THE ARC REDD+ PROJECT

Document Prepared By Amazon Reforestation Consortium (ARC)

Project Title	The ARC REDD+ Project
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Project Location	State of Para, Brazil
Project Proponent(s)	Amazon Reforestation Consortium amazonreforestation.consortium@gmail.com Address: Rodovia BR 010 Km 15, Paragominas, Para, Brazil CEP: 68.625-970
Prepared By	Amazon Reforestation Consortium (ARC)
Validation Body	4K Earth Sciences Private Limited
Project Lifetime	1st January 2016 – 31st December 2046; 30-year lifetime
GHG Accounting Period	1st January 2016 – 31st December 2046
History of CCB Status	Not applicable.
Gold Level Criteria	Not applicable
Expected Verification Schedule	

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1 SUMMARY OF PROJECT BENEFITS

This project is an Agriculture, Forestry and Other Land Use (AFOLU) project under the Reducing Emissions from Deforestation and Degradation (REDD) project category. Specifically, the project is of the "Avoided Unplanned Deforestation & Degradation" (AUDD) project category.

The project preserves and conserves the native amazon forest of around 53,528 hectares in a critical region of the eastern amazon biome. A region where there is high deforestation risk. The project has quantifiable CCB benefits, as it has generated full time employment, training and access for the families that live in and around the project area, created self-empowered in a region where there are few job opportunities. The project has also provided cookstoves with chimneys to help mitigate lung related diseases (which is the most common disease in the surrounding area due to improper cooking methods) and more efficiently burn fuel for cooking. Also, the company is intensifying and improving its practices to support the sustainable social development, maintaining and improving the biodiversity monitoring at the project area in the framework of FSC certification and REDD activities.

From the implementation of this REDD Project, it is estimated that 31,10,878 tons of carbon dioxide emissions will be avoided which would have been emitted into the atmosphere in a period of 10 years in the absence of the project, not including the project's non-permanence risk buffer contribution.

1.1 Unique Project Benefits

Outcome or Impact Estimated by the End of Project Lifetime	Section Reference
1) Protection and conservation easement of 53,528 hectares in the Amazon.	2.5
2) Protection of habitat for countless fauna and flora.	5.2
3) The Project will manage the land as a private protected area, thus conserving local ecosystems through avoided unplanned deforestation and will enhance ecosystem functionality by allowing patched of deforestation to regenerate thus eliminating ecosystem fragmentation.	4.2
4) The medium term goal is to allow forest regeneration thus increasing the amount of carbon sequestered in the forest.	5.2

1.2 Standardized Benefit Metrics

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
GHG emission reductions or removals	Net estimated emission removals in the project area, measured against the without-project scenario	N/A	
	Net estimated emission reductions in the project area, measured against the without-project scenario	7,749,856 tCO_2	3.2.4
Forest[1] cover	For REDD[2] projects: Estimated number of hectares of reduced forest loss in the project area measured against the without-project scenario	53,528 hectares	3.2
	For ARR[3] projects: Estimated number of hectares of forest cover increased in the project area measured against the without-project scenario	N/A	
Improved land management	Number of hectares of existing production forest land in which IFM[4] practices are expected to occurred as a result of project activities, measured against the without-project scenario	N/A	
	Number of hectares of non-forest land in which improved land management practices are expected to occurred as a result of project activities, measured against the without-project scenario	N/A	
Training	Total number of community members who are expected to have improved skills and/or knowledge resulting from training provided as part of project activities	40 families	4.4
	Number of female community members who are expected to have improved skills and/or knowledge resulting from training as part of project activities	15	4.4

[1] Land with woody vegetation that meets an internationally accepted definition (e.g., UNFCCC, FAO or IPCC) of what constitutes a forest, which includes threshold parameters, such as minimum forest area, tree height and level of crown cover, and may include mature, secondary, degraded and wetland forests (*VCS Program Definitions*)
[2] Reduced emissions from deforestation and forest degradation (REDD) - Activities that reduce GHG emissions by slowing or stopping conversion of forests to non-forest land and/or reduce the degradation of forest land where forest biomass is lost (*VCS Program Definitions*)
[3] Afforestation, reforestation and revegetation (ARR) - Activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing and/or restoring vegetative cover through the planting, sowing and/or human-assisted natural regeneration of woody vegetation (*VCS Program Definitions*)
[4] Improved forest management (IFM) - Activities that change forest management practices and increase carbon stock on forest lands managed for wood products such as saw timber, pulpwood and fuelwood (*VCS Program Definitions*)

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
Employment	Total number of people expected to be employed in project activities,[5] expressed as number of full-time employees[6]	30	4.4
	Number of women expected to be employed as a result of project activities, expressed as number of full-time employees	8	4.4
Livelihoods	Total number of people expected to have improved livelihoods[7] or income generated as a result of project activities	40 families	4.4
	Number of women expected to have improved livelihoods or income generated as a result of project activities	15	4.4
Health	Total number of people for whom health services are expected to improve as a result of project activities, measured against the without-project scenario	40 families	4.4
	Number of women for whom health services are expected to improve as a result of project activities, measured against the without-project scenario	15	4.4
Education	Total number of people for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario	20	4.4
	Number of women and girls for whom access to, or quality of, education is expected to improve as result of project activities, measured against the without-project scenario	10	4.4
Water	Total number of people who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	N/A	

[5] Employed in project activities means people directly working on project activities in return for compensation (financial or otherwise), including employees, contracted workers, sub-contracted workers and community members that are paid to carry out project-related work.
[6] Full time equivalency is calculated as the total number of hours worked (by full-time, part-time, temporary and/or seasonal staff) divided by the average number of hours worked in full-time jobs within the country, region or economic territory (adapted from the UN System of National Accounts (1993) paragraphs 17.14[15.102];[17.28])
[7] Livelihoods are the capabilities, assets (including material and social resources) and activities required for a means of living (Krantz, Lasse, 2001. *The Sustainable Livelihood Approach to Poverty Reduction*. SIDA). Livelihood benefits may include benefits reported in the Employment metrics of this table.

Category	Metric	Estimated by the End of Project Lifetime	Section Reference
	Number of women who are expected to experience increased water quality and/or improved access to drinking water as a result of project activities, measured against the without-project scenario	N/A	
Well-being	Total number of community members whose well-being[8] is expected to improve as a result of project activities	40 families	4.4
	Number of women whose well-being is expected to improve as a result of project activities	15	4.4
Biodiversity conservation	Expected change in the number of hectares managed significantly better by the project for biodiversity conservation,[9] measured against the without-project scenario	53,528 hectares	2.1.1
	Expected number of globally Critically Endangered or Endangered species[10] benefiting from reduced threats as a result of project activities,[11] measured against the without-project scenario	5	5.2

[8] Well-being is people's experience of the quality of their lives. Well-being benefits may include benefits reported in other metrics of this table (e.g. Training, Employment, Livelihoods, Health, Education and Water), and may also include other benefits such as strengthened legal rights to resources, increased food security, conservation of access to areas of cultural significance, etc.
[9] Managed for biodiversity conservation in this context means areas where specific management measures are being implemented as a part of project activities with an objective of enhancing biodiversity conservation, e.g. enhancing the status of endangered species
[10] Per IUCN's Red List of Threatened Species
[11] In the absence of direct population or occupancy measures, measurement of reduced threats may be used as evidence of benefit

2 GENERAL

2.1 Project Goals, Design and Long-Term Viability

2.1.1 Summary Description of the Project (G1.2)

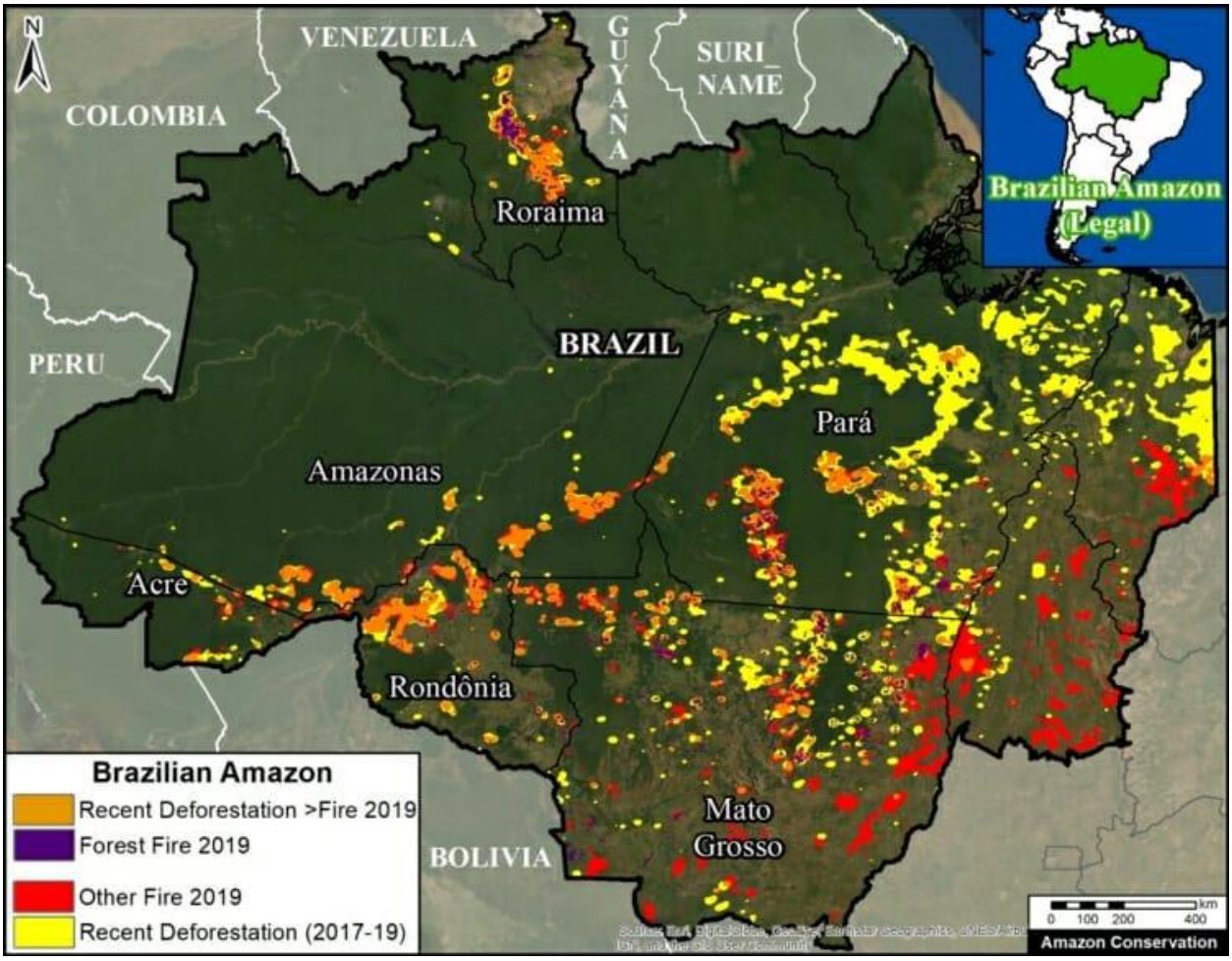
Amazon Reforestation Consortium (ARC) seeks to combine elements of conventional integrated conservation and development projects (ICDP) with a “payments for ecosystem services” (PES) approach when designing and implementing the ARC REDD project. REDD has at times been conceived narrowly as simply a system of conditional performance-based payments (PES), (Sills et al. (2009), The evolving landscape of REDD projects). Projects developed by Amazon Reforestation Consortium & REDD group are similarly premised on performance-based payments, but we have gone further in developing an approach to project implementation that recognizes the part that can be played by tried and tested interventions. These include participatory land use mapping, boundary determination, development of land use plans, clarification of tenure, income generating activities, employment and community development.

The ARC REDD+ Project that has a primary focus of preserving native forest in the Amazon in regions that is prone to deforestation. . Project is mainly focussed on conserving the native forest through protection and the avoiding further actors of deforestation. who are seeking to degrade, The native forest conservation will be able to support and protect more flora and fauna. The project preserves 53,528 hectares of the native forest.

The project goal it to prove out the economic feasibility of preserving the forest in regions that are already heavily degraded, and where it is still considered socially acceptable to convert forest to agriculture. Prior to the current owner the land was a degraded forest, with no cutting plan, the forest area still has a high threat situation, and it is common for illegal loggers to be operating in and around the project area.

The project is located in the eastern part of the Brazil in the state of Para, which is shared between three municipalities of Paragominas, Ulianopolis and Nova Esperanca do Piria. This project area covers 53,528 hectares of Amazon forests and is located 300 km from Belem, the capital of Para state, Brazil. As depicted in Figure 1, this area is under increasing threat from deforestation.

Figure 1. Deforestation in and around the project area. (source: Brazilian Amazon 2019. Data: UMD/GLAD, NASA (MODIS)).



The Project will continue to protect the forest land, and help the forest area to regenerate from the previous landowner who degraded all aspects of the 53,528 hectares. • It also creates job for local population, bi-annual training in reforestation practices, sustainable development, fire prevention, and the project helps the local population to have high capacities to move into the rural middle class through training in sustainable land use.

However, these areas have been affected by livestock and agricultural activities, represented by dual-purpose cattle (milk and meat), cultivation of cassava and beans production. These activities are characterized by traditional, low-tech products and low value-added products. Based on prevailing historical land use trends in the region, agricultural and livestock uses are the scenarios identified prior the implementation of the activities (baseline scenario). In this regard, the main project objective is the reduction of illegal logging and the recovery of degraded forests through the development of REDD project.

Climate Benefits:

Estimated annual GHG reductions are 258,328 tons of CO2e per year, the project corresponds to an estimated 7,749,856 avoided deforestation over the life of the project.

Community Benefits:

The main object of the project for the community is to direct the community towards *employment* opportunities in the area. In addition to this project has provided cook stoves for the local population and conducts bi-annual training on sustainable land use to conserve the native forest. There are 4 different villages next to the project area, where the project attempts to focus hiring from these villages, where it saves the project money by not having to transport people from the two population centers of Ulianopolis and Paragominas. Also to Improve livelihoods of Paragominas, to Promote sustainable tourism in designated zones of the reference region of the project and to Secure land rights to the locals living in and around the project area.

Biodiversity Benefits:

Project has created the concept of animal corridor by the constructing the bridges for Capuchin monkey, which were very common in and around the project area but now to the increased rate of deforestation which are under threat and have been listed under endangered species under IUCN. Strengthening governance in and around the project area by employing security guards for forest protection. Main intention of creating bridges was to avoid road accidents for the monkeys. Since the project area is surrounded by agricultural lands and other plains, death of monkeys were very common on the roads due to accidents. By creating the rope bridges for monkeys to cross the roads and to enter the project area, monkey deaths have been minimized.

2.1.2 Project Scale

Project Scale	
Project	
Large project	Yes

2.1.3 Project Proponent (G1.1)

Organization name	Amazon Reforestation Consortium
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Title	Project Manager

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2.1.4 Other Entities Involved in the Project

Organization name	Transportadora Floresta do Araguaia Ltda.
Contact person	Ms. Daniela Gontijo
Title	Head
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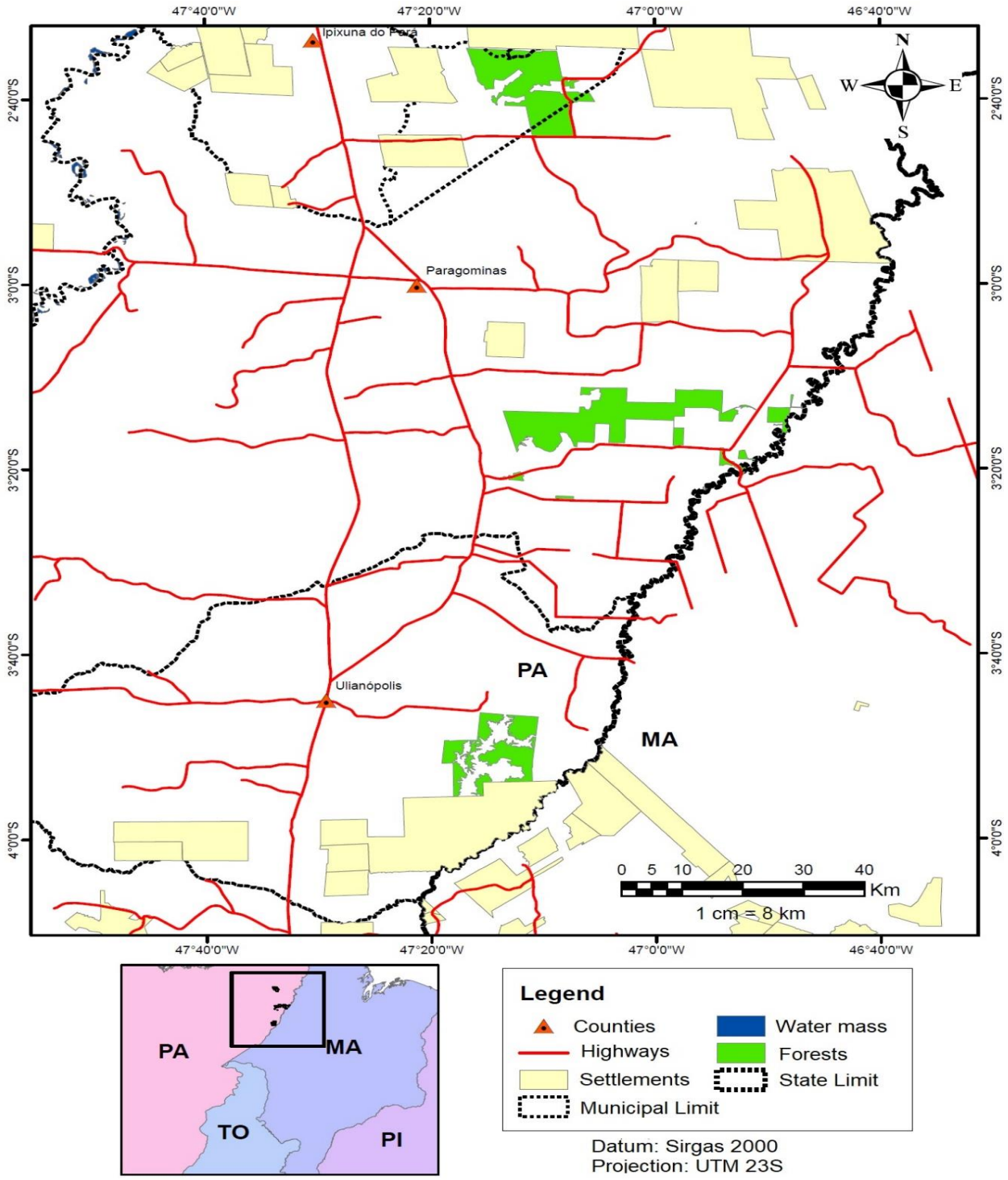
2.1.5 Physical Parameters (G1.3)

1. Location of the project

The project is located in the northern part of the Brazil, State of Para, under three municipalities namely Nova Esperanca do Piria, Paragominas and Ulianopolis. Nearest Airport is around 300 Kms by road which is located at Belem.

