazil	Endangered in IUCN
Tinimidae			
Tinamus tao	azulona	VU	VU
Psophiidae			
Psophia viridis	jacamim-de-costas-verdes		VU
Columbidae			
Patagioenas subvinacea	pomba-botafogo		VU
Ramphastidae			
Ramphastos vitallinus culminatus	tucano-de-bico-preto		VU
Psittacidae			
Pionites leucogaster xanthurus	marianinha-de-cabeça-amarela		VU
Pyrrhura perlata	tiriba-de-barriga-vermelha		VU
Pyrrhura snethlageae	tiriba-do-madeira		VU
Thamnophilidae			
Hypocnemis ochrogyna	cantador-ocráceo	VU	
Dendrocolaptidae			
Hylexetastes uniformis	arapaçu-uniforme		VU

Source: Adapted, Casa da Floresta (2015).

Recorded bird life is defined by the prevalence of species that depend on the forest (72%, n=198), many of which are very sensitive to changes in habitat (32%, n=87), i.e. cannot withstand fragmentation and deforestation. This fact is in agreement with the importance of the venue's forest preservation, to allow maintenance of bird life habitat.

In general, appropriate stewardship when exploiting timber appears to have little impact to the majority of bird species (WUNDERLE et al., 2006). Keeping forests intact is a means of preserving numerous forest taxons, and together with sustainable stewardship this avoids the main impacts that threaten the biome's bird life, such as hunting or fire, possibly caused by unlawful occupation or unauthorized roads.

Mammals

The Project Area's mammal inventory covered only medium and large species, i.e. those that weigh over 1.0 kg (BECKER and DALPONTE, 1991) including primates. In order to compare data gathered and bibliographical research, a previous survey took place of secondary data on mammals found in the project's zone of influence.

The wealth of species detected in the Project Area by gathering primary data resulted in a record of 43 large and medium-sized mammals that belong to 19 families, with Primates and Carnivores being the most numerous, with 12 and 11 species respectively (attached). Data gathered during studies held in areas surrounding the project area indicate the likely occurrence of 69 large and medium-sized mammal species, and the Manoa Farm was one of the richest areas, in connection with data gathered as well as the resulting inventory.

In Brazil the Amazon Forest holds the largest mammal diversity among neo-tropical biomes, with 399 species (PAGLIA et al., 2012), including in this list small flying and non-flying mammals. Considering only large and medium-sized mammal, the number of species is closer to 150, with primates (92) and carnivores (18) as the most representative groups (PAGLIA et al., 2012).

Please note the unprecedented and unexpected records that were not listed in the secondary data. One of these deals with *M. rondoni* (sagui-de-rondônia), a small new primate species described in 2010 (FERRARI et al., 2010), endemic in the state of Rondônia and already deemed to be endangered, probably due to its extremely restricted distribution.

Another record describes a rare South American canid, the *Atelocynus microtis*, found in the absolute reserve (RA) only. This is a lone omnivorous mammal, with a not well defined geographic distribution (PERES 1991); EISENBERG and REDFORD, 1999; LEITE-PITMAN and WILLIAMS 2011). (Figure 30). However, it is known that roughly 40% of its distribution is exactly in the deforestation region that concentrates the Amazon Forest's greatest distribution rates (LEITE-PITMAN e BEISIEGEL, 2013). According to Peres (1991) and Leite-Pitman & Williams (2011), records of its presence in fauna inventories are very uncommon. To date, what is known of the *A. microtis* ecology is that it seems to prefer forest environments with little or no changes (LEITE-PITMAN & WILLIAMS, 2011). Hence, detecting this species in the RA i.e. in the control area evidences its good state of preservation and increases the importance of caring for environments with greater forest integration.

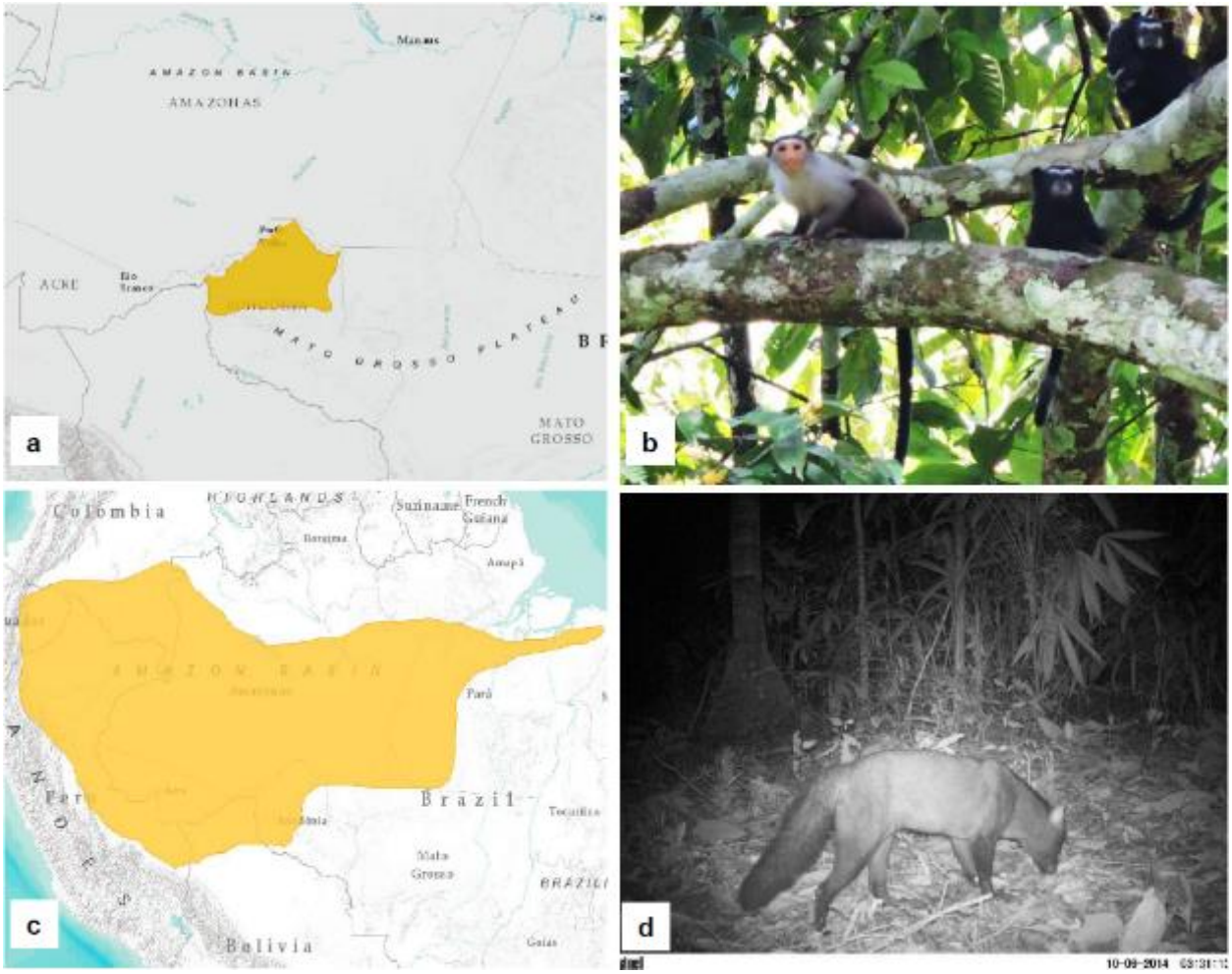

Figure 30. Source: Casa da Floresta (2015); Two unprecedented records in the project area. **a.** *M. rondoni* (sagui-de-rondônia) distribution map adapted from IUCN (2015); **b.** the primate's record in the project area; **c.** *Atelocynus microtis* (cachorro-do-mato-de-orelhas-curtas), adapted from IUCN (2015); **d.** *A. microtis* recorded solely in the RA.

Of the 43 species recorded, 12 are under a degree of danger according to international (IUCN, 2015) and/or domestic lists (IBAMA, 2014), which is equal to roughly 28% of medium and large mammals in the Manoa Farm (Table 43). Eight species are considered vulnerable (VU) to extinction by both lists, save for the *P. brasiliensis* (ariranha) and *Ateles chamek* (macaco-aranha), rated as endangered (EN) by the IUCN. The four remaining species: *Panthera onca* (onça-pintada), *Leopardus sp.* (gato-do-mato), *S. venaticus* (cachorro-vinagre) and *A. microtis* (cachorro-do-mato-de-orelha-curta), are endangered only in the Brazilian list, in the vulnerable class. Please note that of mammals at risk as a whole, one-half are in the Carnivore order, and all are vulnerable to extinction in accordance with at least one of the lists adopted. In general, key threats to wild carnivores consist in habitat loss and fragmentation (COSTA et al., 2005),

which change the environment and reduce areas available to the populations, as well as hunting, directly or indirectly through the reduction of prey available.

Table 43 Endangered large and medium-sized recorded in the Project Area.