Figure 2 : Project location of all three municipalities

Figure 3 : Project location of all three municipalities with municipal limits



The project is located on private properties which is made up of 3 separate blocks of land representing 53,528 hectares. Geological coordinates of the project of all three blocks is as mentioned below;

a) North block - 3° 43' 0" S Latitude 47° 13' 30.0" W Longitude

b) Central block - 3° 16' 30.0" S Latitude 47° 07' 30.0" W Longitude

c) South block - 3° 46' 0.8" S Latitude 47° 15' 0" W Longitude which is located in the state of Para of Brazil.

1. Basic Physical Parameters

Climate:

The climate of the region can be characterized as hot and humid, with quite high temperature, relative humidity and volumetric rainfall, perfectly framed in the AW type of the Koppen classification (tropical humid, with monsoon rains, dry winter, with precipitation in the driest month below 60 mm). The annual rainfall is around 1,800 mm (Figure:3, 4 and 5)

Figure 3: Annual Precipitation from year 2011 to 2018 – Nova Esperanca do Piria

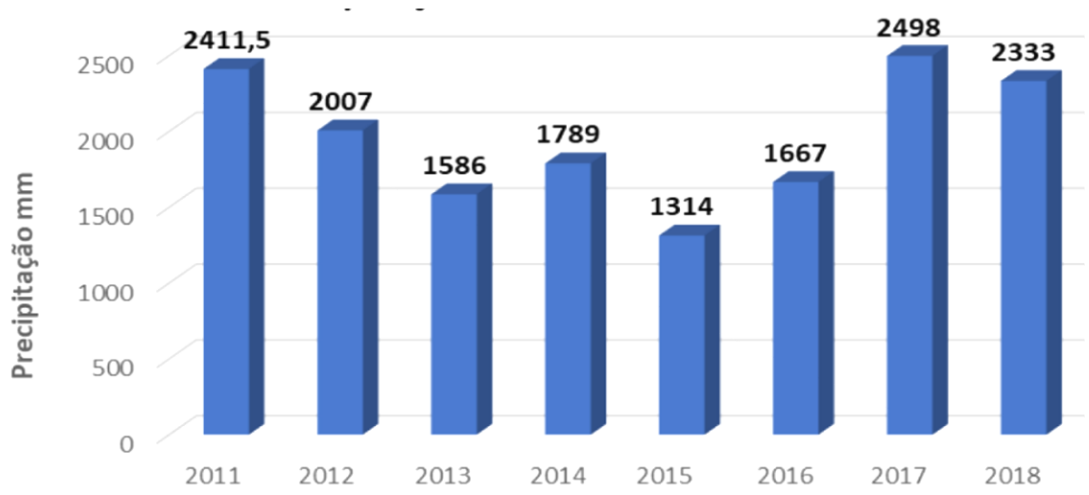


Figure 4: Annual Precipitation from year 2011 to 2018 – Paragominas

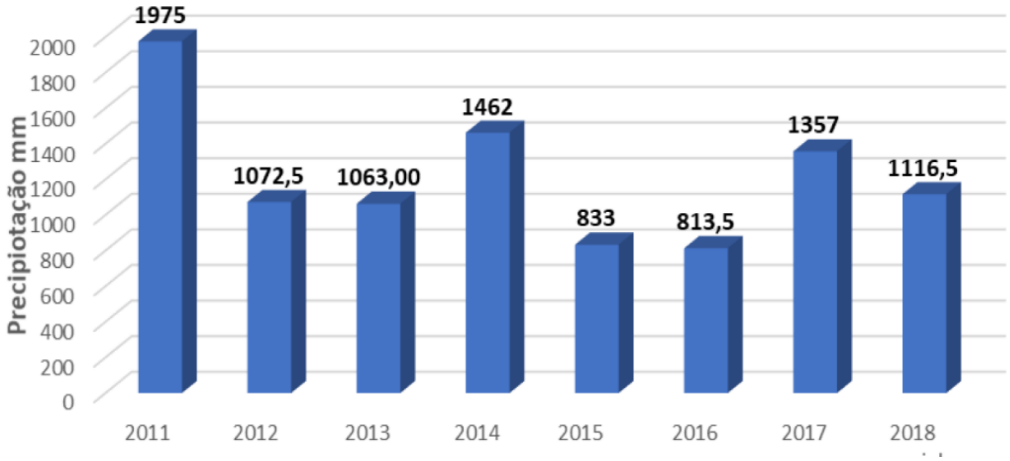
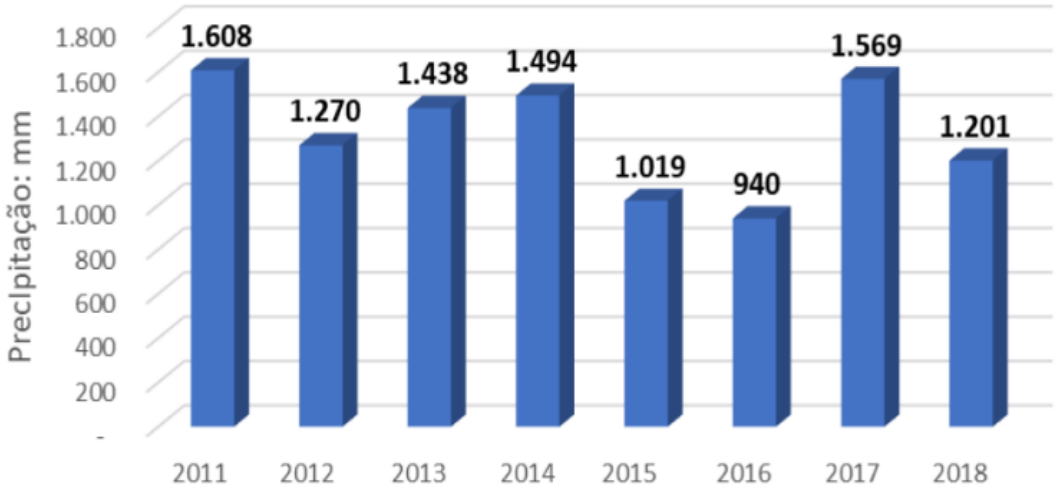


Figure 5: Annual Precipitation from year 2011 to 2018 – Ulianopolis



Soils:

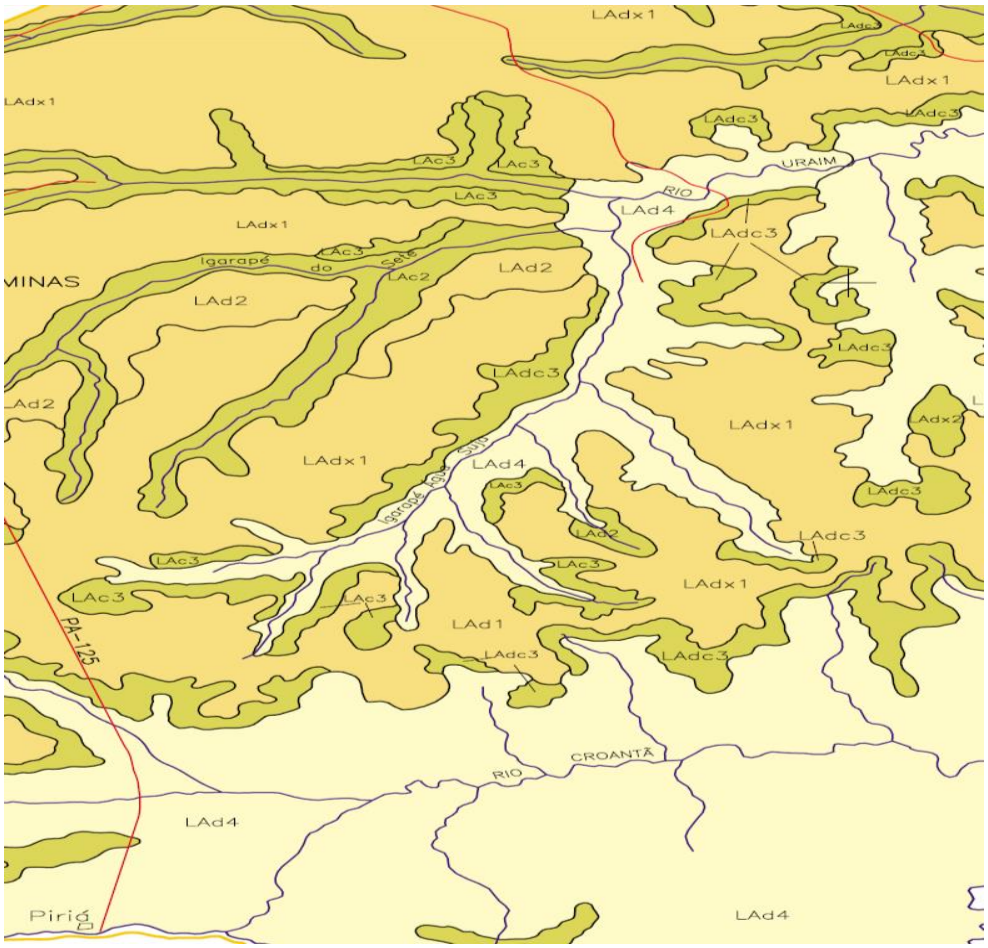
According to Rodrigues et al. (2013) the main soils mapped within the region of the Municipal District of Paragominas were: Yellow Latisols, Yellow Argisols, Plithosols, Gleysols and Neosols. These soils were classified according to criteria and differential characteristics to frame them within the Brazilian System of Soil Classification (EMBRAPA, 1988) (I plano diretor da EMBRAPA: 1988-1992.). As it can be seen in Figure 6, project area soils are Yellow Latisols. According to Viera (1988) (doi.org/10.1002/bit.260310712), they are soils where clay contents in B horizon vary from

15% to more than 60%. It is possible to define a soil classification of intermediate texture (15% to 35% clay), clay-like texture (35% to 60% clay) and of very clay-like texture (more than 60% clay). With reference to use possibilities, Rodrigues et Al. (2003), state that Latisols, due to their unfavourable chemical characteristics for agricultural activities, require correction, mainly in relation to high acidity and high aluminium content. These limiting characteristics are easily corrected by means of correctives and chemical and organic fertilizer application with the aim of increasing concentration and retention capacity of nutrients in the soil. As regards physical properties, Rodrigues et al. (2003) suggest adopting soil and handling conservation practices for Yellow Latisols, although they do not have restrictions for intensive agricultural use, considering soil and nutrient losses due to water erosion resulting from rainfall indices present in the most rainy season.

1 (Rodrigues PMS, Martins SV, Neri AV, et al. (2013) Riqueza e estrutura do componente arbóreo e características edáficas de um gradiente de floresta ciliar em Minas Gerais, Brasil. Rev Árvore 37:1011–23)

2 (Rodriguez et al., 2003. Cuban J. Agric. Sci. 37: 421-424)

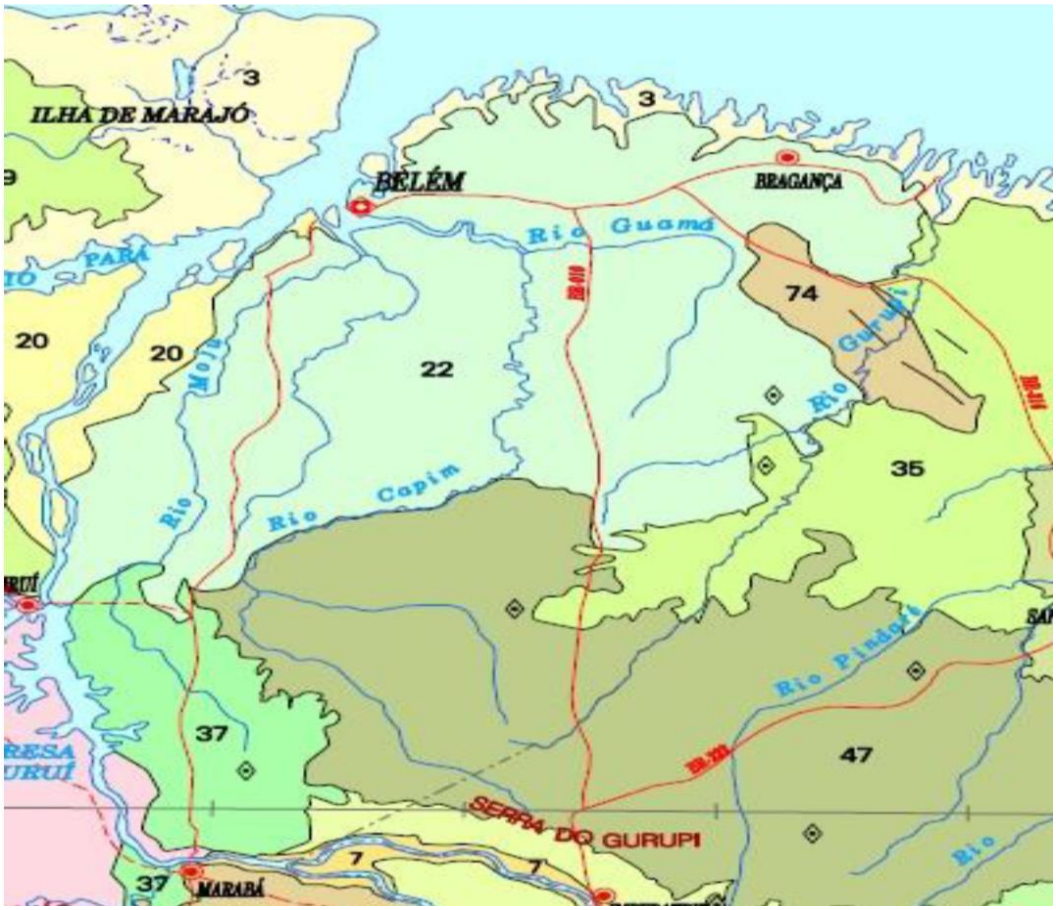
Figure 6: Soil classification map



Hydrology:

The municipality of Ulianopolis is covered by the Gurupi sub-region and the Guamá-Capim Basin. Due to the location of the South Block, near the border with the state of Maranhão, it is located in the Gurupi sub-region. The municipality of Ulianopolis is the southern boundary of the Gurupi sub-region, which belongs to the Northeast Atlantic Hydrographic Region (MMA, 2006) (Figure 7). The Gurupi sub-region has its boundary to the west with the Guamá-Capim Basin, belonging to the Tocantins-Araguaia Basin. Central Block is located in the southern region of the municipality of Paragominas, at the meeting between the Piria River and Rio Gurupi (the Piriá River flows into the Rio Gurupi). The Rio Gurupi is a currency of the states of Pará and Maranhão. North Block is located between the municipalities of Paragominas, Nova Esperanca do Piria and Garrafão do Norte, between one of the sources of the Guamá River and the Igarapés Maritacas and Piriazinho (the Piria River flows into the Rio Gurupi). The study area is located in the Northeast Atlantic Coast Hydrographic Region.

Figure 7: Map of the hydrology region of the project



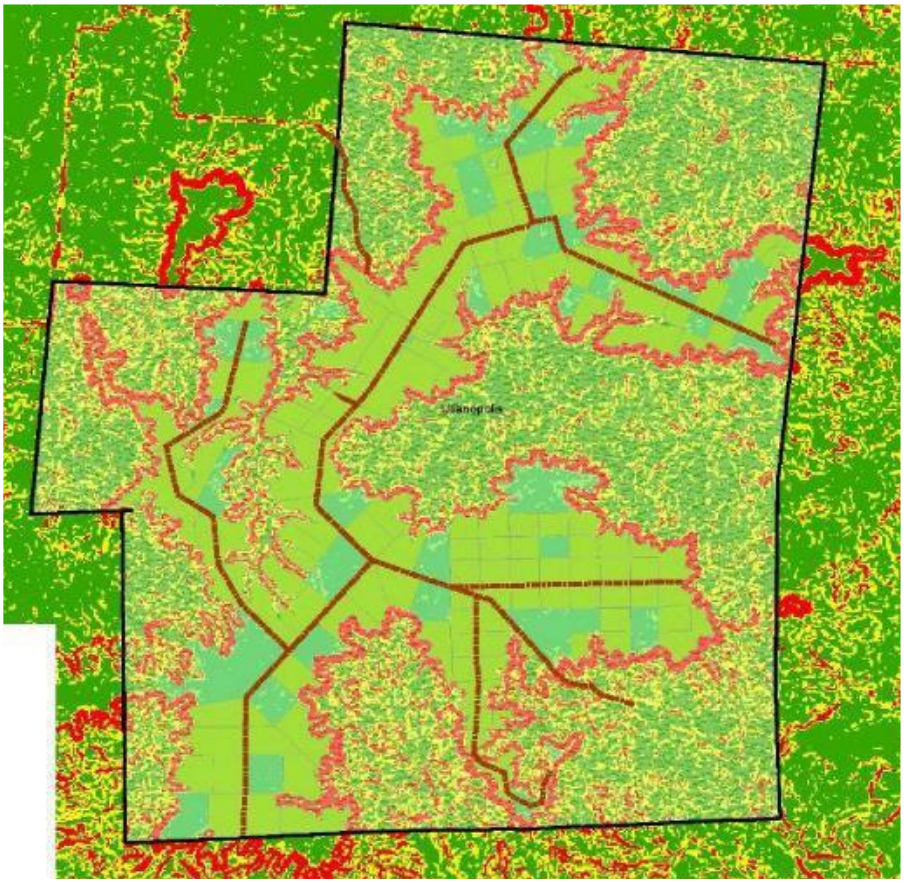
Geology:

The geological terrains of the Paragominas region belong to the Maranhao Basin, according to the definition by Mesner & Wooldridge (1964). However, more recently, Góes (1995) admitted to this extensive Sedimentary Province a polycyclic evolution, enabling its partitioning in the following different basins: Parnaíba, Apercatas, Grajaú and Espigao-Mestre. Taking into account this new conceptualization, the region is situated in the Grajaú Basin, in whose stratigraphy can be identified, from the bottom to the top, the following geological units: Ipixuna Formation, Itapecuru Formation, Detritus-Lateritic Paleogene Coverage, Pleistocene Sedimentary Coverage and Alluvial Deposits.