ORDER/Family/*Species*	**Given Name**	**Endangered in IUCN**	**Endangered in IBAMA**
PRIMATES			
Atelidae			
Ateles chamek	macaco-aranha-de-cara-preta	EN	VU
Callitrichidae			
Mico rondoni	sagui-de-rondônia	VU	VU
CARNIVORES			
Felidae			
Panthera onca	onça-pintada		VU
Puma concolor	onça-parda		VU
*Leopardus sp.**	gato-do-mato	VU	VU/EN
Procyonidae			
Pteronura brasiliensis	ariranha	EN	VU
Canidae			
Speothos venaticus	cachorro-vinagre		VU
Atelocynus microtis	cachorro-do-mato-de-orelhas-curtas		VU
CINGULATA			
Dasypodidae			
Priodontes maximus	tatu-canastra	VU	VU
PERISSODACTYLA			
Tapiridae			
Tapirus terrestris	anta-brasileira	VU	VU
PILOSA			
Myrmecophagidae			
Myrmecophaga tridactyla	tamanduá-bandeira	VU	VU
ARTIODACTYLA			
Tayassuidae			
Tayassu pecari	queixada	VU	VU

*May be equal to the *Leopardus tigrinus* or *L. wiedii* species

Source: Adapted, Casa da Floresta (2015).

Among the species with a greater relative incidence, *Tapirus terrestris* (anta) and *P. onca* (onça-pintada) have a 67% and 17% relative incidence respectively. *Tapirus terrestris* is deemed a great spreader of seeds and it feeds on at least 39 plant species and in many cases it is the only spreader. Discrepancy in relative incidence found for the latter in relation to other species is due mostly to records obtained in the salt lick, representing roughly 90% of total records. The jaguar is the largest feline in the Americas and is at the top of the food chain. It has a low birth rate and needs extensive living space (CHEIDA et al., 2011), characteristics defining it as a species with high ecological requirements in terms of habitat and diet (CASO et al., 2008). However, the moderate frequency of records obtained during the inventory process enable it to be inferred that the Project Area concentrates important attributes for the specie.

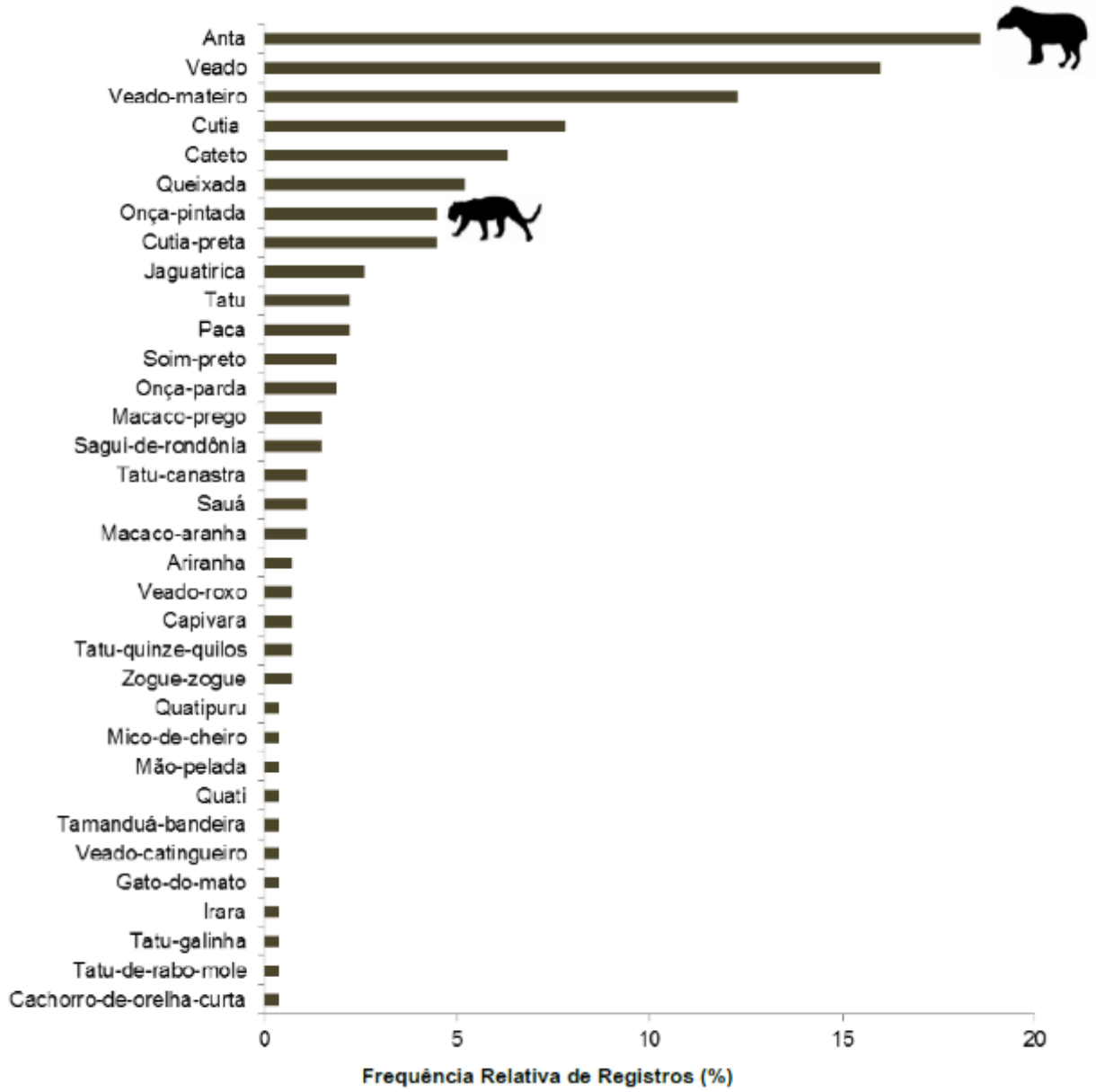

Figure 31 Source: Casa da Floresta (2015). The Relative Frequency (%) is calculated based on the number of large and medium size mammals in the Project Area. To improve visualization, the bar related to the number of tapirs recorded (*Tapirus terrestres)* has been divided into sections and corresponds to 67% of the total number recorded.

Taking into consideration the areas where data concerning large mammals were collected (Areas in the process of being managing, already managed and absolute reserve), it was possible to observe that management operations did not result in a direct impact on the distribution and number of species so much so that there was a balance among the values of the wealth observed in all areas.

The results arising from the biodiversity inventory enabled recognition and characterization of the medium and large size mammal population present in the Project Area and in the remaining surrounding forests and served to illustrate the reality at the time in each one of the sample areas assessed. However, to be able to evaluate the impact of the management operations more precisely, as well as other impact factors related to the project's activities in relation to the large and medium size animal life, a greater period to evaluate and monitor the area would be necessary. Therefore, it would be necessary to conduct constant monitoring so that the possible impacts and changes in the local ecological parameters can be determined.

7.1.3 High Conservation Value Attributes

The forests have environmental and social values as a habitat for wild life, protection of water basins as well as supply of essential ecosystem type services. The forests where these values are considered to be of an exceptional nature or of critical importance can be defined as High Conservation Value Forests – HCV (JENNINGS et al., 2003).

When the biodiversity evaluation was being conducted in the Project Area, a salt lick area was identified, which could be classified as a "High Conservation Value Area" and presents significant importance for the maintenance of the local biodiversity.

The salt licks or clay pits are located in the midst of native vegetation, generally near water ways with little vegetation and exposed soil, rich in macro and micro nutrients (COELHO, 2006) (Figure 32). The salt lick soil is very rich in magnesium, calcium, phosphorous, boron and copper (MONTENEGRO, 2004), although its composition varies depending on the location (VARANASHI, 2014).

The locations are used by many animals, especially mammals and particularly herbivores, frugivores (BLAKE et al., 2011) and omnivores (KLAUSS et al., 1998), that practice geophagia i.e., they ingest the soil. The consumption of soil in these areas has been attributed to its several functions to the animal communities such as: a source of essential nutrients for foraging species (REDMOND, 1982; RUGGIERO e FAY, 1994); for detoxification of existing secondary vegetation origin compositions (SOUZA et al., 2002); and may serve as a food source in times of resource scarcities (HEYMANN and HARTMANN, 1991; MOE, 1993).

Figure 32 Salt lick or clay pit evaluated in the Project Area.

The salt licks could also cause environmental costs associated with the expenditure of energy that the species need to dislocate to the specific location to obtain their dietary supplements (KLEIN and THING, 1989). Additionally, there is also an increased chance of predation (MATSUBAYASHI et al., 2006), and a risk of transmission of parasites and diseases by means of the species who frequent the locations (HENSHAW and AVENI, 1977). Nevertheless, the benefits the salt licks provide the animal population appear to outweigh the costs (KLAUS et al., 1998), since the salt licks are one of the few locations in the forest where it is possible to observe a high density of animals with greater frequency (VARANASHI, 2014).