The areas of the Municipalities of Ulianopolis and Paragominas are located in the Morpho structural Domain of the Non-Bended Sedimentary Plateau, characterized by flattened structural surfaces, in the form of extensive plateaus, with average elevations around 200 m, bounded by plateaus dissected under the form of crests, tabular interfluve's, and developed in sedimentary rocks constituted of argillites, of the Ipixuna Formation, of the Upper Cretaceous period and belonging to the Grajaú Basin and by alluvial plains.

Considering the grouping of geomorphological units that have similarities resulting from the convergence of factors responsible for their evolution, the area was identified as belonging to the geomorphological region of the Northern Plateau Pará-Maranhão. The geomorphological units, resulting from the association of recurrent forms of relief, generated from a common evolution are: Tabular Surfaces of the Tiracambu Mountain, Dissected Plateau of Paragominas, Plains of Ulianopolis and Plains of the Capim and Gurupi Rivers.

Figure 8: The maps of altimetry and slope are, respectively, for the south block. Where red represents areas with high risk of erosion.



They are the remains of a degraded pediplano, developed in sedimentary rocks of the upper unit of the Ipixuna Formation, filled with clayey or sandy-clay sediments, these being recognized as the deposits correlative to an extensive erosive / depositional or interpolar episode occurring at the beginning of Tertiary, called Del'Arco & Mamede (1985) of Paleogenic planning. Environmental conditions, coupled with relative tectonic quietude, have led to the development of thick lateritic crusts that constitute the group of Paleogenic Detrito-Lateritic Coverages, which respond to the preservation of the relief in the chapadões that characterize this geomorphological unit. The altitudes decrease from South to North, with maximum values, around 200 meters.

Dissected Plateau of Paragominas constitutes a relief unit formed by crystalline hills with steep valleys, or by tabular interflúvios with ravenous slopes, modeled in the inferior unit of the Ipixuna Formation and constitute the level of dissection of the Paleogenic planning.

The Planos de Ulianopolis unit represents another planning (flat) surface that lowered the Paleogenic Surface to the altimetric level around 80 meters. It is modeled in sediments of the

Ipixuna Formation, being retouched by erosion recovery, and flooded by the quaternary sediments that constitute the Pleistocene Sedimentary Coverage group, which cover the Ipixuna Formation.

Plains of Capim and Gurupi Rivers plains are developed in the valleys of these rivers, with the presence of terraces and alluvial plains of Quaternary age.

Land Use:

Paragominas is located in the eastern Brazilian Amazon. The dominant vegetation in this region is humid forest with predominantly oxisols perenefólia and Ultisols soils. Paragominas was a large agricultural and timber centre of the country, with its exploitation starting in the 70's and expansion in the 80's. Most of the project boundary is constituted by Pasteur lands with very large patches of human activity. These patches constitute small-scale agriculture. From a social assessment conducted by ARC in the months of December 2014 and January-February 2016, it is known that there were nearby areas under timber extraction within the past ten years. Timber extraction at large scale is not conducted in the project's vicinity anymore. Epiphytes encompass a wide range of plants: some ferns, orchids, cacti and mosses have the ability to live virtually in mid-air. They trap the little soil they need, which is carried by the wind, and this helps them develop roots and a litter base on tree branches. Other plants that are common both as creepers and epiphytes in the Amazon are the aroids, which include philodendrons. These plants begin life on the ground and grow as a tendril that goes up tree trunks and attaches to them by aerial roots. They eventually lose their ground roots and become climbing epiphytes.

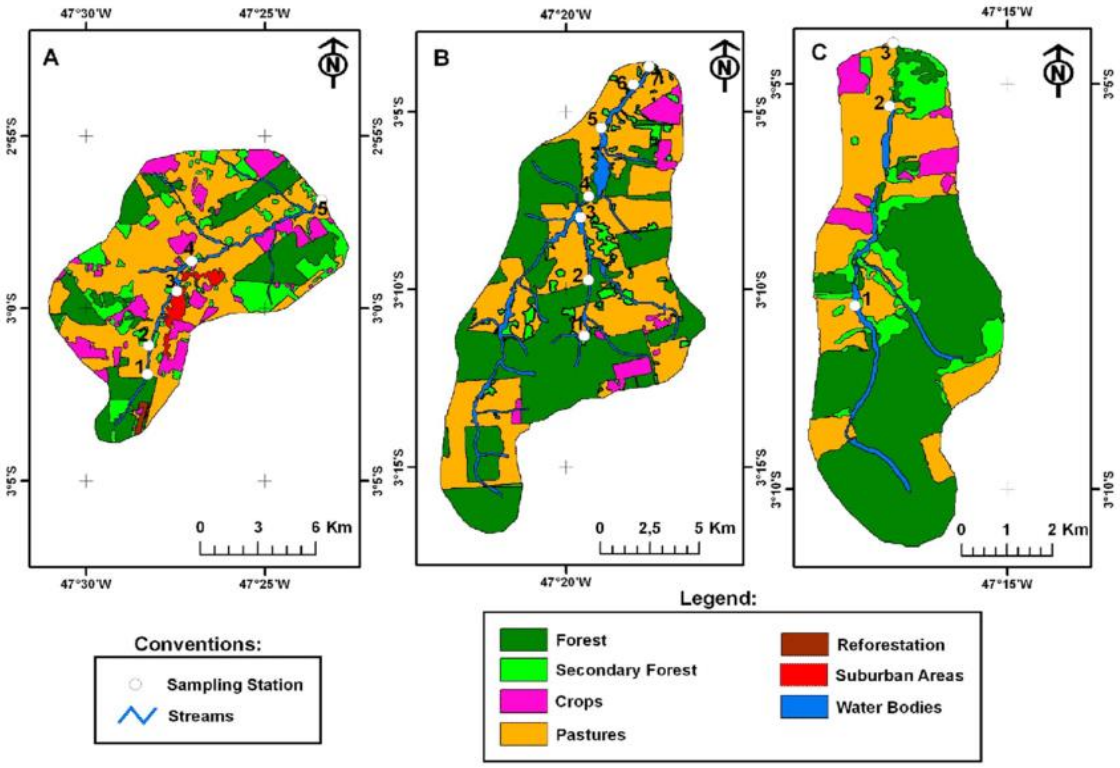
Large areas of forest in the project reference area have been replaced by pasture, and more recently by soybean cropland. By 2003, the forest area had been reduced to 5.3 million km2, 85% of the original area [Soares-Filho et al., 2006] In the future, rates of deforestation are likely to increase as more roads are built through the region's core and as international demand for tropical timber, soybeans, beef, and biofuels continues to grow

A more elaborated and detailed approach to land use can be found in the PDD under VM 0015 (Land-Use, Land-Cover analysis) and attached together with this document. Land uses in the project area are shown below in Figure 9:

3 (Soares-Filho, B. S., D. C. Nepstad, L. M. Curran, G. C. Cerqueira, R. A. Garcia, C. A. Ramos, E. Voll, A. McDonald, P. Lefebvre, and P. Schlesinger (2006), Modelling conservation in the Amazon basin, Nature, 440, 520– 523).

4 [Laurance et al., 2001; Carvalho et al., 2002; Soares-Filho et al., 2006] (Laurance, W. F., M. A. Cochrane, S. Bergen, P. M. Fearnside, P. Delamonica, C. Barber, S. D'Angelo, and T. Fernandes (2001), Environment: The future of the Brazilian Amazon, Science, 291(5503), 438– 439).

Figure 9: Land Use in the Project area



2.1.6 Social Parameters (G1.3)

Ulianopolis was elevated to the category of municipality in 1991. Its colonization began in 1958, when the pioneers set up a small encampment under a Cumarú tree, next to a creek. The head of the camp, engineer Bernardo Sayão, thought that it was the Gurupi river that established the border of the states of Pará and Maranhão. Realizing that it was only a tributary of the Gurupi, he called him Gurupizinho (little Gurupi)

The village, called Gurupizinho, began to house several families in the 1960s. These were attracted by the colonization projects of the Amazon and by the ease in obtaining lands in the region. Uliana was among the first families to reach the site, and its name gave rise to the current denomination of the municipality.

It was elevated to the category of municipality with the denomination of Ulianopolis, by the state law nº 5679, of December of 1991, dismembered of Paragominas.

Already Paragominas was elevated to the category of municipality with the denomination by the State Law n. 3,225, dated 04-01-1965, being dismembered from the municipality of São Domingo's do Capim and Viseu.

Thus, remaining in territorial division dated 1-1-1979, by State Law n. 5,087, of 09-14-1983, the district of Dom Eliseu is created and attached to the municipality of Paragominas. In territorial division dated 18-8-1988 the municipality was constituted of 2 districts: Paragominas and Dom Eliseu. Through State Law n. No. 5,450, dated 05-05-1988, the district of Dom Eliseu was dismembered from the municipality of Paragominas, and raised to the category of municipality, thus remaining two distinct municipalities.

By 1970 the area occupied by the Municipality of Novo Esperanca of Piria was used only by hunters. The access was difficult for those who moved from the seat of the Municipality of Viseu, and for those who were on their way from Ourém, Captain Poço and surrounding areas.

From that year the first families began to settle in the area, introducing subsistence agriculture (rice, beans and cassava). These pioneers from Bahia State (a different state in Brazil), led by Jossué Mendes de Almeida, were responsible for opening the first branch of the road that facilitated access to that area, stimulating the arrival of other families, which resulted in the formation of a population cluster that gave rise to Vila de Piria.

Vila Piria began on March 18, 1972. The first commercial establishment was installed by Ademar Pontes, at 13 de Maio Street. The first house built was the one of Adriano Mendes and Josinal Pires da Silva was the first child to be born in the place, on January 30, 1973.

Subsistence agricultural activity gradually grew as other families moved to Vila Piriá. Logging also contributed to the formation and growth of the urban nucleus that gave rise to that locality, which later became the seat of the municipality.

The Official document forwarded to the Legislative Assembly by the Pro-Emancipation Committee referred to the suggestions of names: Antônio Guerreiro de Serra Azul do Piriá and Nova Esperança Piriá. The latter ended up satisfying the majority of the population, because it reflected the expectation that political-administrative autonomy emerged as a new hope (novo esperanca) for promising days for the municipality and its population.

Table 1: Demographic data for Ulianopolis 2015 (*source ibge.gov.br*)

Population in 2010	*43,341*
Population in 2015	*53,881*
Area in square km of the Municipality	*5,088*
Inhabitants per square km	*8.52*

Table 2: Demographic data for Paragominas 2015 (*source ibge.gov.br*)

Population in 2010	*97,819*
Population in 2015	*107,010*
Area in square km of the Municipality	*19,342*
Inhabitants per square km	*5,06*

Table 3: Demographic data for Nova Esperanca do Piria (*source ibge.gov.br*)

Population in 2010	*20,158*
Population in 2015	*20,663*
Area in square km of the Municipality	*2,809*
Inhabitants per square km	*7,18*

Land markets turnover and the characteristics of settlers:

By definition frontiers are dynamic, as such we would expect that there would be considerable turnover as development proceeds. The initial settlers should be specialists in clearing and making rudimentary investments. As development proceeds, population densities increase, transportation improves, land values increase and market transactions for land exchange of land will entail the issuance of a witnessed receipt for the squatted claim. The exchange of informal claims-squatters rights for a witnessed receipt – represents the initial extension of the market to the frontier. During the transition, lower-valued users of land should sell out to higher valued users.

We interviewed the settlers near the communities of Paragominas, Nova Esperanca do Piria and Ulianopolis and therefore we were able to compare the characteristics of those settlers who stayed with those who sold their plots and migrated. Unfortunately, we do not have systematic data on the in-migrants. We have 54 observations for both Nova Esperanca do Piria and Paragominas, and 64 observations for Ulianopolis. To capture the impact on whether to stay or move, we collected data on the following variables: age of the settler, years of education, wealth (value in USD) and previous number of migrations. Age and education are proxies of human capital and wealth is a proxy for physical capital. The number of prior moves is an additional measure of human and physical capital. Our hypothesis is that each move represents a sale where the seller improves his stock of assets. Our measures of physical capital- wealth and number of moves- most likely increase with age, as does experience. As such, our framework has a life-cycle component. This is in contrast to a view that a class of settlers remains landless, drifting from frontier to frontier. Table 4, represents the mean characteristics of settlers Paragominas, Nova Esperanca do Piria and Ulianopolis.

Table 4: Mean characteristics of settlers who stay or leave

	Nova Esperanca do Piria		**Paragominas**		**Ulianopolis**	
	Sold	***Stay***	***Sold***	***Stay***	***Sold***	***Stay***
N	5	49	11	43	21	41
Mean age	35	43	37	43	39	43
Mean education (years)	3.0	2.9	1.5	1.8	3.3	2.9
Mean wealth	$ 8,262	$ 12,902	$ 500	$ 18,000	$ 8,242	$ 13,912
Number of prior moves	1.4	1.8	1.9	2.4	2.2	2.8

*Note: Differences in the means are significant at 99% *Ulianopolis, Nova Esperanca do Piria*

Agriculture, mining and timber industry were the major drivers for deforestation of native forest lands. Bauxite mining was the main factor for floating population in and around Paragominas. To begin assessing the relative advantages and disadvantages for the communities to sell non-timber products in addition to logs, ARC marketing studies were conducted in Paragominas, Nova Esperanca do Piria and Ulianopolis, the region's commercial centre, and in Paragominas, the nearest city and the centre of the region's logging industry. Described here, the ARC market survey had three primary aims: (1) to identify the non-timber forest resources for which relatively high levels of demand exist in regional markets; (2) to determine the principal sources and prices of these key products; and (3) to examine forces which may impact the future availability and marketing of these products for regional traders.

Figure 10: Bauxite ore mining area of Paragominas

Figure 11: Settlements of Nova Esperanca do Piria

Figure 12: Forest lands converted to agriculture patch observed at Ulianopolis

Social Organization and cultural identity:

All villages are agglomerations of small families and are organized according to religious beliefs. Thus, some villages can be catholic and others evangelic (in the project area there are 6 catholic and 3 evangelic villages). According to the PRA 68.1% of the people in the project area are Catholics, 30.4% evangelic and 1.5% didn't want to respond about their religion.

Churches are the meeting points for each village and it is there where –after mass- interest topics for the community are discussed. In the case of each cult, the person that offers the mass acts as a local leader as well.

Infrastructure and services:

Households in the project area have the following characteristics: 83.8% of residents own their own house and 16.2% have their home transferred, left it for lease for relatives or some floating populations. Houses are mostly made of wooden planks which are processed by chainsaw (which are not sawn).

Appliances in households: 37.7% of residents use radio, 42.0% of the population owns TV, 62.3% uses gas stove to cook and 16.9% of residents use refrigerator.

Drinking water - Local population uses water from rivers and streams as well as groundwater. In the project area 47.8% of the families mentioned that draws groundwater (through artesian wells) and 52.2% from streams and / or rivers. With regard to water quality, 73.9% of respondents mentioned that the water is clean, 15.9% said is muddy and 10.1% said it contains debris.

Drinking water is not treated, and in some towns several illnesses associated with consumption of contaminated water have been identified.

Urban wastewater is let into the backyard and in the local creek or river. The sanitation system is negligible, only 10.1% of households have a silo system at home and 89.9% make their hygienic needs in the field or forest.

Energy consumption - None of the families have public electricity service. Families get electricity by using a diesel-powered electric generator.

Food cooking - most families use gas stoves. Very few households use firewood from forest for cooking, wood is used principally and almost exclusively for the preparation of farinha.