The salt lick evaluated is found in the Permanent Preservation Area (Área de Preservação Permanente - APP) and is already protected under the New Brazilian Forestry Law (Law No. 12.727, of 2012), since this law determines that rivers ranging from 10 to 50 meters, from the edge of the river bed border, have a 50-meter minimum swath of vegetation (in which the salt lick in question can be classified, since the Rio Preto is approximately 35 meters wide). However, this measure does not appear to be entirely effective in its protection. In studies on the effects of the border on the communal vegetation, Chen et al., (1995) affirm that the influence of the effect of the river edge extends for a distance equal to two or three times the height of the canopy. Laurance et al. (1998) have indicated that the majority of the effects of the river bed edge is greater than 100 meters inside the vegetation. Intensification of the effect of the border

changes the local ecosystem, altering the micro climate, increasing luminosity and causing the air to dry in addition to enabling more common species to enter (METZGER, 2010).

Therefore, based on studies that measure the minimum distance to prevent interference in a forest habitat, it is recommended to minimize the impacts caused by forest exploration to the salt lick, that management not be conducted at a distance of under 100 meters, thereby establishing a buffer zone against any impacts on the fauna that use the location, even if the species recorded are highly mobile.

According to that known of the new areas for inventory and exploration, other salt licks could be found distributed throughout the Project Area. In the event that such new salt licks be identified, they should be mapped and protected.

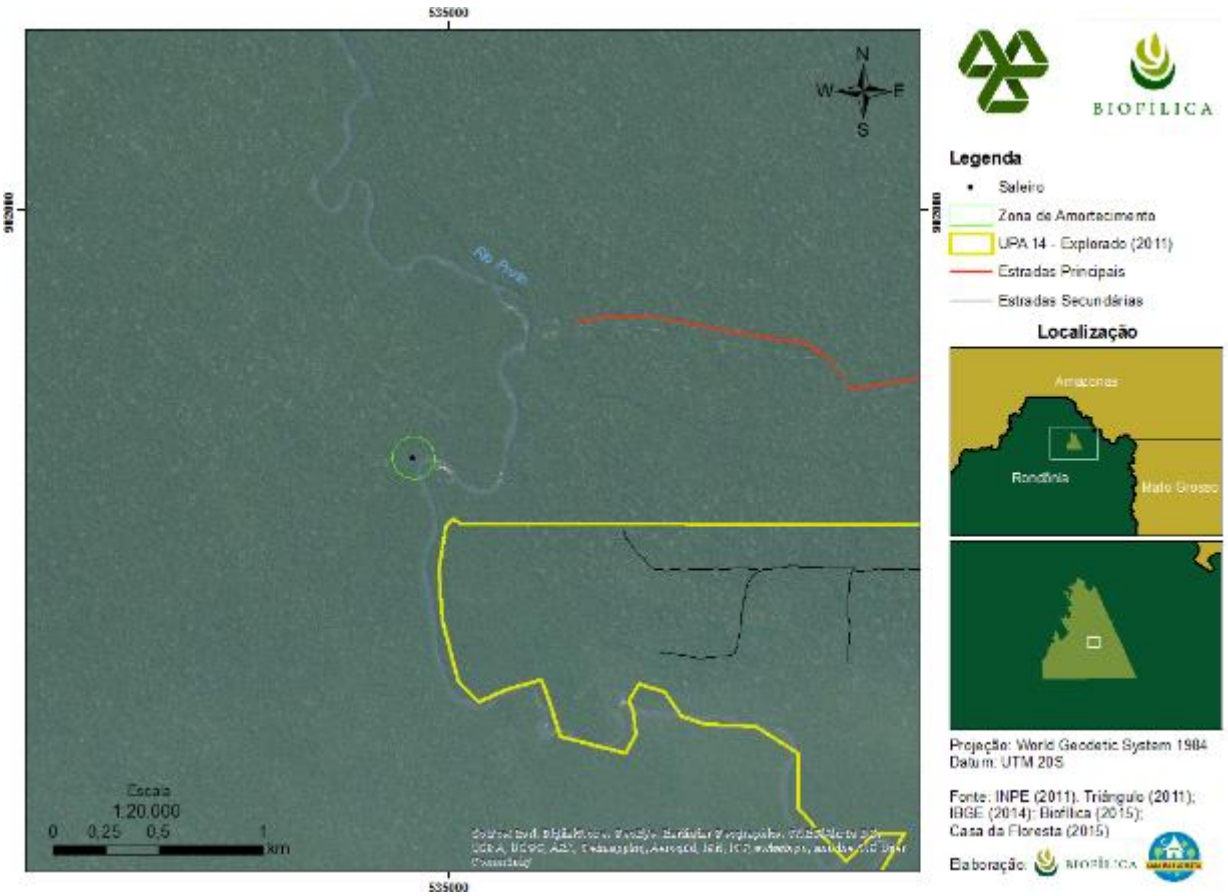

Figure 33 Map of the salt lick location inside the project area.

For the purpose of conducting a preliminary assessment of High Value Attributes for Conservation, the document “Assessment, Management and Monitoring of High Conservation Value Forest” was used: A practical guide for forest managers” produced by Proforest. Table 44 represents an adaptation of the assessment model suggested by Proforest and indicates the parameters identified and the respective justifications for the AAVC (High Conservation Value Attributes).

Table 44 Initial identification of the high conservation value attributes.

Value	Present	Potential	Absent	Justification
HCV 1 – Areas containing significant concentrations of biodiversity values, be they, on a global, regional or nation scale (e.g., endemism, endangered species, refuge).	X			As shown in items 7.1.1 and 7.1.2, there is one species of flora that is threatened (EN), one in critical danger (CR) and six that are vulnerable (VU). In relation to fauna, there are two species that are threatened (EN), one in critical danger (CR), and 21 are vulnerable (VU). The project zone, in addition to comprising a large part of the Rondônia State endemism zone, is made up of a mosaic of Conservation Units that encompass a broad focus on biodiversity conservation. The presence of the salt lick in the Project Area should be emphasized.
HCV 2 – Significantly large scale areas, be they on a global, regional or national scale, where the majority of the viable populations of certain species, if not all, occur naturally along normal distribution and abundance standards.			**X**	Despite the importance of the Project Area as a large area of biodiversity and ecological corridor, the locale does not present greater or unique relevance in relation to the total forest mosaic which comprises the region's Conservation Units.
HCV 3 – Areas that are or are contained within rare and/or threatened ecosystems.		**X**		The presence of the salt lick is remarkable in that it is regarded as a habitat with a concentration of endemic and endangered species and owed to the fact that it is a rare ecosystem attribute.

7.1.4 Future scenarios for biodiversity in the absence of the project

The probable scenarios for biodiversity can be foreseen upon a conjoint analysis of initial conditions for biodiversity in Project Area or in its influence area. In addition to that, these initial conditions can be

related to future projections of deforestation for a scenario without a project, considering that the advance of deforestation is directly related to impacts in biodiversity.

In the regional context, the Project Area is a private area in a mosaic of units of conservation that are suffering from threats to maintain biodiversity in the last decades. These areas contain a degradation history related to wood stealing, invasion, illegal possession of island, among other activities, so despite of protection determined by law, security and surveillance of these areas are extremely fragile and these enable illegal activities.

Future impacts of biodiversity in a scenario without a project include loss of restrict species, habitat loss, loss of connectivity and ecosystem services. In addition such impacts, studies and monitoring of biodiversity that did not occur due to loss of project incentive can be included.

Loss of connectivity and, consequently, loss of habitat for species are directly related to the advance of deforestation, which can result in reduction of gene flow among population and that affects fauna displacement and propagule distribution (LAURANCE e VASCONCELOS, 2009). Forest fragmentation caused by deforestation may cause a drastic reduction in species richness which density and distribution is inferior in terms of small fragments and mainly affects specialist táxons (LAURANCE e VASCONCELOS, 2009) many of them are threaten, endemic or contain restrict distribution. The fact that there are species with restrict occurrence area in the region, as mentioned in survey of birds and mammals *(M. rondoni)*, indicates the importance to protect forest of the region.

According to Silva et al. (2005), the relation among these parts creates a huge system of resilient conservation, with great possibility to reduce future global changes, perform improvements in standard of living of local population and provide ecosystem services to population. In the same way, forest fragmentation results in opposite effects where the effects of edge that change the dynamic of fragments are mainly noted. They strongly affect forest micro climate, tree death and storage of carbon, fauna and other ecologic aspects (LAURANCE, 2011).

Projections of forest baseline in a scenario with no project indicate a total area of 126,685 hectare deforested for the first 10 years in Area of Project reference. In Project area the expectation is to have 1,547 deforested hectares in the same period, since the annual tax of deforestation showed for the Reference area in the historic period was about 0.91%. The numbers indicate that in a scenario with no project, the biological richness of the area probably will not be maintained, since initiatives to preserve the area, such as creation of conservation units, were not so effective until now.

As evidenced by DeFries et al. (2005), deforestation around areas protected directly affects the quality of these areas and the ability to maintain its biological richness. This occurs mainly because of the isolation process caused as a result of no protection in these areas.