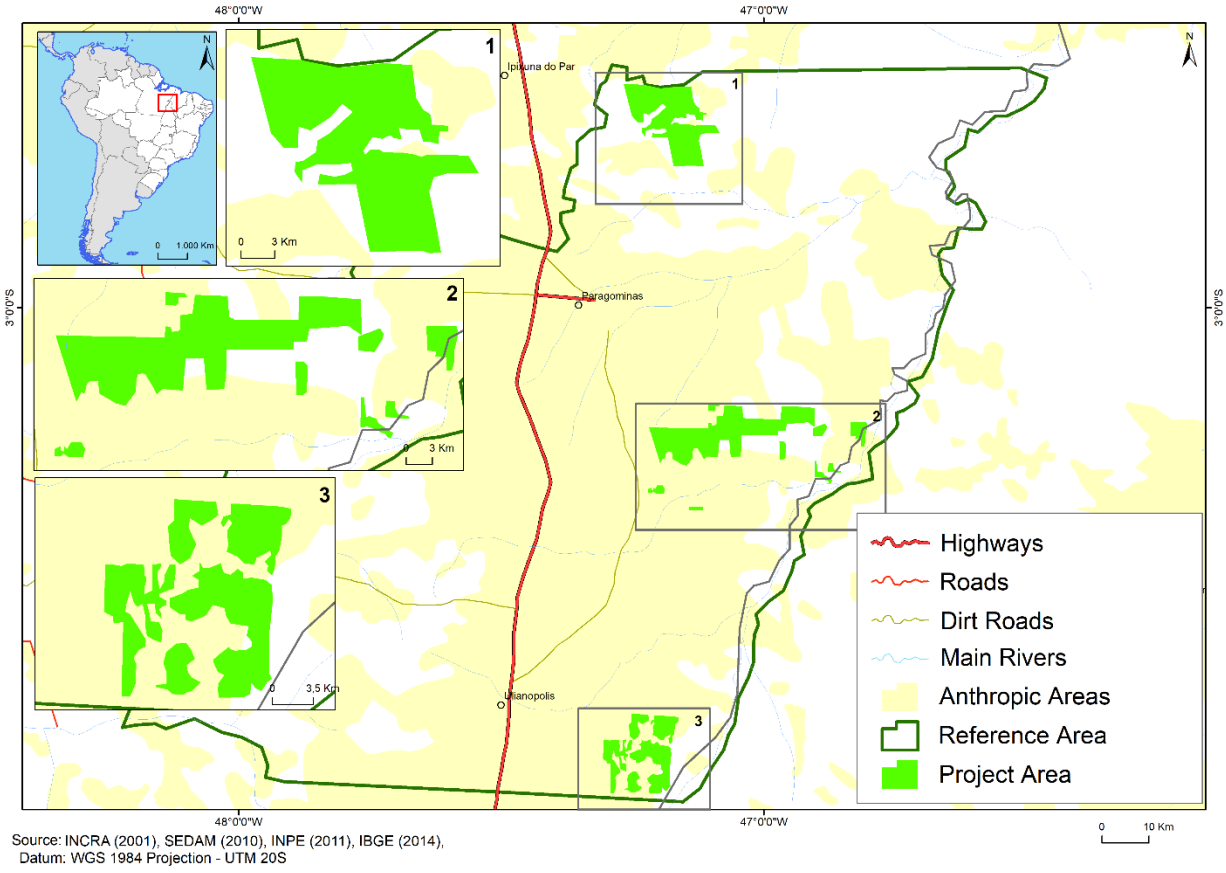
Regarding education - Educational services are highly demanded by local households. Most villages have schools only with elementary level education and only one village (Vila N. Alianca) provides high-school level education covering only the first grade of high school. After having a basic level of education , young people who wish to continue for higher studies have to migrate to nearby towns.

Health - Most of the villages in the project area have no health centres; villagers have to be travel to the health centre of Paragominas and Ulianopolis. The most common serious diseases are malaria, diarrhoea and vomiting in addition to snake bites.

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

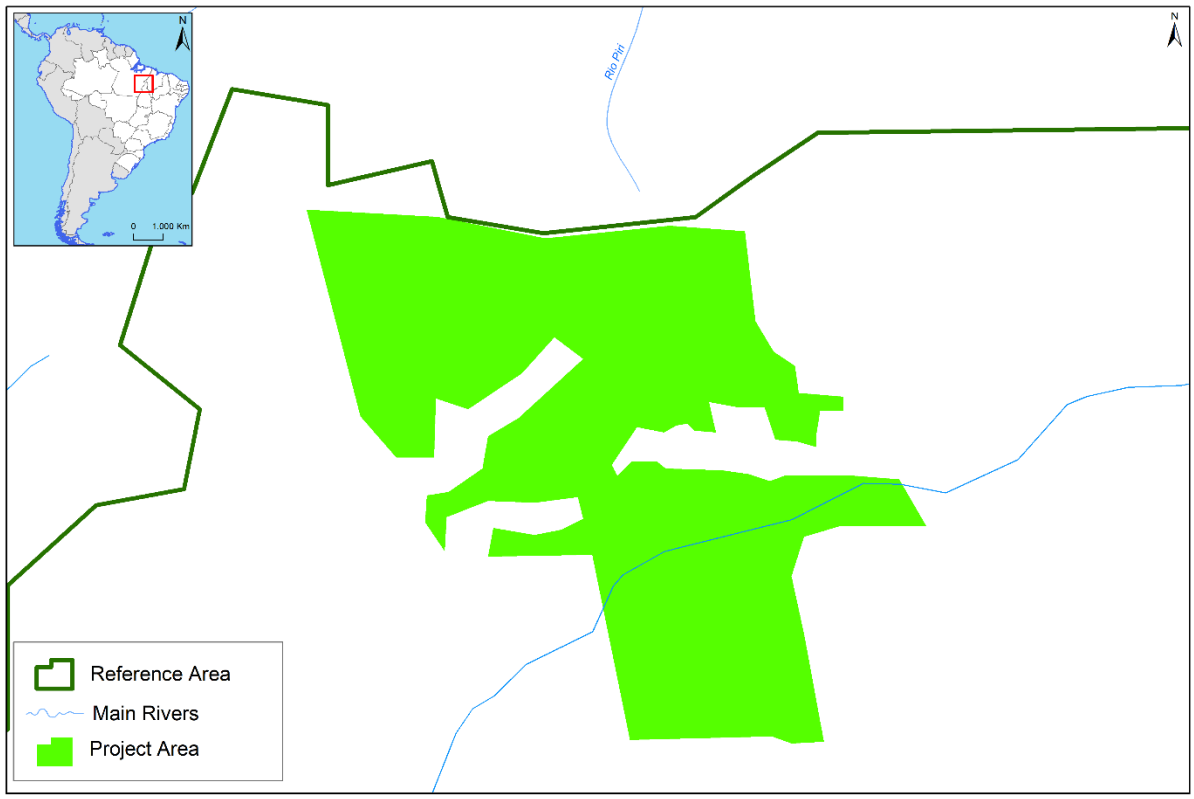
The project area is approximate 40 km from the city of Paragominas. It straddles the river basins of the Gurupa river which divides the border between the state of Maranahao Brazil and the state of Para Brazil – which is to the east of the property and borders part of the property, to the west of the property by 70 km is the river Capim, a major tributary in the region.

Figure 13: Location of the project in the Region



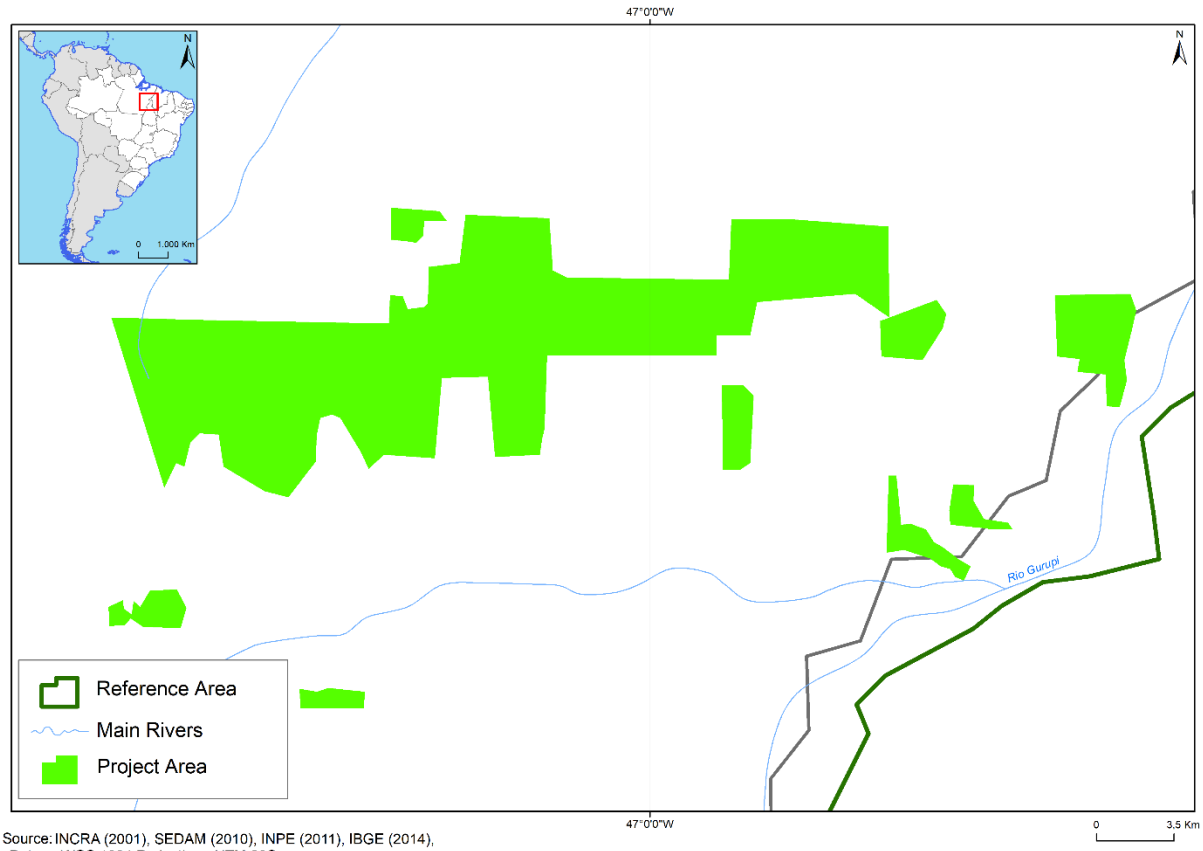
Source: INCRA (2001), SEDAM (2010), INPE (2011), IBGE (2014),
Datum: WGS 1984 Projection - UTM 20S

Figure 14: North Block



Source: INCRA (2001), SEDAM (2010), INPE (2011), IBGE (2014),
Datum: WGS 1984 Projection - UTM 20S

Figure 15: Central Block



Source: INCRA (2001), SEDAM (2010), INPE (2011), IBGE (2014),
Datum: WGS 1984 Projection - UTM 20S

Figure 16: South Block

Source: INCRA (2001), SEDAM (2010), INPE (2011), IBGE (2014),
Datum: WGS 1984 Projection - UTM 20S

Figure 17: Map of Project area showing project boundary, location of communities (identified in Section 2.1.9). High conservation value (HCV) areas (identified in Sections 4.1.3 and 5.1.2).

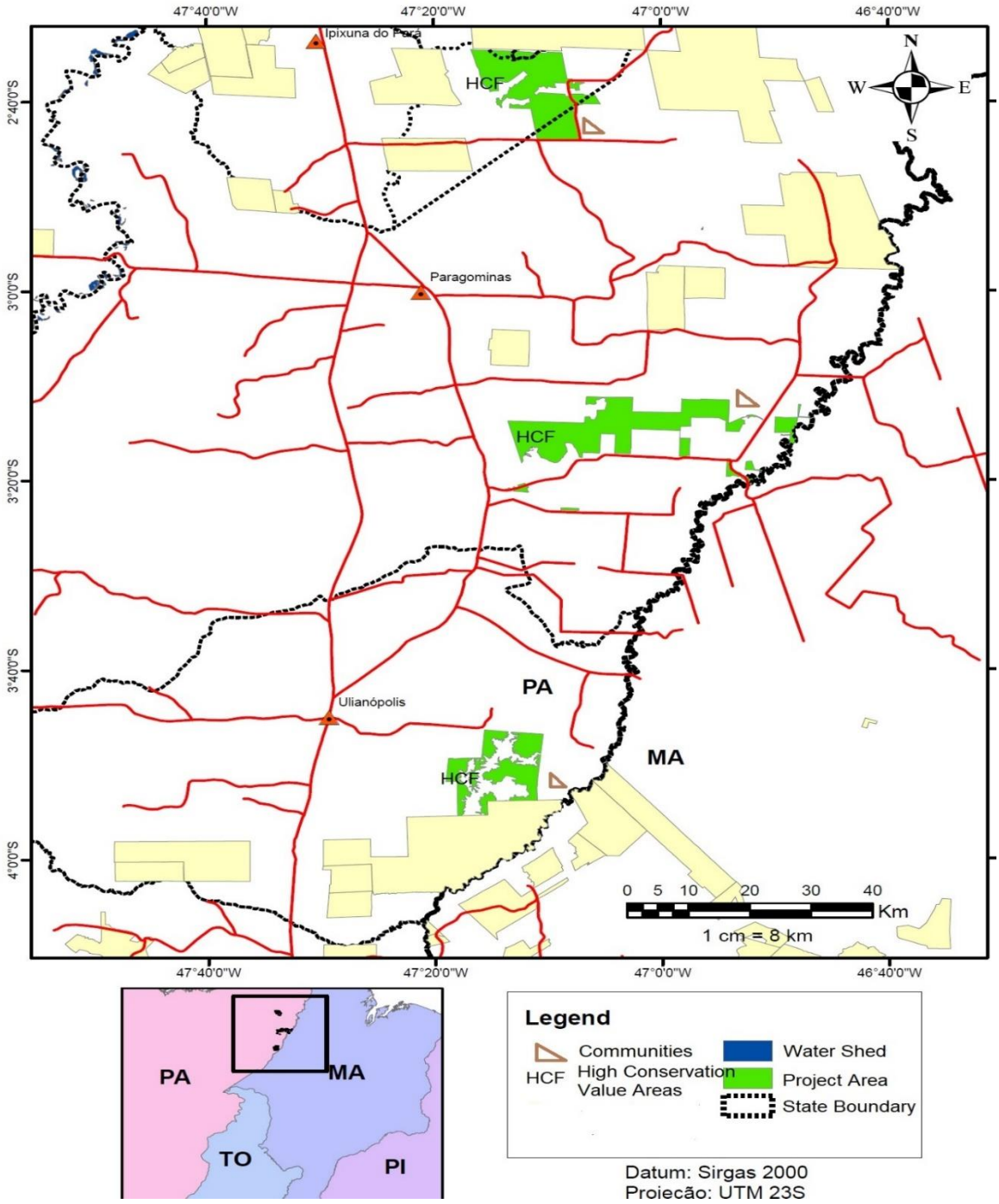
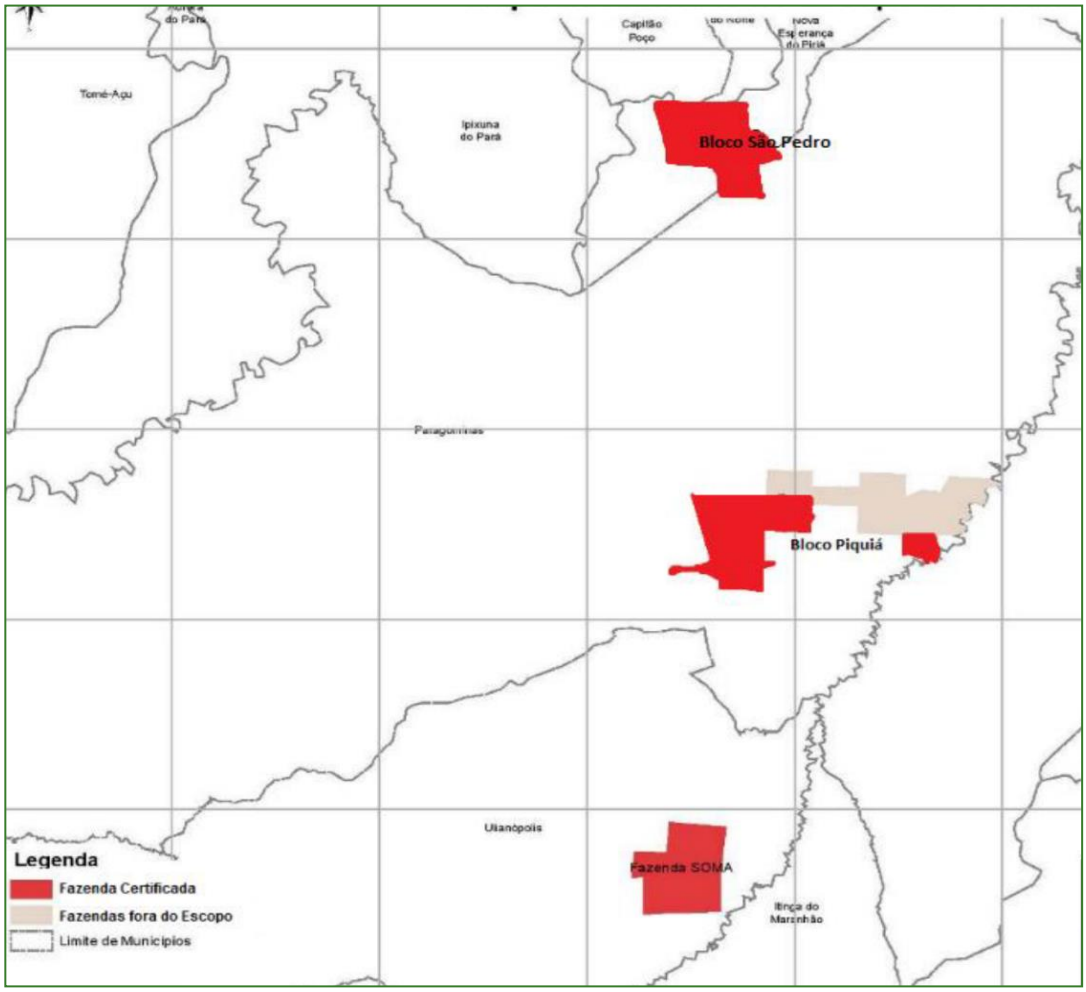


Figure 18: Displaying the 3 blocks of land and their located in the three municipalities: Ulianopolis to the south, Paragominas in the central and Nova Esperanca do Piria in the top.



2.1.8 Stakeholder Identification (G1.5)

As a first step in this identification process, a review of secondary information was made available for both the reference area and the project area. Thus, from official documents such as the Municipal Development Plans and Plans or Schemes of Territorial Ordering, in addition to reports corresponding to studies of socio-economic characterization, it was possible to determine in a preliminary way the actors present in the area. Subsequently, a series of interviews were conducted with social professionals who have accompanied community processes in the project area, with a view to specifying the information previously collected.

Finally, from socialization workshops, the secondary information collected and the information provided by the professionals interviewed will be validated with the community, carrying out the

joint exercise of identification as proposed in the Manual for the Evaluation of Social Impact and the Biodiversity (SBIA) of REDD + projects. For this, the following activities were carried out:

• Brainstorm key informants or focus groups to list and classify stakeholders.

• Classification of wealth or well-being of local actors or the community.

• Analysis of each group of actors according to their interests, motivation to participate and relationships with other actors.

• Analysis of the level of influence and importance of each group of potential actors.

Next, the groups of actors identified in the process of reviewing secondary information for both the area and the project area, as well as the information derived from interviews with professionals in the area, are described. Aspects such as the level of participation of the actors, the classification of their wealth or well-being, their degree of influence in the process and the analysis of each group according to their interests, motivation to participate and relations with other actors, will be specified once the socialization workshops will be developed within the framework of which this identification exercise will be carried out.

During the Pre-Project scenario in 2014 were identified all the commercial stakeholders that would be involved with the security and the community activities of the project.

Prior to the initiation to the project, the local communities were assessed for people who needed jobs, who had families and were indirectly need of income or people who were in need of cookstoves or had current sub-par cooking apparatuses. These are the stakeholders to the project. As long as the project is able to continue planting it is able to service the needs of the stakeholders.

The main stakeholders of the REDD Project are: - Municipalities of Paragominas, Ulianopolis and Nova esperança do piriá of Pará; - Communities of the surroundings and their respective institutions; - NGOs; - Universities and Research Institutions.

ARC interacted with the stakeholders mentioned above during the preparation of this REDD Project and the company also undertakes to carry out a consultation process with the main opinion makers on this final document, while it is under review by the audit team.

Thus, the main interactions with the stakeholders were presentations of what REDD is and about this Project to communities in the project zone and the municipalities of Paragominas and other two during the period from June 23 to June 30, 2017. During 27th and 28th June, 2017 member of ARC visited the neighbouring farms with the objective to inform this REDD Project.

The environmental and social aspects of the project that were raised during this meeting was formally recorded by ARC, and after that, the comments were compiled and documented in this PD.

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

The PRA was developed through a series of field visits, observations, surveys, workshops and interviews to local leaders and experts whom were informed about the project idea, its activities, the potential benefits to the communities and their participation in the project. To complement field information, the team used secondary information from IBGE"s 2010 Census.

List of all Communities, Community Groups and Other Stakeholders:

• Communities: workers of the property, workers families, technicians and experts involved in the Project, people from neighbouring farms (landlords, workers, technicians).

• Community Groups: Villages near the project: N. Alianca; Novo Uniao; P. Araras; Paranoa; Resplendor; Agua Vermalha; V. Louro; Arapua; Escolinha; Vila 21; Piria; Gleba 22; Km 204; Beiradao; Sao Francisco; Sao Mateus; Sapucai; Vila Bom Jesus.

• Other Stakeholders: City of Paragominas and City of Ulianopols where many workers come from.

• Direct Stakeholders: Project Owner; Land Owner; Employees from local villages

• Institutional Stakeholders: Mayoral office of the Municipality of Paragominas and Ulianopolis, Mayoral office of Nova Esperanca do Piria

• Commercial Stakeholders: Grupo Dacko Tree nursery, Brazil Agfor Ltd. land management

Figure 19: Surveys and interviews applied to villagers and local leaders

Carrying out workshops has been one element of great relevance for the design of the project in PRA. The villagers were informed about the project idea and the potential benefits for the communities and how their participation will be throughout the entire process. Likewise, „speaking maps" were constructed in a participatory manner in each one of the workshops which has allowed the villagers to face and describe their current life conditions identifying the main existing problems and the future conditions they would like to have in a situation where the project is being developed.

The tool of elaborating a “current map" and a “future desired map" in each locality has allowed the population and ARC to clarify the needs and expectations of the local villagers in comparative terms on how they are and how they picture their communities in the future.

The information gathered in the field work through the tools mentioned before, especially the needs and problems pointed out by the leaders and local villagers, has been the basis upon which the proposal for the activities of the project has been developed. The project staff believes that it is better to reach the villages with a clear open mind in order to understand local needs and later shape the activities based on the results of the PRA.

For this matter, project activities were conceived right after the social evaluation and not the other way around. Thus, local settlers not only have participated in the design of the project but have indeed provided inputs to ARC staff for such design

The following table shows the main problems, priorities and necessities identified by the population in the workshops and interviews to the local leaders.

Table 5: Main problems, priorities and necessities identified by the population

Identified problems	**Priorities**
Low family income	Access to job opportunities
Limited work opportunities	Agricultural production improvement
Increased difficulty to get resources from hunting and other deforestation activities	Access to communitarian transportation and means in order to facilitate access to Paragominas
Low training levels in relation to agricultural activities	new productive alternatives (fisheries and minor animal breeding)
Limited knowledge and training on productive activities alternative to farinha.	Access to electricity
Low training levels in the organizations for communitarian management	Bi-annual trainings on management
Low levels of citizen participation in communitarian management	Awareness camps
Land tenure uncertainty and insecurity	Land tenure resolution
Unsafe water consumption	Access to drinking water
Limited access to health services	Access to health services
Limited access to education for children	Access to education
Limited access to communication	Access to communication

The proposal for the project activities has been designed based upon the problems and priorities identified and pointed out by the villagers.

The project believes that the proposed activities will conduct an improvement in the quality of life of the local villagers in terms of strengthening their capacities and provide opportunities for the

economic development of the families. Likewise, being aware that it is not the role of the project to cover and comply with the functions and competencies of the State, the project considers that the proposed activities related to organizational and communitarian managerial capacity building will provide enough skills for the community to manage their public services requirements before the correspondent authorities.

Additionally, the project has determined the creation of an additional fund to the budget to develop and implement project activities. The amount is 5% of the annual income from carbon credits to support the initiatives that arise from the capacities strengthening in the localities.

2.1.10 Sectoral Scope and Project Type

The project corresponds to the VCS Scope 14, VM00015 ver 1.1– Methodology for Avoided Unplanned Deforestation. The project aims to protect rainforest, which are expected to be deforested in the absence of the Project.

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

Forests of the project area have become important areas for conservation. Although these are strategic ecosystems in the provision of environmental services, they are surrounded by a mosaic of pasturelands and thus have become highly fragmented and threatened with the expansion of the agricultural frontier. To continue supporting both production and conservation on these lands, adaptation strategies and alternatives to current regional production systems must be sought to both integrate the sustainable use of natural resources and allow for the connectivity of strategic ecosystems. Proper care is taken for man-made forest fires by deploying patrolling activities.

In keeping with the REDD+ approach of examining the direct relationship between human activities, deforestation, and forest degradation, a series of project activities has been proposed to reduce the aforementioned threats on the forests in the project zone and mitigate the associated GHG emissions.

The overarching aim of the project is to support the enactment of the project area resource management Plan (from here on referred to as the RMP or 'resource management plan'). The Project Proponent is distributing finances, providing support for social developmental activities and implementig the monitoring program for bi-annual activities which will be taken care by ARC. The following project activities (see Table 6 below) aim to enforce the resource plan were developed through Dacko Nursery and TFA. In parallel, the project activities described in this section seek to: (i) promote sustainable economic activities that positively impact the local community while reducing the impact of production on forests, (ii) integrate land management into the socioeconomic and political climate, and (iii) fortify management, governance, and technical capacities to ensure the efficient implementation of the REDD+ project.

The project is not located within a jurisdiction covered by a jurisdictional REDD+ program.

The development of the following series of project activities has been proposed after having carefully accounted for the ideas and the wealth of accumulated knowledge particular to the project zone. Among the considered information: a socioeconomic evaluation of the study area (reported from official sources such as the "Scheme for Land Management" and the "Municipal Development

Plans") and the Management Plan of the Regional Integrated Management District (DRMI) of the para of Brazil and surrounding lands," study of an assessment of agents and drivers of deforestation and degradation, collection of inputs from the community, and the expertise of project participant, implementing agency (ARC) and with institutional and community experience, implementation of sustainable development activities will be implemented accordingly as per the proposed plan below in Table 6.

Table 6. Project activities and theory of change

Activity description	Expected climate, community, and/or biodiversity			Relevance to project's objectives
	Outputs (short term)	Outcomes (medium term)	Impacts (long term)	
Capacity building and training	Better understanding of the importance of protecting the forest and how forest conservation will benefit their livelihoods. Opportunity to develop local businesses through an external fund.	In own land illegal activity is minimised and protection is enhanced	Forest is protected Illegal activities are minimized	Improved forest management practices with community participation
Improve local livelihoods for villagers	Diversification of food through agroforestry practices thus an improvement in local nutrition	Improvement in agricultural practices and promotion of income from other activities	Food security is increased Positive impact on	Improvement of livelihoods by capacity building

	More efficient technologies to produce farinha therefore less time is consume in this activity. Generation of income from monitoring activities.		average income	
Improvement of health	Distribution of improved cookstoves to households	Better air quality is ensured in households	Longer life expectancy	Improvement of livelihoods

2.1.12 Sustainable Development

The Project Activity promotes proper handling of the land in the Amazon Biome, contributing to the mitigation of climate change by reducing GHG emissions, by generating e sustainable development through the activities such as capacity building and trainings, reforestation activities, education for younger generation which will support and generate social, climatic and environmental co-benefits. Total of 5 sustainable development goals will be addressed as per the project. Social co-benefits:

Project activities have stimulated an increase in the local workforce employed in the Project Zone (before the project there was only one worker in each section of the property who was responsible for raising 10,000 beef cattle). It has also allowed the specialization and qualification of this workforce and this has produced a wage increase of these workers, with consequent benefits to their families.

Climate co-benefits:

The Project has a positive impact on the micro climate of the region: in fact it contributes, less soil reflectivity, and a reduction in temperatures. This could, as it is done on a large scale, have significant effects on the climate of the micro-region. The project aims to reduce 7,749,856 tCO2e of GHG emissions in the next 30 years of the crediting period.

Environmental co-benefits:

Soil: the Project has a positive impact on the soil, which improves the characteristics, mainly organic matter: this increasing follows the planting and the subsequent cuts because during the harvesting and the selection of the timber abundant vegetable matter (branches and leaves) remains in the location. This wood litter, with natural decomposition, integrates with the soil in the form of organic matter.

Biodiversity:

As for biodiversity in the specific case of the property, there will be an increase in different species of birds (including hawks, woodpeckers, snakes-hunter birds and various species of birds) and mammals (including Anteaters, Tapirs, Deer, Foxes, Wild Boars, Ocelots and numerous species of rodents) can be frequently found in the Project Zone.

2.1.13 Implementation Schedule (G1.9)

Funding for Project activities is secured by funds committed by the Project Proponent until the end of 2018. After 2016 the project is expected to generate enough revenues from carbon credit sale to cover Project costs. The Project financial analysis makes clear how important is the revenue generated through carbon credits to protect the Project Area and to implement the Project activities. The project proponent has made a financial statement to demonstrate their commitment to cover future costs until the project receives credits for the emissions achieved since the Project start date until validation date.

Date	Milestone(s) in the project's development and implementation
1st January 2016	Project start date MoU signed between ARC and TFA (Land owner)
25th June 2016	Consultative meetings with communities – introduction of project aims and requirements
3rd August 2016	Climate change adaptation workshop and presentation of climate change analysis.
21st January 2017	Implementation of biodiversity monitoring plan
28th June 2017	Stakeholder's meeting to complete local stakeholders consultation process for VCS and CCB requirement
10th May 2018	Resource Management Plan completed and signed
17th November 2018	Completion of data collection work and survey for VCS PD
3rd March 2019	Completion of PD and MR
1st June 2019++	Validation and Verification of project activities. ("++" means till the registration of the project)

2.1.14 Project Start Date

The project start date is 1st January 2016. The project start date is based on the time when the project started implementing the planned conservation activities to protect the native rain forest of Amazon which took place immediately after the transfer of the land to a new company.

2.1.15 Benefits Assessment and Crediting Period (G1.9)

Project started on January 1st 2016 and ends on 31st December 2046. 30 years. The benefit assessment period is the same crediting period.

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

There are no anticipated differences between the GHG emissions accounting, climate adaptive capacity and resilience, community, and/or biodiversity assessment periods.

2.1.17 Estimated GHG Emission Reductions or Removals

Year	Estimated GHG emission reductions or removals (tCO_2e)
1	2,21,370
2	2,96,489
3	3,42,703
4	3,32,420
5	3,10,451
6	2,69,718
7	2,77,682
8	2,51,260
9	2,35,914
10	2,21,668
11	2,06,860
12	2,04,739
13	1,97,619
14	1,83,787
15	1,97,998
16	2,03,797
17	2,02,034
18	2,04,809

19	2,06,673
20	2,11,709
21	2,23,953
22	2,22,620
23	2,61,878
24	2,77,818
25	2,77,486
26	2,97,051
27	3,01,952
28	3,19,798
29	3,72,981
30	4,14,618
Total estimated ERs	7,749,856
Total number of crediting years	30
Average annual ERs	258,329

2.1.18 Risks to the Project (G1.10)

The identified risks to the project benefits and outline measures taken to mitigate these risks are described in Table 6.

Table 6. Risks and measures to the project benefits

Risk	**Measure**
Non continuity of the project activities	The project is backed by conservation agreements signed by the owners voluntarily under prior and informed referring to the benefits and commitments to engage in REDD strategy (see folder Land owners Agreements). Likewise, the strategy of permanent communication with the owners and the community and the good results of the project will allow continued ownership of the project by the owners. Any policy changes will not affect our project area since this is being implemented on a private land. The contract has been designed in such a way with the Land owner that even policy changes should not affect the conservation program of the project area. • According to the conservation agreements the land owner is committed to conserve the productive systems implemented in their properties. Also, if a beneficiary want/must sell the land, he/she may transfer the commitments and

	benefits to the new land owner; it will favor the permanence of project benefits regardless the changes in ownership. • Active participation of the community in the project management and the effective communication to show the multiple benefits related to the project in every phase.
Invasion of project land by outsiders	Regular patrols, signage, purchasing of more vehicles to conduct patrols, increasing awareness of community members about conservation and the rules of the resource plan, strengthening and authenticating land rights
Climate change /drought	Reducing deforestation – reduces carbon emissions and creates a better local ecosystem. Diversification of livelihood sources to reduce reliability on livestock.
Weak leadership /governance	Leadership training and capacity building activities for the community leadership and village leadership teams, measures to increase transparency around income and expenditure of funds
Limited allocation of income	Most of the project activities are designed to reduce the maintenance costs and/or increase the profitability of the productive systems. Also, the land owners are trained along with the implementation of the activities, in order to enable that subsequently, the activities can be developed by themselves.
Lack of budget for implementation of activities and / or project monitoring	Most of the project activities are designed to reduce the maintenance costs and/or increase the profitability of the productive systems. Also, the land owners are trained along with the implementation of the activities, in order to enable that subsequently, the activities can be developed by themselves. Amazon Reforestation Consortium has an extensive trajectory in implementing projects with rural communities (especially in the project region) related to forest conservation and productive alternative systems. Therefore, this risk is mitigated based on its certified experience and management and mobilizing resources capacities at the country and international level.
Forest fires and other threats	The land owners are trained by ARC in order to perform the technical tasks in an appropriate manner. Besides, ARC conducts regular visits to the properties which allow them to monitor as well as identify potential risks.
Policy change by local governments	REDD+ may undermine the decentralization of forest management systems in developing countries. Governments could be inclined to recentralize their forest management systems,

	because REDD+ requires governments to establish national carbon-oriented forest management plans, reliable baseline data, MRV mechanisms, and national institutions for the trading and payment of carbon stocks in the forests. If any change happens also will be inclined towards the project development positively.

2.1.19 Benefit Permanence (G1.11)

ARC and its partners have conducted capacity building and training within the communities and Land owners. In addition, project partners are creating monkey corridors and providing job opportunities for the locals in and around the project activity. By creating Animal Corridors, this activity will save them from poaching by the construction of bridges for Capuchin monkey, which were very common in and around the project area but now to the increased rate of deforestation which are under threat and have been listed under endangered species under IUCN. Corridor construction will also help in saving the monkey population by creating them a secure habitat. Reframing and reinvigorating the resource plan Community understanding of the potential for forest conservation to create and maintain native forest.

2.1.20 Financial Sustainability (G1.12)

Through its extensive experience ARC group has developed an operational and management capacity to manage potential contributors (both private companies and donors) such as local Brazilian companies, which will be part of the project leverage. The funds raised by ARC Group were invested in the project implementation activities including community capacity building on technical issues, monitoring and technical follow for the first years. It will allow that subsequently, the activities can be developed by the land owners and the project's climate, community and biodiversity benefits can be achieved, without depending on additional funds that might be obtained in the future.

Projected revenues from GHG emission reductions or other resources, will provide a flow of funds for project´s growth and for achieving bigger project's climate, community and biodiversity benefits.

2.1.21 Grouped Projects

This is not a grouped project activity.

2.2 Without-project Land Use Scenario and Additionality

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

For the determination of the land use scenario in the absence of the Project (baseline scenario) the approved methodology VCS VM0015 version 1.1 was used.

The analysis of deforestation, vector agents and hidden causes, as well as the probable scenarios of land use in the absence of the Project were performed based on the baseline scenario and are detailed in section 3.1.4 of the PD.