Finally, based on the conjoint analysis of quantitative aspects (deforestation projections) and qualitative (regional biodiversity study), it is possible to evidence that the future scenario (without a project) of biodiversity tends to be worst than the one presented in the beginning of the project. Once deforestation

scenario tends to be the same in the future *(business as usual)*, studies show that biodiversity scenario tends to get worse due to the effects of forest fragmentation.

7.2 Net positive impacts in biodiversity (B2)

The project area is a local with great importance to preserve biodiversity. During data collection, secondarily or in the field, biota was really rich and contained typical táxons and indicators of strong environment. There results are mainly related to maintenance of forest in vertical way due to good management practices. In addition to that, the great extension of Project area, when hunting does not occur (predatory or for subsistence) within its limits and the connectivity in other remaining, such as Conservation Units, contribute to a higher richness of species detected in the area.

Measures taken to adopt good management practices in the forest, such as maximum number of trees removed by hectare, turnover and latency period of production units, allowing future exploration (BARRETO et al., 1998) and pre exploratory planning to determine impacts (positive or negative) and its consequences on biodiversity (GARDNER, 2010). The possible negative impacts related to management refer to intervention performed in the forest and it can cause, among other impacts, soil compaction, damages to remaining forest and fauna displacement.

According to these results, even though they are in the beginning, forest management in Project area seems to cause few impact in biotic community. In addition to that, the project REDD+ aims to complement conservation activities already performed and contribute in a more efficient way to preserve local species and its ecosystem services. In addition to that, the project aims to assure socio-environmental benefits, once its purpose is to reduce the impacts in Project zone and in Project area itself through activities reduce deforestation and protection and preservation of natural forests in the region.

It is not expected by the project the creation of invading species or to increase its population, it cannot, as well, use genetically modified microorganisms. Planting to regenerate or for richness is not allowed in forest management of the area and, in case it occurs, native species and the appropriate rules required by current certification must be in place.

Table 45 Frame containing the summary of initial evaluation of the impact in the project about biodiversity on Project area and in its surroundings.

Impacts	Potential impacts on biodiversity in Project zone	Potential impacts on biodiversity out of Project zone
Positive	• Maintenance of biodiversity levels and conservation status of flora and fauna species; • Maintenance of rare and endemic species; • Preservation of attributes with high value of conservation; • Maintenance of key resources for species	• More awareness of biodiversity awareness in the region; • Increase of connectivity with other conservation units and other forest areas;
Negative	• Possible impacts resulted from activities of forest management in Project area	• Increase of request for hunting and fishing near the Project area (information leakage about activities)

7.3 Impacts on biodiversity out of project zone (B3)

As indicated in Table 9, information leakage of illegal hunting and fishing performed by external agents is considered a probable negative impact out of the project zone, once the conservation of this area would not allow these agents to acts inside the limits of the project and would make them migrate to another place.

Project area contains an important regional role in biodiversity because it comprehends deforestation and degradation and also because it is inside the mosaic of conservation units. Thus, the maintenance of this habitat helps the conservation scenario and the relation with other forest aspects in the surroundings, not to mention that is has the potential to call the attention for scientific surveys in the local and to promote courses related to management and forest conservation.

By analyzing the regional context of the project, the potential benefits surpass the possible impacts generated by leakage of predatory activities, so these impacts can be reduced through activities implemented the project area.

7.4 Exceptional benefits for biodiversity (GL3)

7.4.1 Vulnerability

As mentioned in previous sections, according to environmental diagnosis performed in project area, IUCN Red list, and Brazilian Red List of Threatened Species (ICMBio), Project area receive regularly threatened or vulnerable species. Some endemic species in the region and considered vulnerable can be classified as a trigger to fit in Project area as “Key area for biodiversity”. Among these species are *Mico rondoni* (Rondon's Marmose), *Hypocnemis ochrogyna* (Rondônia warbling antbird), *Ateles chamek* (Black spider money), *Pyrrhura perlata* (Crimson-bellied Parakeet), *Pyrrhura snethlageae* (Madeira conure) and Tayassu pecari (White-lipped Peccary).

Rondon's Marmose was first described in 2010 and it is considered threated (VU) probably because it is an extremely restrict animal so, according to its geographic localization provided by IUCN, this specie is totally dependent on the remaining forest coverage in project zone. The Black spider monkey is classified as in danger (EN) by the IUCN. It appears in primary or with low index of noise tropical forests and uses, preferably, high trees (VAN ROOSMALEN, 1985), so it is extremely sensitive to deforestation impacts. The Madeira conure and Crimson-bellied Parakeet (Figure) are other examples of threated species that fit in vulnerable category (VU), according to IUCN list and that were seen in great number in the area.

Figure 34 Threatened Parakeets registered in the salt area: **a.** madeira conura (*Pyrrhura snethlageae)*; **b.** Crimson-bellied Parakeet (*P. perlata*).

7.4.2 Recent population trends

In the case of M. rondoni, there is a decrease in population tendency, mainly because its geographic distribution is extremely restricted. Few studies were performed, so there is little information about how rare this specie is. An important characteristic identified was the probable association with other small size primate specie: *Saguinus fuscicollis* (Saddleback Tamarin). According to Ferrari et al. (2010) this is a ecologic characteristic of this specie and can be used as a key factor to determine how rare it is and the absence of Rondon's Marmose in some places.

Regarding Black spider monkey, studies revealed an estimative of decrease in its population in at least 50% in the last 45 years, mainly due to activities of hunting and loss of habitat (IUCN, 2008). According to IUCN (2008), the population tendency of species is to decrease in relation to the actual scenario, mainly due to degradation of its natural habitat occurred by the advance of agricultural borders on native forest.

Hypocnemis ochrogyna specie, also popularly known as Rondônia warbling antbird, is not classified as vulnerable, according to IUCN list. According to some IUCN criteria, this specie presents great number of distribution and suffered a reduction of its population in less than 30% in the last 10 years and, for this reason, is not considered vulnerable specie. However, this specie is considered vulnerable in Brazilian Red List of Threatened Species (ICMBio) because it is an endemic specie and appears mostly in Rondônia state and great part of native forest in distribution area is within the limit called “Arc of Deforestation” in Amazon.

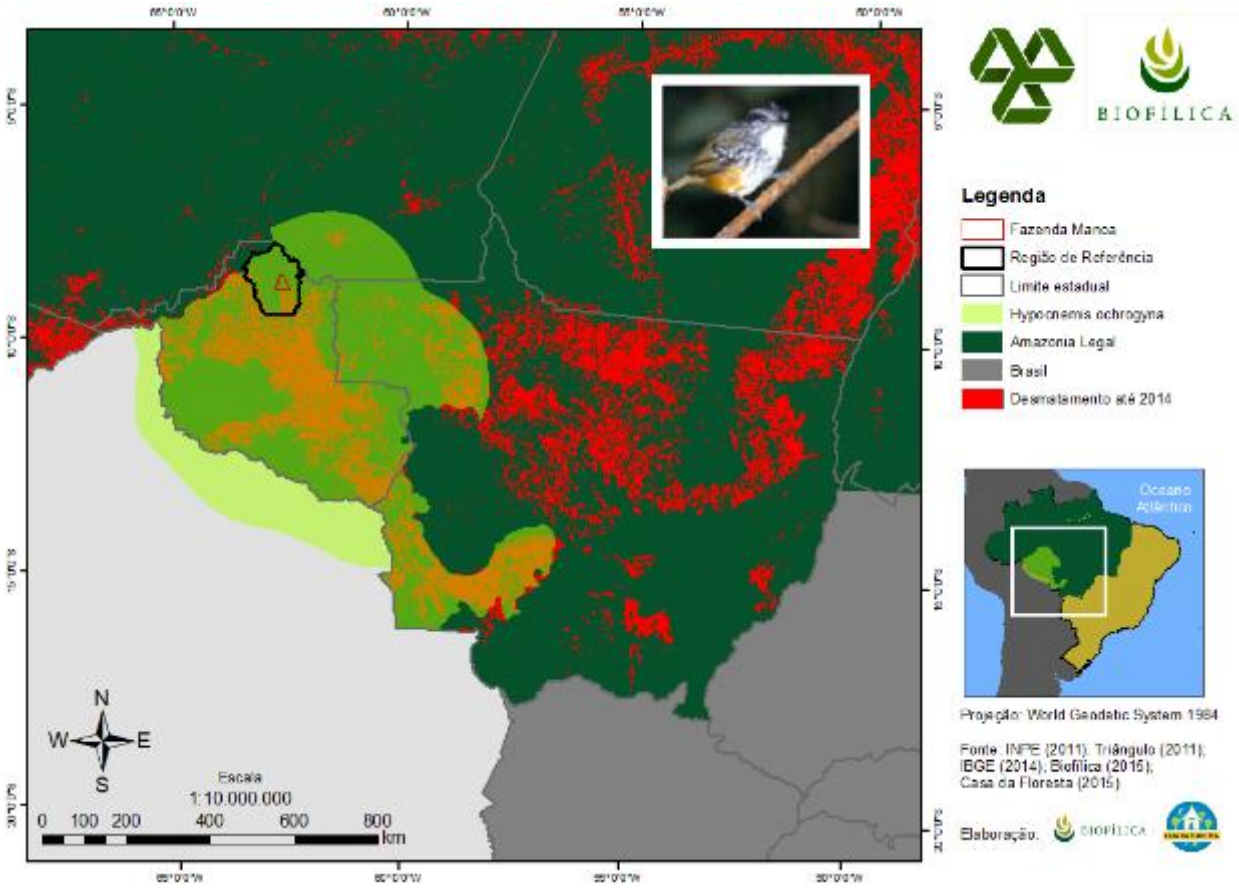

Figure 35 Distribution of *Hypocnemis ochrogyna* (Rondônia warbling antbird) surpassing deforestation in Amazon until 2014 (PRODES, 2014).