The range of potential land use scenarios and the associated drivers of land use changes most likely to occur within the project zone in the absence of the project, are:

- Deforestation for the expansion of livestock activities
- Deforestation for the expansion of the agricultural frontier and crops

In order to mitigate these risks, the project has several proposals for training activities directed to the population with aims at Improving local livelihoods for villagers, Capacity building and training with appropriate and adaptive forestry practices contributing to guarantee security in the intervention area. Improvemnet in their health and education systems.

Moreover, it is foreseen to maintain a better water table level and the precipitations patterns in a microclimate environment by maintaining a forest cover, which at the same time provides protection to extreme events such as reducing the impact during heavy rains, soil erosion and maintenance of the air temperature.

2.2.2 Most-Likely Scenario Justification (G2.1)

In the absence of the project, the most likely activities are livestock development which leads for grazing and expansion of the agricultural frontier; all these activities are practiced traditionally for their survival which gives continuity to management practices that generally they are detrimental to natural resources. This in turn affects gradually the loss of soil fertility, increase erosion and decrease topsoil, and as a result, a decrease in productivity is achieved with unprofitable products. It has also got direct impacts on flora and fauna. Due to native forest loss, we may have to lose many endemic species in the area which leads to ecological imbalance. Illegal logging, deforestation due to the expansion of township and for grazing is going to be continued in the project area without the project activity.

However, these activities continue to perform as traditional methods also involve low capital investment and implementation of known techniques. The age old methods of cultivation, livestock breeding and other old traditional methods of cooking, all these characteristics are most important when taking into account that much of the rural population in the prioritized area corresponds to adult age groups, culturally most established to the knowledge acquired from their parents and less willingness to change their traditional systems production. Without the implementation of this project, the surrounding population will continue the same old traditional methods which leads in deforestation of native forests.

2.2.3 Community and Biodiversity Additionality (G2.2)

The current scenario in the absence of the Project would be limited in generating benefits to climate, community and biodiversity. The scenario without the Project tends to progress to the increase of illegal extractive activities, conversion of forest areas into unplanned irregular occupations, expansion of the area of agriculture and livestock with low productivity and environmental degradation due to the lack of basic knowledge on environment and forests, increasing the

deforestation pressure in the project's area of expansion and gradually advancing towards the boundaries of the Project area.

The present scenario with the development of the REDD+ Project is socially, environmentally and economically positive. Sustainable development activities is an important path for the conservation of forests and for the improvement of the local economy of communities. The Project seeks to improve lifestyle management of locals, revenue generation and control of the forest loss by conducting proper training programmes annually. In the area of agriculture and livestock, agroecological production techniques, increased productivity in smaller areas and the strengthening of production networks can contribute to reductions in environmental impacts, as well as enhancing socioeconomic improvements for the region's population.

The role of education in the project scenario is extremely important, and access to schools, vocational and technical courses should provide better conditions of employment and income. In addition, incentives to develop sustainable forest management practices reduce forest stress.

The project, together with its mechanisms, guarantees the permanence of the forest and the consequent conservation of biodiversity, maintenance of ecosystem services, water quality and climate regulation. In the scenario without Project, the forest environment is being replaced by areas that are more and more anthropized through deforestation (FEARNSIDE, 2006) As explained about the scenarios, which is presented with and without REDD, through secondary data, the importance of the implementation of the project and development of the Project is reiterated.

The scenarios outlined above are in consistent with enforced mandatory applicable laws and regulations of the country. Project area is a private land which is in line with the approval of the district governments of Paragominas. Project would not have been implemented due to financial constrain, ARC has taken initiative and have invested significant VCS and CCB expenses prior to project registration under VERRA considering the future VCS revenue to implemented the planned activities under REDD+. Even though the old and new version of the Brazilian Forestry Code indicates that 80% of the forest within a privately owned area should be preserved, it is well know from the literature and re-affirmed by our historical analysis with Landsat TM imagery and interviews with local experts that such regulations is weakly enforced.

However, no national or district government funds are made available for the management of the project, nor are there any finance requirements imposed on the management of native forest lands.

For further details on Project additionality for community and biodiversity can be found in sections 4.1.4 – Without-Project Scenario: Community and 5.1.3 – Without-Project Scenario: Biodiversity.

5 (Fearnside, Philip. (2006). Dams in the Amazon: Belo Monte and Brazil's Hydroelectric Development of the Xingu River Basin. Environmental management. 38. 16-27. 10.1007/s00267-005-0113-6.).

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

Not Applicable

2.3 Stakeholder Engagement

2.3.1 Stakeholder Access to Project Documents (G3.1)

The ARC REDD+ Project has determined three methods of communication with the parties involved, aiming to guarantee access to documents and all other information of the Project through oral, written and virtual form, as described below.

Writing: a printed version of each document related to the Project, such as the Project design document, monitoring report, validation and verification report and the summary will be available for consultation at the ARC office. Information and news about the Project are disclosed through local public notices.

Virtual: documents related to the Project are available through virtual means on the VCS and ARC company websites. The circulars of the project and ARC REDD+ are also digitally accessible. News and novelties about the Project will be published in the ARC and Dacko newsletter through social media.

Oral: information and news about the Project will also be conveyed orally at REDD+ Technical Board events through meetings between the community council of agricultural communities and technicians as well as other opportunities for contact between stakeholders and project proponents.

The communities that are not directly involved in the development of the Project, but which are part of the Project area, will receive important information about the Project from similar dissemination tools.

2.3.2 Dissemination of Summary Project Documents (G3.1)

Summary documentation describing the proposed project activities and its requirements have been translated into Portuguese shared with all community groups at all levels of administration through consultative workshops and specific training sessions. ARC group has set in place a Carbon Champions program, training young men and women from each of the five villages in climate change and project development. These carbon champions have travelled to all villages and sub-villages to inform people about this REDD project.

2.3.3 Informational Meetings with Stakeholders (G3.1)

During all consultation aspects of the climate change and carbon markets were addressed by providing information and general concepts in simple language that could be understood by all participants. The documentation and information regarding the Project was made available to the community through the following mechanisms:

• At the beginning of each meeting, participants received a summary sheet of the Project for them to understand the Project.

• During the meetings aspects related to forest carbon project, specific project activities and participants were explained.

• There were question and answer sessions after the talks. The questions of the participants were resolved and all observations were heard and taken into consideration.

• The information provided, included contacts (phone number and email) of the people in charge of the Project documentation (project developers), in order to give the attendants, the possibility to permanently communicate their concerns or comments.

• Once the project document is ready, it will be published on the website of the CCB for public Comments.

In addition to the topics mentioned above, during the local consultation were analysed the possible impacts that the project might have on individual or collective actors in terms of economic, social and biodiversity aspects. This analysis was performed through the use questions, comments and opinions regarding to the exposed topics. The result of the evaluation, assigned to each impact a rating of positive, negative or neutral according to the effect on the quality of life of each participant.

During the local consultation, all participants were informed about the validation and registry process while pointing out that an external auditor (a validation and verification body) who visits the area of influence executes this process, interacts with stakeholders, evaluates the project information and issues a report of the evaluation.

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

Through carbon benefits workshop all participants were explained the benefits of the project and the potential costs and risks that they could perceive due to the implementation of the project. However, the project activities have been designed in conjunction with the owners in order to minimize possible negative impacts.

In addition, in every consultation workshop each participant interested in being involved in the project received an “Intention letter” which they voluntary signed to continue with the process of visit their properties and evaluate whether their areas are eligible for the project purpose.

On the other hand, there were also people who wanted to evaluate their participation and talk with their respective families, so that they were given the possibility of carrying the letter of intent and then a ARC group technician would pick up the letter from the concerned. Finally, during all the workshops they were repeated that participation in the project is totally voluntary.

During sessions in August 2016 focussed on how the proposed project would affect the communities, what the communities would have to put in place to qualify for carbon payments and how project activities relate to existing land use plans and user-rights conferred to the villages through the creation of the Wildlife Management Area the communities identified 4 areas of risk involved with participation in the project;

Area	Risk	Mitigation
Grazing	Better quality grazing could attract others to the area and lead to increased pressure	The resource management plan plays out the rules for incursions by non-natives into the community grazing lands
Finance	Increased revenue could lead to corruption and theft	ARC structure includes checks and financial transparency will be a linchpin of all project dealings and activities
Culture	Project could threaten the ancient culture in the area due to exposure	The project is based on the resource management plan which was designed by the communities specifically to protect their culture and traditional natural resource uses
Land use	The project could affect the way land is used in the community and restrict access	The project is based on the resource management plan which was designed by the communities specifically to protect traditional land uses

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

The validation and verification process was explained during the local consultation workshops. A power point presentation was used, and when performed in areas where there was no electricity, billboards with the same information were used. In this way, ensured that all participants will always receive the same information about the project cycle.

During the local consultation process, all participants were informed about the mechanisms that generate Carbon Credits and the validation and registry process while pointing out that an external auditor (a validation and verification body) who visits the Project Area and executes the process, interacts with stakeholders, evaluates the Project information and issues evaluation reports.

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

Referring to the Project Proponent, has maintained constant and direct communication with the Land Owner in order to give the guidelines and clarity aspects related to the project cycle, including validation, registration and project monitoring. We have explained to the stakeholders of the property, the project process is in a comprehensive way giving the timing for the visit of the DOE. The Forest Operations Manager, will take in charge of collecting comments from the workers of any kind of questions to be asked to the DOE during the site-visit.

2.3.7 Stakeholder Consultations (G3.4)

The Project designed its activities based on the results of the PRA. It was intended since the beginning to develop activities that were tuned with local livelihoods and the best way to do so was by first consulting with local stakeholders.

Within the framework of the project, one local consultation workshops were held to socialize the objectives and scope of the project and identify the owners interested in being part of this initiative.

The workshop was held during August 2017 in the municipalities of Paragominas. The objectives of socialization were:

- To inform all local actors, partners of the REDD + project, new industries initiators in and around the project boundary

- Explain the project's climate, community and biodiversity objectives.

- Disseminate the relationship between deforestation and climate change, forest carbon projects, voluntary carbon markets, tools and strategies to mitigate climate change.

- Explain the requirements to participate in the REDD + initiative.

- Identify the perceptions of the community.

- Identify landowners and potential beneficiaries of the project.

- Participatory identification of potential project activities.

The convocation process was carried out by means of radial broadcasting, physical invitations and direct telephone calls with the presidents of the Community Action Board of the paths.

Considering the recommendations of the presidents of TFA Board the most appropriate time, place and time for the meetings were arranged, in order to facilitate the assistance of the owners and the community in general. The workshops were developed in the rural area of the municipalities.

During the local consultation the aspects of climate change and carbon markets were addressed by providing information and general concepts in simple language that could be understood by all participants.

Figure 20: Workshop in TFA office

The documentation and information regarding the project were made available to the community through the following mechanisms:

• At the beginning of each meeting, participants received a summary sheet of the project (Figure 20).

• During the meetings aspects related to forest carbon projects, requirements to participate, REDD+ mechanism and potential project activities were explained.

• Question and answer sessions were developed after the talks. The questions of the participants were resolved, and all observations were heard and taken into consideration

• Contacts (phone number and email) of the people in charge of the project documentation (project developers) were delivered, in order to give the attendants, the possibility to permanently communicate their concerns or future comments.

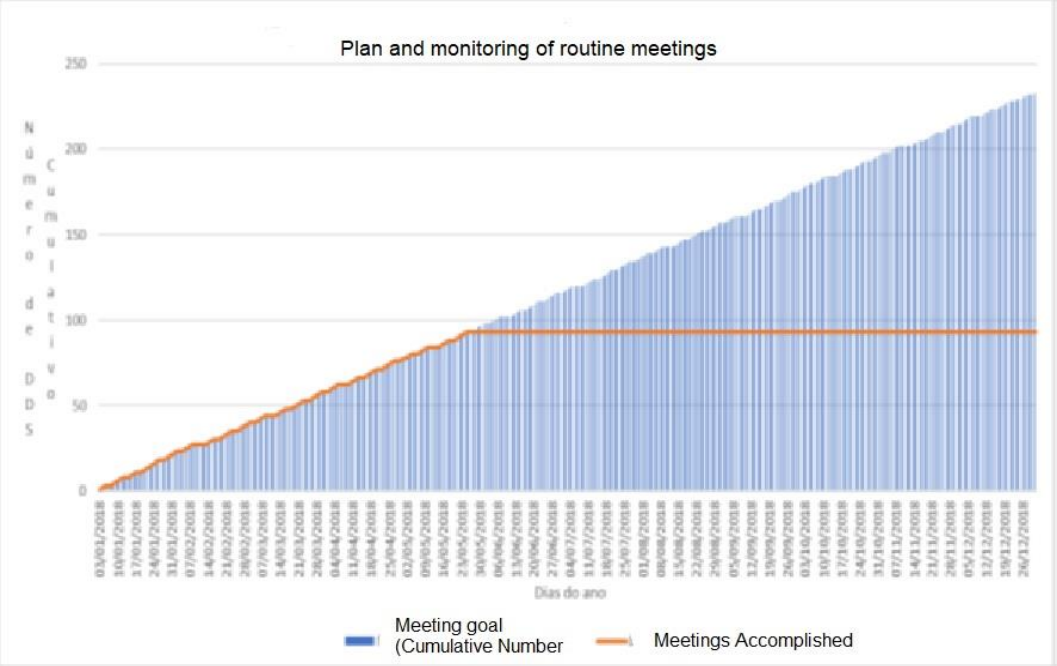
• At the end of the local consultation, attendees were informed about the process to follow up on questions, concerns and / or comments raised at the workshops; which consist in incorporate the relevant comments to the design of the project development.

2.3.8 Continued Consultation and Adaptive Management (G3.4)

Weekly meetings will be conducted to address all aspects from the carbon credit projects, about fire prevention and other sustainable plans.

The updated meetings and project status will be both open to the workers and their families, as well as the communities and their families and also to the town members. The following figure 21, shows the dates of training for 2018.

Figure 21: Meeting schedules held in the year 2018



2.3.9 Stakeholder Consultation Channels (G3.5)

ARC has conducted a number of stakeholder engagement and consultation meetings with identified project communities and other stakeholders from the nearby villages and settlements. Our project staffs have conducted participatory surveys with the Participatory Rural Appraisal (PRA) method as part of the consultative process. This included focus group discussions (FGDs), interviews with men and women living in nearby settlements and villages, and observation and ground checks with local residents including participatory visits to a variety of important areas and community epicentres.

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

The project proposes to conduct a process of FPIC to continue the informative process initiated with the PRA in order to promote a reasonable understanding about the project and their activities, an equitable participation in decision-making processes and the involvement of the population in

the implementation of the proposed project. Consultations ensure to engage with both men and women, and more marginal stakeholder groups in culturally appropriate ways to ensure that the project can hear a wide range of perspectives.

2.3.11 Anti-Discrimination Assurance (G3.7)

ARC has company policies to prevent discrimination and outline a course of action, should it occur, the human resource (HR) policy provides a clear statement on discrimination relating to gender, religion or sexual discrimination. Discrimination is considered a level A misconduct under the HR policy. Where discrimination occurs within the company, partner organisations or within project areas (project participants), actions are outlined in the grievance policy to ensure that any discrimination is dealt with by the senior management. All company employees and field partners sign a code of conduct with ES that includes anti-discrimination.

2.3.12 Feedback and Grievance Redress Procedure (G3.8)

TFA and ARC has a clear grievance redress mechanism which is outlined in the company grievance policy. The grievance policy is also part of the files kept at the ARC office. The policy defines a grievance and its scope and outlines both an informal and formal procedure for managing grievances. Under the informal procedure, affected person first discuss with a director or another member of the management team. The director will attempt to resolve the grievance on an informal basis, taking advice if necessary from other parties. The director and affected person will work together to resolve the problem. If a grievance cannot be resolved via informal discussions, the formal procedure may then be used. The formal procedure requests the grievance to be in written form (or if not possible, by telephone to the director). An investigation is arranged within 1 week (7 days) to gather additional information, followed by a grievance hearing. The hearing should occur within 10 working days of the investigation being completed. Additional details, including the contact numbers of the directors, are included in the grievance policy, available in both English and Portuguese.

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

Accessibility of the feedback and grievance procedure is ensured as grievances can be reported at multiple levels. Individual community members have direct communication access to ARC group staff, the community has bi-annual meetings designed for this specific purpose, and the leadership have direct formal channel to air grievances and general feedback. Landowners will also engage in this process, as they are highly active at the grassroots level in the community and are a neutral group. Furthermore, the concept of feedback and grievance and the channels of using the mechanism have been explained to the community at all these levels.

The person in charge of the feedback and grievance redress procedure (for both channels mentioned in section 2.3.12) must be available during the days and times previously agreed with the community, to receive and / or make calls. In addition, he or she will be responsible for maintaining the registration forms of communication duly completed and digitized.

Besides, the contact information was provided during the local stakeholder's consultation. This should allow direct communication with property owners and answering questions that will arise during the project implementation.

2.3.14 Worker Training (G3.9)

ARC group has extensive experience in conservation and community development projects. The activities of the Project have been designed to transfer knowledge and technological packages to the owners involved in the project through workshops and the direct activities developed in each of the properties.

ARC RMP is designed to promote sustainable community development and to consistently improve the quality of conservation. ARC WMA is committed to involving the community in its program of work, and to contributing toward sustainable local development. There is a preference for hiring local people. Candidates from the local community who meet a position's requirements are given preference in hiring decisions. It is important to note that there is a lack of individuals with advanced technical or professional studies in the local area and therefore this type of service has to be contracted from outside the communities.

To fulfil the worker responsibilities, the recruiting manager is responsible for integrating and managing confidential personnel information, verifies information provided and drawing up contracts. Once hired, the staff goes through a trial period. For the selection of officials, the human resources team will have the principle to find qualified and reliable staff whose skills are in line with the requirements and objectives of the company, through technical, transparent and non-discriminatory procedures, based on merits and excellence.