Birds belonging to Pyrrhura snethlageae specie (Madeira conure) and *Pyrrhura perlata* (Crimson-bellied Parakeet) are species of threatened parakeets and classified as vulnerable (VU) (IUCN, 2015) and were registered with high concentration in salt area: According to IUCN, Madeira conure presents a restrict distribution area, mainly in Rondônia, south of river Madeira. Its population is decreasing in the last decades and with decrease superior to 30% in the last three generations. Crimson-bellied Parakeet presents a distribution area less restrict in relation to Madeira conure and its population is considered stable in the last decades, however, it can be found in “Belt of deforestation” in Amazon. This fact provides vulnerability for the future species.

7.4.3 Project measures to improve conditions for species population

Project REDD+ Manoa intends to act mainly in habitat maintenance of species in the project area and to reduce and control threatens suffered by biotic community through project activities described in item 2.2 Description of Project activities.

Data from survey related to biodiversity were satisfactory once it assessed the current context to preserve biodiversity on Project zone, in its surroundings and focused on Project area, however, longer studies are required to explain variations that occur in biotic community along with forest modifications, whether they come from decrease of forest area in Project area and outside of the farm, climate changes or management activities, so its dynamic can be better understood (HENRIQUES et al., 2003).

Thus, to improve population condition of species, the project intends to prepare a fauna and flora monitoring plan to have a better knowledge of biota in the region. The purpose is to maintain local richness and of species threatened for preservation (trigger) and attributes of high value conservation (HCVs).

7.4.4 Monitoring and indicators for GL3

More details in Item 8. Monitoring, this document.

8 MONITORING

8.1 Description of the monitoring plan (CL3, CM3 & B3)

The monitoring plan of project REDD+ will provide information on three components: climate, community and biodiversity. As proponent and implementing partner of this project, Biofílica will coordinate monitoring processes during this project. Climate aspects will be monitored directly by Biofílica team. Social and biodiversity aspects will be monitored by Ecoporé and its partners experts in the area.

1.1.1. Climate impacts monitoring plan

Climate impacts monitoring plan will contain essential aspects to prove reduction of emission due to deforestation and degradation due to deforestation not planned and avoided (according to methodology applied VM0015) and changes in carbon stock during the project resulting from changes in the use of land in project area and in belt of leakage.

Part 1 - Application of methodology VM0015

Task 1: Monitoring of changes in carbon stock and GHG emissions for periodic checks.

1. Monitoring of current changes in carbon stock and GHG emissions within project area.

a) Technical description of monitoring tasks

Monitoring of changes in carbon stock and GHG emissions within the project area will be performed through deforestation monitoring not planned and avoided. Monitoring of the efficiency of REDD+ activities that aim to avoid deforestation not planned will be developed by Biofílica through the monitoring of such areas of forest coverage by satellite images and field check in project area.

b) Data to be collected:

Table 46. Data to be collected by the monitoring of changes in carbon stock and GHG emissions for periodic checks

Data/Parameter	Description	Unit	Source	Frequency
$AUDPA_{icl,t}$	deforestation area not planned in forest category icl in	Hectares (ha)	Calculated through remote sensing images	Annual

Data/Parameter	Description	Unit	Source	Frequency
	year t in project area			
$APDPA_{icl,t}$	deforestation area planned in forest category icl in year t in project area.	Hectares (ha)	Calculated through remote sensing images, technical maps and data, field information and post exploratory of management.	Annual
$\Delta CPLdPA_t$	Total decrease in carbon stock due to planned activities of harvesting in year t in project area.	Tons of equivalent carbon dioxide (tCO2-e)	Calculated	Annual
$ACPA_{icl,t}$	annual area within project area affected by catastrophic events in category icl in year t.	Hectares (ha)	Calculated through remote sensing images.	Whenever a catastrophic event occur.
$\Delta CUCdPA_t$	Total decrease in carbon stock due to catastrophic winds in year t in project area.	Tons of equivalent carbon dioxide (tCO2-e)	Calculated	Whenever a catastrophic event occur.
ΔCUDdPAt	Total of current change in carbon stock due to deforestation planned and not	Tons of equivalent carbon dioxide (tCO2-e)	Calculated	Annual

Data/Parameter	Description	Unit	Source	Frequency
	avoided in year t in project area.			

c) Summary of procedure to collect data

Monitoring of changes of use and land coverage:

Main activities developed by the project to collect and process data:

- Selection of satellite optical images with less cloud coverage and date of collection close to dry season in Amazon and appropriate radiometric quality;
- Geo referencing of satellite images with topographic maps in scale 1:100.000 or images from NASA from MrSID in orthorectified format;
- Creation of a model with spectral mixture of percentage of vegetation, soil, shade component for each image pixel;
- Application of the technique for segmentation that identifies spatial adjacent regions (segments) in satellite images with similar spectral features;
- Classification of segments to identify forest categories, nonforest vegetation and deforestation.

Monitoring of carbon stock and emission on non CO2:

Monitoring of changes (reduction) in carbon stock will be performed through forest inventory, measure of diameter to chest height (DBH = 130 cm) for each tree with DBH higher or equal to 15 centimeter within parts of forest inventory. DBH is the main variable used to stimulate carbon stock and changes in carbon stock in project REDD+ Manoa.

d) Procedures to control and guarantee quality

Monitoring of change of use and land coverage:

To validate information from satellite images, the information mapped of deforestation will be checked through data collected in field with a navigation GPS. The minimum accuracy in classification of use and land coverage is 80%. For areas covered with clouds, sensor SAR images such as RADRSAT-2, Cosmo SkyMed or TerraSar-X will be used.

Original digital data (raster) and processed (vectors) of satellite, coordinated images, technical maps, photos and field tab will be stored by Biofílica Investimentos Ambientais during the project. Maps with infrastructure installed, satellite images and reports on deforestation will be available for verification in each verification event.

Monitoring of carbon stock and emissions on non CO2:

The procedure to control and guarantee forest management quality is conducted by Triângulo in preharvesting inventory phases, during and after harvesting. Biofílica will have access to reports and original field tabs. It will have a copy of these documents during project life cycle. Inventory spreadsheets and reports and monitoring of remaining parts will be available to the verification body at each verification event.

e) Data archive

All data and report produced by REDD+ Manoa project will be stored by Biofílica Investimentos Ambientais though digital files during project life cycle. Original reports (physical) and field tabs produced by forest management activity will be stored by Triâgulo. Biofílica Investimentos Ambientais will keep a copy of these documents in digital format during the project. All documents related to project monitoring will be transformed in physical files and/or virtual and will be available to the verification body at each verification event.

1.1. Monitoring of Project implementation

Implementation of REDD+ activities will be monitored through financial spreadsheets, performance and quality reports, social management reports, vegetation coverage maps, meeting reports, invasion occurrence report and other relevant documents.

1.2. Monitoring of changes of use and land coverage within project area

Monitoring of planned and not planned deforestation will be performed through mapping of forest coverage in project area using satellite images with spatial resolution of 30 meters or more. Deforestation monitoring to implement infrastructure of social activities will be performed through specific field tabs and, to build roads, tracks and yards for storage within the project area, Pre exploratory reports, maps and satellite images containing information of forest coverage area converted in nonforest category will be used. To have more flexibility in the process to map forest, different techniques for classification and visual interpretation of SAR images using field data and cartographic standard quality can be used.

Data related to deforestation events will be compared to baseline scenario. Values of emissions reduced during deforestation period will be based according to comparison between foreseen and actual deforestation.

1.3 Monitoring of changes in carbon stock

Within project area:

It is expected that the ex-ante estimative of carbon stock according to forest classification does not change baseline period. However, Methodology VCS VM0015 requires monitoring of carbon stock in project area to be subjected to a significant loss of carbon stock in project, according to ex ante assessment, due to controlled deforestation and management planning activities or areas subjected to reduction not planned and important to carbon stock in baseline.

Total change in carbon stock due to not planned deforestation not avoided within project area is calculated as follows:

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

Where:

$\Delta CUDdPA_t$ Total change in carbon stock due to not planned deforestation not avoided within project area in year t.

$AUDPA_{icl,y}$ deforestation area not planned in initial icl forest category in year t within project area in project scenario.

$\Delta Ctoticl_{,Ac}$ Loss of carbon stock in initial icl forest category during changes AC (# of years after change LU/LC).

$AUDPAfcl_{,y}$ non forest category area fcl in time t within project area after deforestation not planned in project.

$\Delta Ctotfcl_{,Ac}$ Gain of carbon stock in final fcl non forest category during changes AC (# of years after change LU/LC).

In case there is an important reduction in carbon stock due to sustainable forest management activities, such reduction will be reported during verification process through table 29 of Methodology VCS VM0015 version 1.1.

Within areas of leakage management:

Areas are not subjected to planned loss of carbon stock in areas of leakage management in the project.

Monitoring of non CO2 emissions resulted from forest fire:

Emissions resulted from biomass burn will not be considered in this project.

1.4 Monitoring of natural disturbance impacts and other catastrophic events

Loss in carbon stock and increase in GHG emissions due to natural disturbances or catastrophic events will be controlled through monitoring of forest coverage via satellite by using the same methods applied for monitoring forest coverage in project area (section 1.1.2).

Main activities to be developed to collect and process data:

- Selection of satellite optical images with less cloud coverage taken during dry season in Amazon and with appropriate radiometric quality;
- Geo referencing of satellite images with topographic graphics in scale 1:100.000 or images from NASA in MrSID in orthorectified format;
- Mapping of affected forest coverage areas.

Emissions resulted from natural disturbances or catastrophic events will be estimated by multiplying the area of forest loss mapped by the average of forest carbon stock. In case there is an important reduction in carbon stock due to natural disturbances or catastrophic events, such reduction will be reported in processes of verification by using tables 25e, 25f and 25g of methodology approved VCS VM0015 version 1.1.

2. Leakage monitoring

a) Technical description of monitoring tasks:

REDD+ Manoa project evolves two activities of leakage source monitoring:

I. The monitoring of reduction of carbon stocks and/or increase of GHG emissions associated to measures to prevent leakage if project proponents implement activities such as planting of trees, agricultural intensification, fertilization, production of forage and/or other measures to improve agricultural areas and creation of cattle. Is these activities cause reduction on carbon stocks and/or increase in GHG emissions in leakage management areas, such changes in carbon stock and/or GHG emissions are estimated by Biofílica Investimentos Ambientais.

II. Monitoring of forest coverage in leakage belt through satelite images will be performed by Biofílica Investimentos Ambientais.

b) Data to be collected

Table 47. Data to be colected for leakage monitoring.

Data	Description	Unit	Source	Frequency
$\Delta CLPMLK_t$	Reduction of carbon stock due to measures to prevent leakage	tCO_2-e	Calculated	Annual

$EgLK_t$	Emissions resulted from animals on pasture in leakage management area in year t	tCO_2-e	Calculated	Annual
$ELPMLK_t$	Total annual increase of GHG emissions derived from measures to prevent leakage in year t	tCO_2-e	Calculated	Annual
$\Delta CabBSLLK_t$	Total change in carbon stock in belf of leakage area	tCO_2-e	Calculated	Annual

c) Summarized description of procedures to collect data

Monitoring of changes in carbon stock and GHG emissions associated to activities to prevent leakage

The main activities developed to collect and process data to monitor changes in carbon stock due to implementation of activities in leakage management areas are:

- Activities to prevent leakage will be listed;
- A map showing areas and type of intervention will be prepared;
- Areas in which activities to prevent leakage impact on carbon stock will be identified;
- Categories of nonforest existent within these areas will be identified;
- Carbon stocks in categories identified will be measured or literature estimative will be used;
- Changes in carbon stock in leakage management area in project scenario will be reported in table 30b of methodology VM0015;
- Liquid changes in carbon stock caused by measures to prevent leakage during the period established in baseline and the period of accreditation of project will be calculated;
- Results of calculation will be reported in table 30c of methodology VM0015.

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

Monitoring of changes in carbon stock

Procedure to collect data used will be the same applied in deforestation monitoring in project area (session 1.2).

Monitoring of increase in GHG emission

Emissions resulted from forest fire are not considered in baseline.

d) Procedures to control and guarantee quality

Monitoring of changes in carbon stock and GHG emissions associated to activities to prevent deforestation:

To be determined depending of activity, if implemented.

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

Procedure to control and guarantee quality used will be the same applied to monitor deforestation in project area (session 1.2).

e) Data archive

Original reports and field tabs will be stored by Triângulo. A Biofílica Investimentos Ambientais will keep a copy of these documents in digital format during the project life cycle. Original digital data (raster) and processed (vectors) of satellite T images, coordinated images, technical maps, photos and field tab will be stored by Biofílica Investimentos Ambientais during the project life cycle. Annual map of deforestation areas, satellite images and reports will be available for each body of verification in each event of verification.

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

Reduction in carbon stocks due to activities developed in leakage management areas is not expected, once none of the activities to improve agricultural techniques or management of pasture areas can change carbon stocks and increase GHG emissions when compared to baseline scenario contain the implementation required.

The following activities in leakage management area can, occasionally, cause decrease in carbon stock or provide addition to GHG emissions:

- Changes in carbon stock due to activities implemented in leakage management areas;

According to the most recent version of VCS Standard, nitrous oxide (N2O) emissions resulting from nitrogen fertilization are always considered insignificant. The consumption of fossil fuel is always considered as insignificant in activities of AUD project and should not be considered.

2.2 Monitoring of carbon stock decrease and increase of GHG emissions due to leakage displacement

Data of activities in the area of belt of leakage are determined through the same method applied to deforestation monitoring in project area (section 1.2). If a deforestation event greater than expected in baseline scenario is noticed in belt of leakage during the monitoring process and such deforestation is related to deforestation agents in project area, the losses in carbon stock are considered and reported by using table 22c and 21c of methodology approved VM0015.

Total change in carbon stock due to not planned deforestation not avoided within the area of belt of leakage is calculated as follows:

$$\Delta CBSLLK_t = \sum_{y=1}^{t} \left(\sum_{icl=1}^{icl} AUDLK_{icl,y} * \Delta Ctot_{icl,t-y} - \sum_{fcl=1}^{fcl} AUDLK_{fcl,y} * \Delta Ctot_{fcl,t-y} \right)$$

Where:

$\Delta CBSLLK_t$ Total change in carbon stock due to unplanned deforestation not avoided within the leakage belt area in year t.

$AUDPA_{icl,y}$ deforestation area not planned in icl forest category in year t within leakage belt area in project scenario.

$\Delta Ctoticl_{,Ac}$ Loss of carbon stock in initial icl forest category during changes Ac (# of years after change LU/LC).

$AUDLK_{fcl,y}$ non forest category area fcl in time t within the leakage belt area after unplanned deforestation in project.

$\Delta Ctot_{fcl,Ac}$ Gain of carbon stock in final fcl non forest category during change Ac (# of years after change LU/LC).

2.3 Total estimated of ex post leakage

Results will be displayed to the body of verification in each verification event through table 35 of methodology VM0015.

3. Ex post liquid reduction of GHG gases

a) Technical description of monitoring tasks

In the verification process, the results will be displayed through table 26 of methodology applied VM0015 version 1.1 along with spatial data (deforestation map, when available).

b) Data to be collected

Table 48. Data to be collected to monitor ex post liquid reduction of GHG gases.

Data	Description	Unit	Source	Frequency
$\Delta REDD_{,t}$	Liquid reduction of anthropogenic emissions of GHG related to AUD activities of the project in year t	tCO2-e	Calculated	Annual
VCU,t	Number of Verified Carbon Units (VCUs) to be available for commercialization in time t	tCO2-e	Calculated	Annual

c) Summarized description of procedure to collect data

The number of Verified Carbon Units (VCUs) to be created by activities in project REDD+ Manoa in yeat t will be calculated through equations 19 and 20 of methodology approved VM0015 version 1.1.

d) Procedures to control and guarantee quality

All tasks and tools indicated in part 2 of methodology VM0015 will be used to assure that all data are appropriate to the process of verification and VCUs numbers are reliable.

e) Data archive

All data and report of project REDD+ Manoa project will be stored by Biofílica Investimentos Ambientais though digital files during project life cycle. All documents related to project monitoring will be compiled in physical files and available to the verification body at each verification event.

f) Organization and responsibilities of parties involved in description above

These activities are Biofílica Investimentos Ambientais responsibility.

Task 2: Reviewing future baseline projections to establish baseline

1. Updated information about agents, vectors and underlying causes of deforestation

Statistic and spatial data, studies and information about agents, vectors and underlying causes of deforestation required to perform steps 2 and 3 of methodology VM0015 will be updated and used to review projections in baseline after the period established of 10 years. When available, forest management monitoring data and other activities developed by the project will be used.

2. Adjustment of component of change and use and soil coverage in baseline

If a national or subnational baseline becomes available during the period established for baseline, that one will be applied in the following period. If a national or subnational baseline becomes available, step 4 of methodology VM0015 will be performed again, considering the period of 10 years (from 2013 to 2022) by using variables updated for agents, vectors and underlying causes of deforestation in the region of reference. The two main components to be reviewed are: annual area of deforestation and location of baseline deforestation.