All ARC WMA personnel receive training through the administration and operations program when they are hired, including content related to professional ethics and conduct as part of the institutional culture. Staff evaluations and staff training are part of the RMP. New employees are informed through briefing about their legal rights, anti-discrimination laws and policies and methods of resolving problems and formalizing complaints within the organization. With regards to adherence to host country laws regarding workers' rights, the project proponent, to the best of its knowledge, complies with all relevant national laws, including labour laws.

At the end of the training, the workers sign the participation document and specific certificates are given to each worker who, in addition to attesting their participation, also have the function of enhancing the person and increasing the professionalizing process of each participant.

2.3.15 Community Employment Opportunities (G3.10)

For hiring staff, the ARC verify that the person meets the hiring profile established for the vacant position, without any discrimination of age, sex, marital status, ethnicity, social status or religious convictions, political ideas and / or sexual orientation. It is not allowed to employ under age young people (18 for Brazil).

To full-fill their responsibilities, the ARC is responsible for integrating and managing confidential personnel information, verify information provided and drawing up contracts. Once hired, the staff goes through a trial period of 90 days (as expected by law). For the selection of officials, the Project Owner will have the principle to find qualified and reliable staff whose skills are in line with the requirements and objectives of the company, through technical, transparent and non - discriminatory procedures, based on merits and excellence.

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

Local villagers will receive clear and adequate information about the requirements of national and international regulations on workers' rights before entering in a contract agreement with ARC.

AR will make sure to comply with the applicable national regulations on workers' rights. This will be assured by yearly audits held by a third party that will be identified once the project starts its census in the area. Such audits will be announced to local authorities and villagers and they will be encouraged to meet with audit entity. This way, local people can rest assure that all their complaints about workers' rights are known in a straightforward and clear way.

The labour laws in Brazil, although they have previous origin, are born in the government of Getúlio Vargas. From the year 1930, President Vargas joined a group of lawyers and legislators to elaborate the Consolidation of Labour Laws - CLT.

The labour laws of Vargas's era, as they are also called, took 13 years of development, and sought to guarantee a series of securities and regulations in the relationship between employers and employees.

Since 1943, the CLT has undergone a series of modifications - natural, in Law. The Labour Laws in 2015 best represent the new labour relations, and the main changes relate to new technologies, and their use in work.

There are a number of issues addressed in the CLT, but some stand out due to the advances that have accrued for the living conditions of the working classes and to the systematization of the Brazilian labour market.

Undoubtedly, the CLT is one of the greatest examples of a law that is concerned with the worker. The following are the main Brazilian labour laws:

- Law 605/1949 - Repouso Semanal Remunerado (Paid Weekly Rest);
- Law 2.959/1956 - Contrato por Obra ou Serviço Certo (Contract for Work or Right Service);
- Law 3.030/1956 - Desconto por Fornecimento de Alimentação (Discount for Food Supply);
- Law 4.090/1962 - Gratificação de Natal;
- Law 4.749/1965 - 13º Salário
- Law 4.886/1965 - Representantes Comerciais Autônomos (Autonomous Business Representatives);
- Law 4.950-A/1966 - Remuneração de Profissionais (Engenharia, Química, Agron. e Veter.) (Remuneration of Professionals (Engineering, Chemistry, Agron. And Veter.);
- Law 5.859/1972 - Empregado Doméstico (Housekeeper);
- Law 5.889/1973 - Trabalho Rural (Rural Work);

▪ Law 6.019/1974 - Trabalho Temporário Urbano (Temporary Urban Work);

▪ Law 6.494/1977 - Estagiários (Trainees);

▪ Law 6.919/1981 - FGTS de Diretores (FGTS of Directors);

▪ Law 6.932/1981 - Médicos Residentes (Resident Doctors);

▪ Law 7.418/1985 - Vale-Transporte (Transportation vouchers);

▪ Law 8.036/1990 - Lei do FGTS (FGTS Law);

▪ Law 8.906/1994 - Advogados (Lawyers);

▪ Law 9.601/1998 - Banco de Horas e Contrato por Prazo Determinado (Bank of Hours and Contract for Term Determined);

▪ Law 10.101/2000 - Participação dos Trabalhadores nos Lucros ou Resultados (Workers' Participation in Profits or Results);

▪ Law 10.607/2002 - Declara Feriados Nacionais (National Holidays);

▪ Law 10.748/2003 - Programa Primeiro Emprego – PNPE (First Job Program);

▪ Law 10.820/2003 - Desconto de Prestações em Folha de Pagamento (Discount on Payroll Benefits);

All these laws aim to achieve justice in the relations arising between employers and workers, under a spirit of economic coordination and social balance. All hiring processes that occur inside the Project are governed by the labour code, in addition to the internal quality system that has processes and procedures associated with the management of human resources.

As mentioned before, all workers have a contract, in which its duties, rights and laws that protect them are reported.

2.3.17 Occupational Safety Assessment (G3.12)

Work within ARC group and on-site includes low-level risks typically associated with activities conducted in sites with little infrastructure and irregular conditions. The level of risk varies depending on the type of employment in ARC group and the associated activities, although none of the work requires undue exposure to risks. Work in the ARC group does not require the operation of heavy machinery or vehicles larger than the rangers' pickup trucks. All ARC group field staff have first aid training and all vehicles carry first aid kits. ARC group through land owner structures provides assistance to injured project participants. ARC group policy instructs participants to avoid to the best of their ability situations which pose unnecessary risk to personal safety. As participants live with-in and often traverse the landscape risks like exposure to dangerous animals, snake bites, etc. are unaffected by employment in the ARC group. ARC group discourages the use of weapons in any project related activities.

2.4 Management Capacity

2.4.1 Project Governance Structures (G4.1)

The current governance structure of the project is composed of the project proponent and landowners:

Project Proponent: Amazon Reforestation Consortium

- Coordinates owners of the land around the project.

- Represents landowners

- Sets conservation agreements with the owners

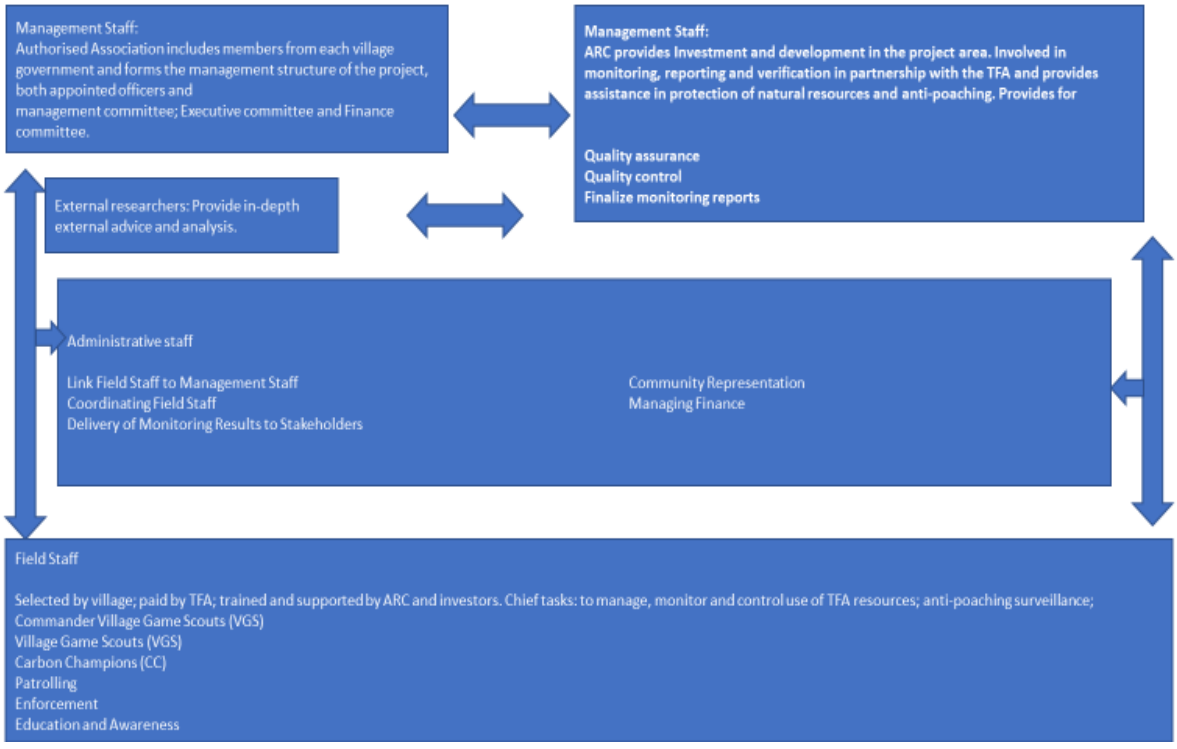
- Manages resources for implementation

- Hires / implements project activities

- Hires / implements the monitoring Project

Landowners

The land owners are linked to the project by the conservation agreements signed between each of them and the Project Proponent. Their participation in the project is completely voluntary, through free, prior and informed consent and through free commitments and the benefits expected. Management capacity is explained below;



2.4.2 Required Technical Skills (G4.2)

Project participants and their activities are summarized below;

• Knowledge of the region and social science / local community related skills like handcrafts.

• Experience in sustainable practices for local / rural development, conservation and management of biodiversity and ecosystem services.

• Knowledge in planning, execution and control of administrative and financial resources. Extensive experience and skills in managing resources from donors and co-operators.

• Experience in carbon markets, VCS and CCB standards.

• Experience in biodiversity monitoring, sampling methods of wildlife and ecosystem assessment using quality indicators.

• Extensive experience in working with the community and environmental education.

• Knowledge of the area and experience in field implementation of restoration activities, crop improvement, woodlots, silvo-pastoral systems, efficient stoves and solar power panels.

• Abilities to manage the geographical information system and databases of property owners, as well as to generate all required cartographic analysis.

2.4.3 Management Team Experience (G4.2)

Michael Greene – Project Coordinator and project developer. Is currently responsible for the general coordination of the project. He has a Bachelor's degree in Industrial Engineering from Kettering University in Michigan. He has lived in Brazil for 10 years, consulting related to complex real estate situations. Michael's specialty is the coordination of the program plots for the poor. This is a program to help each family gain title. He oversees an engineer and geomancer team of 4 people in the field and 2 people in front of computers, categorizing each family and there their plots of land where they are located. He also directs the security boat patrols and is taking quotations from companies to build 30 security houses within the project area. He has also got wide experience in developing REDD+ projects in Brazil before. He has developed more than 2 projects under REDD at Brazil.

Carla Campos – Social Director, is currently responsible for coordinating, managing and implementing the social aspects of the project. She has a Bachelors of Science in Biology, and a Master degree in Anthropology from the Federal University of Pernumbuco. She has worked over the last 20 years in numerous projects involving traditional people, indigenous people, and environmental projects. She has numerous publications under her name. She has been contracted by numerous organizations in the last 20 years to implement projects similar to the ARC project.

Vanderley de Oliveira- Twelve years ago moved to the North of Brazil, started a tree nursery and gained a reputation for good ethics. Today that nursery produces between 20 and 25 million trees per year. He is responsible for all training and other implementation programs in the project area.

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

Transportadora Florestal do Araguaia - TFA Reflorestamento LTDA (TFA) – Land owner and company registered in Brazil, works to empower marginalised people in the forests of Brazil and focusses to conserve natural resources and reforestation activities in Brazil.

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

The ARC has experience of developing and marketing REDD+ projects on the global market, and has used this applied experience to form conservative estimates for expected annual credit sales for the many REDD+ Projects. Additionally, the ARC's combined REDD+ project development experience have contributed to a detailed financial model for the development and management of the Project. Predicted credit sales and an accurate estimated annual budget demonstrate sufficient cash flow from predicted contracted sales to sustain the project through the end of the crediting period. ARC team developed the project through a US based investors in partnership with other organisations within the State of Para in Brazil. Documents supporting these investments can be produced to the project auditor for inspection. ARC has equity investors and a concise business plan and financial modal that are available on request. The company is with the full financial where with all to finance and manage the entire project due to its large financial asset base.

The project partners are all well-funded, sufficiently capitalized organizations, and include a major companies support like Dacko Nursery and TFA with impressive histories of financial sustainability.

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

All forms of bribery and corruption are prohibited. ARC group will not tolerate any act of bribery or corruption. Any breach of ARC group company policy on corruption and unethical behaviour or local law could result in disciplinary action being taken. A bribe does not actually have to take place - just promising to give a bribe or agreeing to receive one is prohibited.

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

There is no commercially sensitive information in this project description document. Supporting documents which include commercially sensitive information that will not be made publicly available include: the MOU; Contracts with Buyers and Service Providers; and documents related to project financials.

2.5 Legal Status and Property Rights

2.5.1 Statutory and Customary Property Rights (G5.1)

All project lands are private property managed by the land owners who are engaged to the project through a free, prior and informed consent. Land does not belongs to any indigenous and traditional communities or

to the government. The conservation agreements signed freely between ARC group and the owners are the result of the socialization workshops and the commitment of both parties.

Currently there aren't any laws or regulations related to REDD projects in Para or Brazil (Santos et al. 2012). Nevertheless, the following area the regulations that apply to conservation activities in privately owned land such as the case of this Project:

- The Principles and rules established in the Federal Constitution.
- The Brazilian government signed an agreement with the United Nations Framework Convention on Climate Change (UNFCCC) ratified by the Legislative Decree n° 1 on February 3rd 1994
- Federal Law n° 12.187 from 2009 (which institutes the National Policy on Climate Change), the Federal Decree n° 7390 from 2010 (which regulates the National Policy on Climate Change) as well as all the legislation related with the aforementioned legal instruments.
- Federal Law n° 6.938 from 1981 about the National Environmental Policy.

2.5.2 Recognition of Property Rights (G5.1)

The property rights for each parcel are recognized and respected. All properties involved in the project either have property titles or equivalent documents to certify and assure rights over the land. Within the project area, there are no communities of Brazil or indigenous heritage with collective property titles.

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

The free prior informed consent (of the appropriate holders of property rights and other stakeholders) has been applied throughout the implementation period and will continue to be applied throughout the duration of the ARC REDD Project. The property where the Project is located has a vastly larger area than the area used for the Project activities and there is no interference in the surrounding properties. In addition, the Project does not aim to develop any activity on private property, belonging to indigenous and traditional communities or to the government. In relation to social activities and monitoring of biodiversity, it is guaranteed that no activity will be carried out without the free, prior and informed consent of the parties involved.

No activity related to the Project will result in the involuntary removal or relocation of the Property Rights Owners of their lands or territories, nor will force them to relocate activities important to their culture or livelihoods. Any proposed removal or relocation takes place only after obtaining the Free Prior Informed Consent from the appropriate Owners of Property Rights.

In addition, all the stakeholders that could be impacted in some way by the ARC REDD Project were consulted. In the communities related to the Project, workshops were carried out in order to pass information about the Project, as well as consultations regarding the opinions of the community about the Project. These consultations will continue throughout the life cycle of the Project. In addition, all information about the ARC REDD Project can be acquired in virtual channels, such as

Dacko website and newsletter by social media such as Facebook and LinkedIn, ARC office and TFA Group.

2.5.4 Property Rights Protection (G5.3)

The project activities do not lead to any type of involuntary relocation or relocation because all the participants / owners own their land and present documents that accredit it. In addition, ARC group has informed in all the socializations that at no time will be made purchase of land. Finally, the conservation agreements signed freely between ARC group and the owners are the result of the socialization workshops and the commitment of both parties to identify and define the activities that will be developed in each one of the farms; which ensures that they have not been forced to relocate activities important to their culture and livelihood. At the same time, one of the measures implemented by the project proponent is to maintain constant communication with the owner.

2.5.5 Illegal Activity Identification (G5.4)

In the baseline scenario, the illegal deforestation practised in the project area generates problems related to a scenario without the project. The project aims to prevent these illegal practices by means of a set of activities aimed at the conservation of the forest.

Illegal activities in the area are constituted by unplanned timber extraction. Such logging operations are eventuated by the proliferation of pioneer roads between nearby project area and Belem. It is known from literature that extractive operations will take advantage from the fact that local farmers don't have land titles to displace them or to gain access to the forest resources nearby villages (Araujo, Bonjean et al. 2009) At the same time, illegal logging operations thrive whenever there are forested areas that seem to be under no-use and where the presence of the landowner is not made evident (Margulis 2004)

6 (Claudio Araujo, Catherine Araujo Bonjean, 2009. Property rights and deforestation in the Brazilian Amazon. Ecological Economics, vol. 68:8-9(2461-2468)

7 (Margulis, Sergio. 2004. Causes of Deforestation of the Brazilian Amazon. World Bank Working Paper;No. 22. Washington, DC: World Bank).

The project will train local villagers to work as a monitoring staff inside the project area and at the LMA. This is one of the main activity to identify, prevent and avoid illegal activities which was taking place in the project area.

As support measures against illegal activities, the Project will provide land titles against conservation results to villagers living within the Project Boundaries and will provide support to neighbour villagers to achieve land tenure on unused public lands, this was discussed with the farmers and the stakeholders during LSC process.

Stakeholders in neighbouring villages will be encouraged to report encroachers and illegal loggers trying to get into nearby forests. The project will help to make the respective denounce to local authorities in case such type of the situation is occurring in the project area. Through this mechanism the project will be generating positive leakage.

2.5.6 Ongoing Disputes (G5.5)

The project has no ongoing disputes.

2.5.7 National and Local Laws (G5.6)

Brazil is one of the signatories of Kyoto protocol. The project is in compliance with this regulatory framework, because in the AFOLU scope, conservation is one of several mechanisms by which GHG emissions are expected to be reduced.

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.

• 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 Défense 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 Aquafarming.

(Reference: http://domhelder.edu.br/revista//index.php/veredas/article/viewFile/1316/24704)

2.5.8 Approvals (G5.7)

The Project is developed on privately owned land and complies with all the required laws and regulations regarding forest protection in private lands. Given the fact that in Brazil there are not regulations regarding REDD projects and the fact that the Project will not undertake extractive activities but will preserve 100% of its Project Area, permits are not required from municipal, state or federal authorities.