Assumptions and hypothesis considered when framing future deforestation dynamics (socioeconomic data), just like data used in spatial projection (roads, locations and distance of new deforestation places updates) will be reviewed and updated.

3. Adjust in carbon component in baseline

The spatial estimate of carbon can be reviewed according to results occurred during changes in monitoring of changes in carbon stock, according to methodology VM0015 version 1.1, Part 3, item 1.1.3. During the project, new technologies and methodologies can be analyzed to biomass spatial estimate as, for example, LIDAR or SAR data.

1.1.2. Plan to start monitoring impacts in communities

Impacts monitoring plan in relation to communities contain, essentially, process indicators and part of result indicators. To present the Complete monitoring plan of impacts to communities, the plan will be evaluated and validated by the interested parties, process indicators and results will be complemented and impact indicators will be established.

Following the same strategic logic of activities, monitoring aims at accessing the efficacy of interventions described in item **Erro! Fonte de referência não encontrada.** Description of project activities through the Theory of change.

a) Data to be collected

Data and parameters to be collected are in item **Erro! Fonte de referência não encontrada.** of this document.

b) Summary of procedure to collect data

Data will be collected during and after activities with communities and/or through specific interviews. The annual evaluation of the project aims to deal with part of this demand. To complement it, structured interviews with families will be done annually.

This information will be inserted in the system and displayed annually in project social activities reports, in the meeting to define priorities of investments.

c) Procedures to control and guarantee quality

Data researched and reported will be shown and evaluated during the meeting with interested parties, to which all people interested in the project will be invited to participate.

d) Data archive

All data and report produced by REDD+ Manoa project will be stored by Biofílica Investimentos Ambientais though digital files during project life cycle. Original reports (physical), meeting minutes and field tabs produced will be stored by Triângulo and Ecoporé to perform social activities. Biofílica

Investimentos Ambientais will keep a copy of these documents in digital format during the project. All documents related to project monitoring will be transformed in physical files and/or virtual and will be available to the verification body at each verification event.

e) Organization and responsibilities of parties involved in description above

Social monitoring activities are under Biofílica Investimentos Ambientais and Ecoporé responsibility.

1.1.3. Plan to start monitoring impacts to biodiversity

The monitoring plan aims at evaluating local community in relation to management and forest integrity practices. To fauna, it is planned to implement two annual campaigns; one per semester, such as presence of migratory species and reproductivity periods be implemented. To flora, the monitoring plan includes reduction of permanent parts within a period of 5 years to evaluate forest dynamics (recruiting taxes, mortality, substitution of species) and variations in carbon stock.

Regarding impacts on forest management, in terms of levels of disturbances to biodiversity, it was not possible to clearly determine the interference of management in local community. Such information can be clearly explained with long term management (HENRIQUES et al., 2003).

In

More details in Item 8. Monitoring, this document.

, proposals to monitor project biodiversity for the project is shown with definition for periodicity, purpose, indicators and positive impacts shown in the project in conservationist terms.

a) Data to be collected

Data and parameters to be collected are in item **Erro! Fonte de referência não encontrada.** of this document.

b) Summary of procedures to collect data

Parameters related to impacts of project activities are annually monitored. Parameters related to fauna diagnosis are collected at least two times a year (summer and winter). This information is inserted in the system and presented through reports to monitor fauna related to one year of monitoring, before each verification event.

Relevant species data are collected during studies. This information is inserted in the system and presented through reports to monitor fauna related to one year of monitoring, before each verification event.

c) Procedure to control and guarantee quality

Procedures to control and guarantee quality that are related to data collection will depend on internal procedures of the company responsible for field survey in each study.

Survey based on ethnozoology will be displayed and validated during the meetings with interested parties and communities nearby will be invited to participate, within other members, to the whole life cycle of the project.

d) Data archive

All data and report produced by REDD+ Manoa project will be stored by Biofílica Investimentos Ambientais though digital files during project life cycle. Original reports (physical) and field tabs produced will be stored by the organizations responsible for the field survey and/or by Triângulo e Ecoporé. Biofílica will keep a copy of these documents in digital format during the project. All documents related to project monitoring will be transformed in physical files and/or virtual and will be available to the verification body at each verification event.

e) Organization and responsibilities of parties involved in description above

All monitoring activities are under Biofílica Investimentos Ambientais and other companies collaborating in biodiversity studies and Ecoporé responsibility.

8.2 Data and parameters available for validation

Unit of data/Parameter:	**Deforestation**
Unit:	Hectare (ha)
Description:	Maps of forest coverage area converted into areas with no forest coverage.
Source:	Measures through project PRODES/INPE data.
Value applied:	2.1%/year in average (2000-2012).
Justification of data chosen or description of means of measurement and procedures applied	To map deforestation and production of Mapa da Marca de Excelência de Cobertura Florestal (Map of Excellence of Forest Coverage) data of program PRODES Digital (Satellite of official mapping of deforestation of Brazilian Amazon) were used. A total of 33 Landsat images were used during the period analyzed. ISOSEG method of nonsupervised classification was used to classify images to map forest categories, nonforest vegetation, hydrography and deforestation.
Purpose of data:	To determine baseline scenario To calculate baseline emissions To calculate project emissions To calculate leakage
Comments	Check documents: • Câmara *et al*. 2006. *Metodologia para o cálculo da taxa anual de desmatamento na Amazônia Legal* • *Determinação da Linha de Base e Dinâmica de Desmatamento para o projeto Manoa*

Unit of data/Parameter:	***Ctot***
Unit of data:	$tCO_2e\ ha^{-1}$
Description:	Average of carbon stock per hectare in all carbon reservoirs in forest category used in baseline scenario.
Source:	Calculated according to allometric equations, expansion factor of literature and data measured in the field.
Value applied:	508.5 $tCO_2e\ ha^{-1}$

Justification of data chosen or description of means of measurement and procedures applied	Estimates on biomass above and under soil were performed through forest inventory data and allometric equations developed in similar areas and project area (SILVA, 2007). Deadwood reservoir was estimated based on forest inventory data and Silva equations (2007).
Purpose of data:	• To determine baseline scenario • To calculate baseline emissions • To calculate project emissions To calculate leakage
Comments	Check documents: • Estimativa do Estoque de Carbono Florestal para o projeto REDD+ Manoa
Unit of data/Parameter:	**DBH**
Unit of data:	cm
Description:	Diameter to chest height (130 cm) for each tree with DBH equal or superior 15 cm in each part of the forest inventory
Source:	Measured in the field by Florestal Paisagismo
Value applied:	See spreadsheet with field data
Justification of data chosen or description of means of measurement and procedures applied	Requirement of Methodology VCS VM0015. Data of forest inventory collected in less than 10 years ago with multiple parts located in large spatial distribution
Comments	Main variable to estimate carbon estimate

Unit of data/Parameter:	$BGB_{fw} = 0{,}0469 \text{x} DAP^{2{,}4754} \text{x} fc_1$ $AGB_{fw} = 2{,}2737 x DAP^{1{,}9156} \; fc_1$
Unit of data:	Kg (bioamass fresh weight)
Description:	Equation to convert DBH in fresh biomass
Source:	SILVA, 2007
Value applied:	$BGB_{fw} = 0{,}0469 \text{x} DAP^{2{,}4754} \text{x} fc_1$ $AGB_{fw} = 2{,}2737 x DAP^{1{,}9156} \; fc_1$

Justification of data chosen or description of means of measurement and procedures applied	Equation developed for forest with characteristics similar to forests in the region of reference.
Comments	

Unit of data/Parameter:	**CF**
Unit of data:	t
Description:	Content of carbon in dry biomass
Source:	Nogueira, E.; Fearnside, P.; Nelson, B., et al., 2008. Estimativas de biomassa florestal na Amazônia Brasileira: Novas equações alométricas e ajustes da biomassa dos inventários de volume de madeira. Forest Ecology and Management, 256 (11), pp.1853-1867
Value applied:	0,485
Justification of data chosen or description of means of measurement and procedures applied	Value found in scientific literature.
Comments	

Unit of data/Parameter:	**44/12**
Unit of data:	tCO_2e
Description:	Carbon mass to factor of conversion of CO_2e mass
Source:	From scientific literature: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 AFOLU.
Value applied:	44/12
Justification of data chosen or description of means of measurement and procedures applied	Standard value of IPCC

Comments	

Unit of data/Parameter:	**Release area for management infrastructure**
Unit of data:	Percentage
Description:	Area available to build the infrastructure required in sustainable forest management activities such as yards, primary and secondary roads.
Source:	Post exploratory report and specialists opinion
Value applied:	3%
Justification of data chosen or description of means of measurement and procedures applied	Data are collected in field after harvesting activity. Post exploratory reports
Comments	

8.3 Monitored data and parameters

Climate

Unit of data/Parameter:	**Deforestation of project area and belt of leakage**
Unit of data:	Hectare (ha)
Description:	Areas with forest coverage converted into areas with no forest coverage withing project area and belt of leakage in project REDD+ Manoa
Source:	Calculated based on remote sensing images along with GPS data collected in the field.
Description of measurement means and procedures to be applied.	The monitoring of forest coverage in project area and belt of leakage will be done through analysis of Satellite images. When data of PRODES system are not available, the forest coverage monitoring will be performed according to automatic classification and visual interpretation of other optic sensors images or SAR data.
Frequency of monitory/registry:	Annual

Value applied:	N/D
Equipment for monitoring:	Remote sensing images of digital processing program, systems of geographical information and navigational GPS.
GQ/CQ procedures to be applied:	Images with special resolution of 30 m or more will be used in mapping. The minimum mapping unit is 1 ha. Classification evaluation will be performed through data collected in field by using GPS navigation. The minimum precision of classification map of soil use and coverage is 80%.
Method of calculation:	If not planned deforestation areas are detected, the Map of Excellence of Forest Coverage will be updated according to maps algebra.
Comments	PRODES Digital project: http://www.dpi.inpe.br/prodesdigital/prodes.php More information on control and quality assurance available in: • (CÂMARA et al., 2006). *Metodologia para o cálculo da taxa anual de desmatamento na Amazônia Legal*

Unit of data/Parameter:	***Ctot***
Unit of data:	$tCO_2e\ ha^{-1}$
Description:	Average of carbon stock per hectare in all carbon reservoirs in forest category used in baseline scenario.
Source:	Calculated according to allometric equations, expansion factor of literature and data measured in the field by Florestal.
Description of measurement means and procedures to be applied.	Estimates on biomass above and under soil will be performed through forest inventory data and allometric equations developed in similar areas and project area (Silva, 2007).
Frequency of monitory/registry:	Data of forest inventory collected in up to 10 years period in multiple parts.
Value applied:	N/D
Equipment for monitoring:	N/D

GQ/CQ procedures to be applied:	Mandatory monitoring, according to Methodology VM0015. Data of forest inventory collected in up to 10 years period in multiple parts.
Method of calculation:	Comparison of medium value in carbon stock in forest category used in baseline scenario, according *Estimativa do Estoque de Carbono Florestal para o projeto REDD+ Manoa*
Comments	Mandatory required of Methodology VM0015 for areas with woof extraction.

Unit of data/Parameter:	**DBH**
Unit of data:	cm
Description:	Diameter to chest height (130 cm) for each tree with DBH equal or superior 15cm in each part of the forest inventory
Source:	Calculation starting from the circumference at chest height measured in field by Hdom
Description of measurement means and procedures to be applied.	DBH calculated starting from the circumference data at chest height (CAP) of each monitored tree measured in field.
Frequency of monitory/registry:	Data of forest inventory collected in up to 10 years period in multiple parts.
Value applied:	N/D
Equipment for monitoring:	Calculation starting from the circumference at chest height measured in field by using tape measure.
GQ/CQ procedures to be applied:	Mandatory monitoring, according to Methodology VM0015. Data of forest inventory collected in up to 10 years period in multiple parts.
Method of calculation:	DBH calculated starting from the circumference data at chest height (CAP) of each monitored tree measured in field.
Comments	

Unit of data/Parameter:	**Deforestation planned for forest management infrastructure**

Unit of data:	Hectare (ha)
Description:	Map of areas with forest coverage converted in areas of non coverage area due to construction of roads, trails and forest yards required in forest management
Source:	Images of remote sensing, technical maps and specific field letters to monitor construction of roads, trails and forest yards in forest management
Description of measurement means and procedures to be applied.	Monitoring in areas with forest coverage will be performed through analysis of satellite images, maps to build roads, trails and yards for forest management and field verification. If planned deforestation occurs, the Forest Cover Benchmark will be update through the maps algebra. Decrease in carbon stock in project area will be reported during the processes of verification.
Frequency of monitory/registry:	During the management year of each APU.
Value applied:	N/D
Equipment for monitoring:	Field records and geographic information system.
GQ/CQ procedures to be applied:	
Method of calculation:	If planned deforestation areas are identified, the Forest Cover Benchmark will be update through the maps algebra.
Comments	N/D

Unit of data/Parameter:	**ΔCabBSLLKt**
Unit of data:	tCO2-e
Description:	Changes in total carbon stock in belt of leakage area
Source:	Calculated
Description of measurement means and procedures to be applied.	Activities to prevent leakage will be listed; A map showing areas and type of intervention will be prepared; Areas in which activities to prevent leakages impact on carbon stock will be identified; Non forest categories within these areas in case baseline are identified;

	Carbon stock are measured in categories identified or conservative literature estimates are used; Changes in carbon stock in leakage management area in project scenario will be reported in Table 30b of methodology VM0015; Changes in carbon stock in liquid stage caused by prevention measures during the fixed period of baseline and, optionally, in the period of accreditation of project will be calculated; The results of calculation will be reported in Table 30.c of VM0015.
Frequency of monitory/registry:	To be determined depending of activity
Value applied:	n/a
Equipment for monitoring:	To be determined depending of activity
GQ/CQ procedures to be applied:	To be determined depending of activity
Method of calculation:	To be determined depending of activity
Comments	N/D

Community

Unit of data/Parameter:	**Number of courses and training courses**
Unit of data:	Number/year
Description:	Number of courses and training courses performed in CEFLOM
Source:	Monitoring and activities report in the project
Description of measurement means and procedures to be applied.	To be defined
Frequency of monitory/registry:	Annual
Value applied:	n/a
Equipment for monitoring:	n/a

GQ/CQ procedures to be applied:	Validation of information in the system in the Monitoring and activities report draft with proponents before the official publication of the report.
Method of calculation:	n/a
Comments	N/D

Unit of data/Parameter:	**People that received training**
Unit of data:	Number of people who received training
Description:	Number of people who received training in a year
Source:	Monitoring and activities report in the project
Description of measurement means and procedures to be applied.	Interviews structured and supporting document (list of presence)
Frequency of monitory/registry:	Annual
Value applied:	n/a
Equipment for monitoring:	n/a
GQ/CQ procedures to be applied:	Validation of information in the system in the Monitoring and activities report draft with proponents before the official publication of the report.
Method of calculation:	n/a
Comments	N/D

Unit of data/Parameter:	**Agricultural production**
Unit of data:	Kilos/liters/cans
Description:	To measure impacts of project activities agricultural production of families
Source:	Monitoring and activities report in the project
Description of measurement means and procedures to be applied.	Structured interviews
Frequency of monitory/registry:	Annual

Value applied:	n/a
Equipment for monitoring:	n/a
GQ/CQ procedures to be applied:	Validation of information in the system in the Monitoring and activities report draft with proponents before the official publication of the report.
Method of calculation:	n/a
Comments	N/D

Unit of data/Parameter:	**Families benefited from REDD+ project**
Unit of data:	Number of families
Description:	Number of families participating in project social activities
Source:	Surveys in field and interviews
Description of measurement means and procedures to be applied.	Structured interviews to determine the benefits generated by REDD+ project
Frequency of monitory/registry:	Annual
Value applied:	n/a
Equipment for monitoring:	Format of survey
GQ/CQ procedures to be applied:	Validation of information in the system in the Monitoring and activities report draft with proponents before the official publication of the report.
Method of calculation:	Statistical analysis
Comments	N/D

Biodiversity

Unit of data/Parameter:	**Number of species of monitored animals**
Unit of data:	Number
Description:	Quantity of species of monitored animals
Source:	Field records, data sheets and Report to monitor fauna

Description of measurement means and procedures to be applied.	To be defined
Frequency of monitory/registry:	twice a year
Value applied:	N/a
Equipment for monitoring:	n/a
GQ/CQ procedures to be applied:	To be defined
Method of calculation:	Data sheets
Comments	N/D
Unit of data/Parameter:	**Diversity in vegetation communities in permanent parts**
Unit of data:	n/a
Description:	Variety of species found in vegetation within permanent parts.
Source:	Field records, data sheets and post exploratory report
Description of measurement means and procedures to be applied.	To be defined
Frequency of monitory/registry:	One year before harvesting. In intervals of one, tree and five years after harvesting in APU.
Value applied:	To be defined
Equipment for monitoring:	To be defined
GQ/CQ procedures to be applied:	To be defined
Method of calculation:	Data sheets
Comments	N/D

Unit of data/Parameter:	**Monitoring of *Ateles chameck*** *(*Spider monkey**)**
Unit of data:	Abundance
Description:	Monitoring of ***Ateles chameck*** *specie (*Spider monkey)
Source:	Survey in the field
Description of measurement means and procedures to be applied.	Data survey must be performed periodically by a specialist team

Frequency of monitory/registry:	twice a year
Value applied:	n/a
Equipment for monitoring:	To be defined
GQ/CQ procedures to be applied:	To be defined
Method of calculation:	Linear transection
Comments	

Unit of data/Parameter:	**HCVF Saleiro**
Unit of data:	Number of species present
Description:	
Source:	Survey in the field
Description of measurement means and procedures to be applied.	Data survey must be performed periodically by a specialist team
Frequency of monitory/registry:	twice a year
Value applied:	n/a
Equipment for monitoring:	Cameras trap
GQ/CQ procedures to be applied:	To be defined
Method of calculation:	To be defined
Comments	