The REDD initiative in Paragominas, Ulianopolis and Nova Esperanca do Piria is a precedent created that will encourage new REDD projects and strengthen the existing ones towards a solid and robust system in Para. For this reason the Project –although not required to do so yet- will make arrangements to inform about its activities to local institutions at state and federal level.

To this end, the Project will design a strategy to properly identify and approach institutions that most likely will have key roles in a potential REDD framework in Paragominas or in Ulianopolis or in Nova Esperanca do Piria.

During the preliminary social evaluation, the informed consent about the development of activities for the study, the design of the project and its latter implementation was obtained from 19 leaders and local authorities.

The population has also been adequately informed and has actively participated in the elaboration of a diagnosis through the participatory workshops carried out in 5 localities and in which 56 settlers have participated and have expressed their main needs and local priorities. During these activities the population was consulted about the implementation of the project being studied and has manifested much interest in participating in it.

In addition to this, it has been planned to carry out a participatory census in the entire project zone in order to have a complete and appropriate participation before the beginning of the social activities of the project. During this census, several meetings will take place with the local leaders from all the communities involved in the project area boundaries. Assemblies with the population will also be developed in order to inform the details of the activities of the project and the PRA results will be shared.

By the end of each participatory workshop, the free and informed consent for the project implementation from each village will be requested. Such free and informed consent will be registered through and act with the signature of each village. This document will be filed in an electronic version as well as a hard copy by the time of the first verification.

2.5.9 Project Ownership (G5.8)

The ownership of the lands inside the project area is supported by legal documentation (see folder: contract between ARC group and the land owner (TFA)).

Through the signing of the letters of intent, the land owners and ARC group (as the project proponent) agree that the benefits generated by the reduction of greenhouse gas (GHG) emissions, will be used to give continuity to the project and expand its scope. This will be managed by project manager with the participation and follow-up of the community.

Also, ARC group signs voluntary agreements with other project owners (outside the project area, but inside the project zone). These project owners are supported throught the implementation of the project activities in their lands. Despite the agreements are signed for a period between 3 to 10 years, these will be subject to periodical and conditional renewal, according to the medium-term results.

2.5.10 Management of Double Counting Risk (G5.9)

To date, the State of Pará, Brazil does not have a defined State REDD+ Strategy or any Forum for Climate Change registry, that would be the main organization to lead discussions on the subject, is currently inactive. In addition, the State Government does not provide formal procedures for registering or recognizing private voluntary projects under any jurisdiction REDD+ project. Also, the project does not intent to get the project registered any other carbon market registry. Hence, it is concluded that there will be no issues of double counting of carbon credits generated from the project.

2.5.11 Emissions Trading Programs and Other Binding Limits

Does not apply.

2.5.12 Other Forms of Environmental Credit

The ARC REDD Project is not intended to generate any other form of environmental credits related to the reductions and removals of GHG emissions claimed under the VCS (Verified Carbon Standard) program.

2.5.13 Participation under Other GHG Programs

The ARC REDD Project did not receive or sought to be registered in any other GHG program, in addition to submitting the Project to validation and verification in the VCS (Verified Carbon Standard) and CCBS (Climate, Community and Biodiversity Standard).

2.5.14 Projects Rejected by Other GHG Programs

The ARC REDD Project has not undergone validation/verification of any other GHG program and is therefore not rejected by any other GHG program.

2.5.15 Double Counting (G5.9)

The carbon credits generated from the project will be registered under the Verified Carbon Standard and sold under that mechanism. Credits from the project will not be registered or sold under any current regulatory scheme, as these schemes currently do not allow REDD credits to be sold. If and when the credits become eligible under a regulatory scheme, the proper procedures will be taken to ensure that credits are not sold twice.

3 CLIMATE

3.1 Application of Methodology

3.1.1 Title and Reference of Methodology

- VCS Methodology for Avoided Unplanned Deforestation (VM0015 v1.1), sectoral scope 14, Agriculture, Forestry, Land Use.

- VCS-approved VT0001Tool for the Demonstration and Assessment of Additionality in VCS AFOLU Project Activities v3.0.

- VCS AFOLU Non-permanence Risk Tool: VCS Version 4

- Climate, Community & Biodiversity Standards (CCBS) v3 and VCS v3.3

3.1.2 Applicability of Methodology

Table 7: Applicability conditions of the methodology VM0015

Condition	Applicability
a) Baseline activities may include planned or unplanned logging for timber, fuel-wood collection, charcoal production, agricultural and grazing activities as long as the category is unplanned deforestation according to the most recent VCS AFOLU requirements.	Baseline activities include unplanned utilization. This scenario considers the conversion of native forest areas into agriculture and pasture through unplanned deforestation.
b) Project activities may include one or a combination of the eligible categories defined in the description of the scope of the methodology (Table 1 and Figure 2 of the methodology).	At a baseline deforestation, an "old growth forest with logging" (mature natural forest with logging activities). This implies a protection scenario with charcoal production, extraction of firewood and controlled forest extraction (Baseline C).
c) The project area can include different types of forest, such as, but not limited to, old-growth forest, degraded forest, secondary forests, planted forests and agro-forestry systems meeting the definition of “forest”.	The Project Area includes only forest according to the definition of Brazil. (According to the UNFCCC, Brazil’s definition for forest is 1 hectare with 30% crown cover and 5 meters tree height.
d) At project commencement, the project area shall include only land qualifying as “forest” for a minimum of 10 years prior to the project start date.	At the beginning of the forest, the project area includes only forest more than 10 years back according to the definition of forest of Brazil that consider a minimum of land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use. (unfccc.int). Landsat TM images from more than 10 years before the Project start date have been analyzed to

	identify only forested areas according to Brazil's definition of forest. From the year 2000 to the start date 2016.
e) The project area can include forested wetlands (such as bottomland forests, floodplain forests, mangrove forests) as long as they do not grow on peat. Peat shall be defined as organic soils with at least 65% organic matter and a minimum thickness of 50 cm. If the project area includes forested wetlands growing on peat (e.g. peat swamp forests), this methodology is not applicable.	The Project does not include forested wetlands.

http://cdm.unfccc.int/DNA/index.html)

3.1.3 Project Boundary

The physical locations where project activities take place are presented below (Figure 26 and Figure 27): project boundary and leakage management areas.

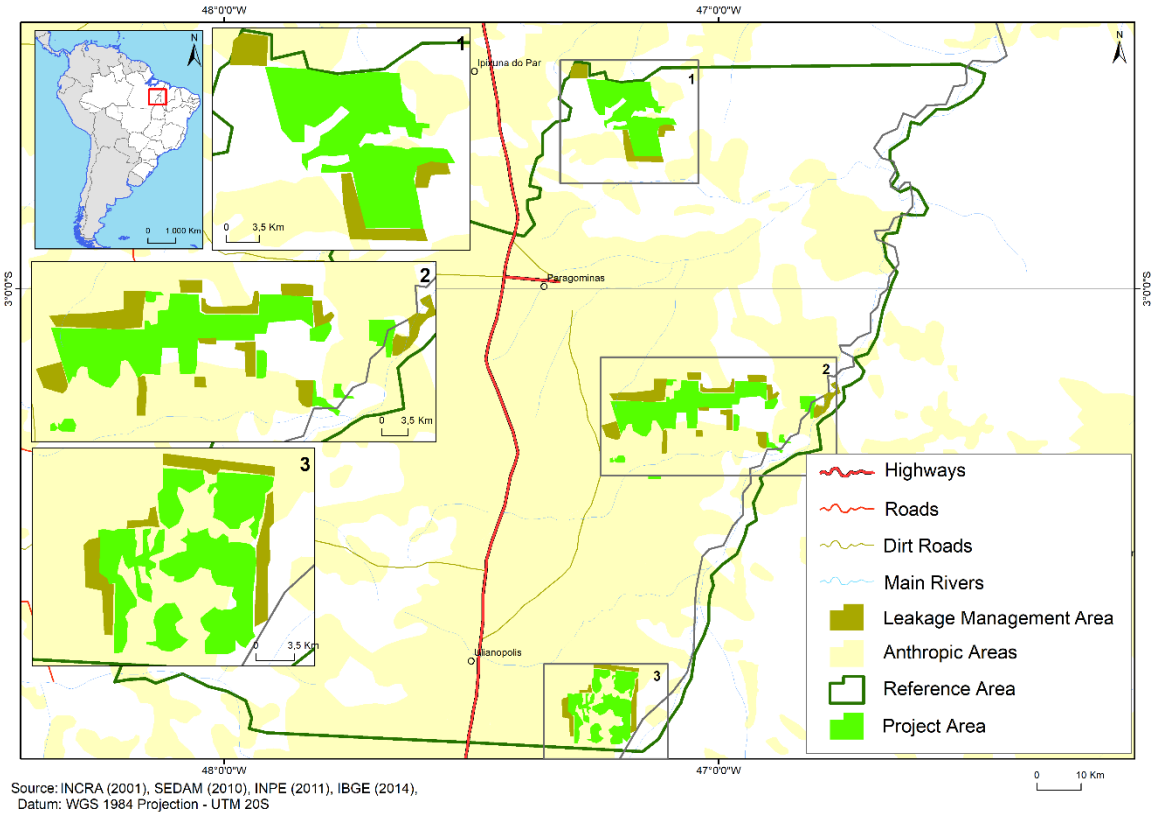
Step 1.1 of VM0015 Project Spatial Boundaries

Region of Reference

The reference region is the spatial boundary where rates, agents, vectors, and patterns of land use and land cover are analysed, projected for the future, and monitored. The Project area, leakage belt and leak management area are contained in the reference region (Figure 22 and 23).

Figure 22. Location of the Reference Region, Project Area, Leakage belt, and Leak Management Area

Figure 23. Leakage management area



Reference region area:

The reference region covers 2,722,271 ha (two million, seven hundred twenty–two thousand, two hundred seventy one ha) and presents a historical deforestation rate (between 2000 and 2014) of 6,613 ha per year (0.40% per year - in relation to the remaining forest area in 2000).

In defining the spatial boundary of the reference region, environmental characteristics (river basin boundaries), deforestation direction vector and land tenure situation were considered. The boundary of the reference region followed the guidelines described on page 17 of the VM0015 methodology, with the final area within the range suggested by footnote 05 (page 18 of methodology VM0015). The reference region may include one or several discrete areas. It must be larger than the project area and include the project area.

The characteristics of the reference region meet the similarity requirements with the Project area determined by the methodology VM0015 (presented on pages 22 and 23 of VM0015), presenting the following characteristics:

1. Deforestation agents and vectors - improved infrastructure (such as roads, railroads, bridges, hydroelectric reservoirs, etc.) is expected to develop near the project area, new industries have been planned already in and around the project area where impact on forest cover was similar to the one expected from the old improved infrastructure in the project area.

2. Landscape configuration and ecological conditions - these are uniform throughout the RRD. Although some areas may present slight variations in slope, elevation and precipitation fall within the same range in all the areas of the RRD. Vegetation is mostly Ombrophilous Forest with evidence of agricultural plots no further than 3Km from navigable rivers due to cassava crops implemented by local population. The RRD complies with the requirements of the VM0015 methodology in terms of representativeness of the characteristics found in the PA by satisfying all the four landscape configuration and ecological conditions.

3. Socioeconomic and cultural conditions - The legal status of the land (private) is a unique patch of land present in the most deforested and degraded lands as compared in the baseline case within the project area of the reference region. The legal status of the private land is not biasing with the baseline of the project area. Table 8 presents the carbon pools used to account for carbon stocks for the Project.

Table 8: Carbon pools included/excluded (Refer to Table 3 - VM0015)

Carbon pools	**Included / TBD/ Excluded**	**Justification / Explanation of choice**
Above-ground	Included	Carbon stock change in this pool is always significant
Below-ground	Included	Included to account for all the trees biomass.
Dead wood	Excluded	This pool is less present in the baseline scenario than in the Project scenario, thus is conservatively excluded.
Harvested wood products	Excluded	This pool didn't pass the 5% significance test.
Litter	Included	According to the VM0015 methodology (version 1.1) it can be included.
Soil organic carbon	Excluded	Not to be measure when forest is converted to pastures in the baseline scenario according to VCS VM0015 methodology.

Table 9. Carbon sources included/excluded (Refer to Table 4 - VM0015)

Sources	**Gas**	**Status**	**Justification / Explanation of Choice**
Biomass Burning	CH_4	Included	Fires are the main technology to clear the forest

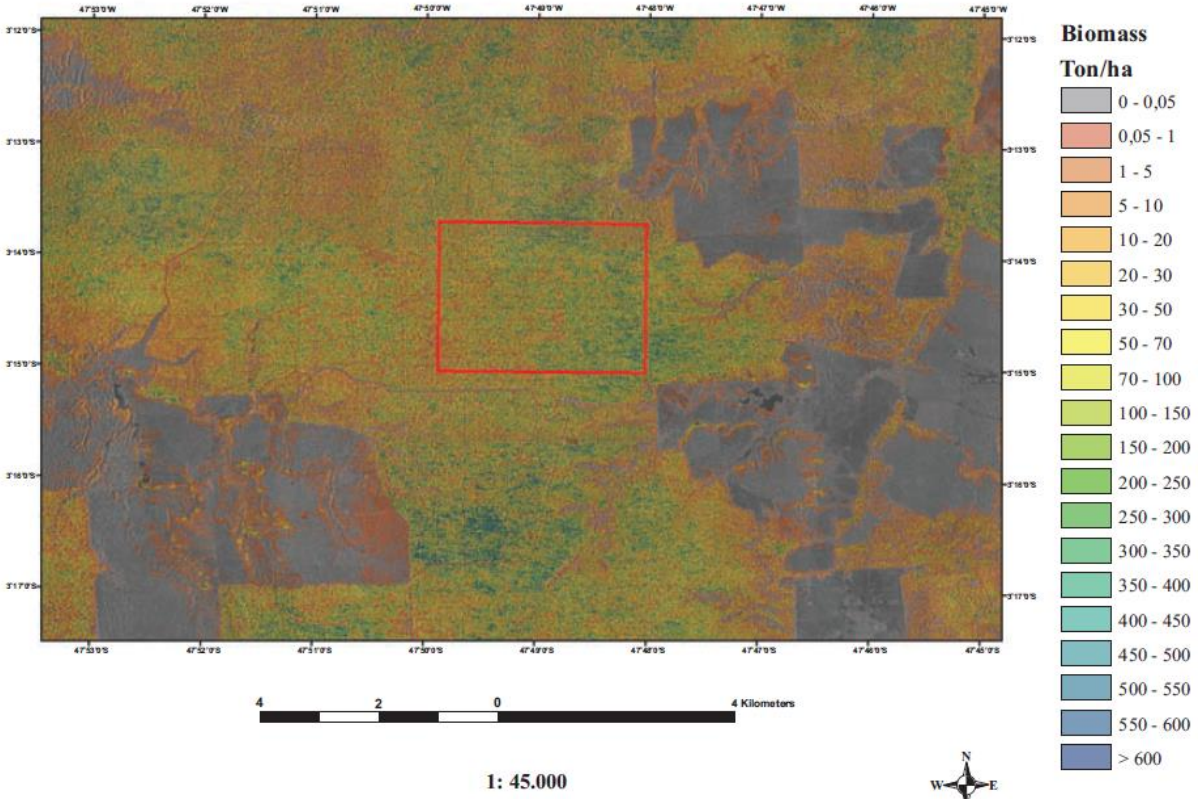
3.1.4 Baseline Scenario

The baseline scenario as identified in the additionality assessment is the progressive loss of forest cover by the, expansion of cattle ranches, forest clearance for agricultural activities and illegal logging for timber.

Other driver for both deforestation is land speculation. , which is practised for economic benefits , way of illegal land clearance under real estate business. A land with forest cover is assumed to be non-productive thus under no use; a deforested land is worth 5 to 10 times more than the same forested area; the Brazilian Constitution recognizes the rights of squatters to invade and claim public and private lands if such appear to be under no-productive use (Claudio Araujo, Catherine Araujo Bonjean, Jean-Louis Combes, Pascale Combes Motel, Eustaquio J.Reis. Property rights and deforestation in the Brazilian Amazon. 2011. ffhalshs-00556699).

Given the widespread unclear land tenure and weak law enforcement, squatters use to move freely in the project area before the intiation of the project. Squatters take advantage of the constantly evolving roads network developed by illegal loggers (pioneer roads) and invade previously inaccessible forested lands. The forest fires are quite common in amazon which is believed to have been nearly all set by humans -- cattle ranchers and loggers who want to clear and utilize the land (The fires are believed to have been nearly all set by humans -- cattle ranchers and loggers who want to clear and utilize the land).

Figure 24: Map of the forest biomass of the project area



9 https://edition.cnn.com/2019/10/03/health/amazon-fire-children-breathing-intl-hnk-scli/index.html.

Several remote sensing technologies are being developed (Sambatti, 2012) (Sambatti, Julianno & Leduc, Raphael & Lübeck, Dieter & Moreira, João & Santos, João. (2012). Assessing Forest Biomass and Exploration in the Brazilian Amazon with Airborne InSAR: an Alternative for REDD. The Open Remote Sensing Journal. 5. 10.2174/1875413901205010021.) to provide accurate estimates of forest biomass to guarantee that REDD can effectively reduce carbon emissions from deforestation and forest degradation. X/P-band InSAR combines the potential for wall-to-wall data acquisition in very large areas and estimation of forest biomass in conditions - such as with the presence of cloud cover, and dense vegetation – that other remote sensing technologies face difficulties to deliver. We confirmed the results of the studies demonstrating that, when Hint is available, forest biomass estimation is improved substantially. This can overcome the known limitation of using P-band backscatter alone for biomass estimation, i.e., signal saturation above a certain biomass threshold. It was evident from the study that cattle ranching and timber logging are the main drivers of deforestation in and around the project area.

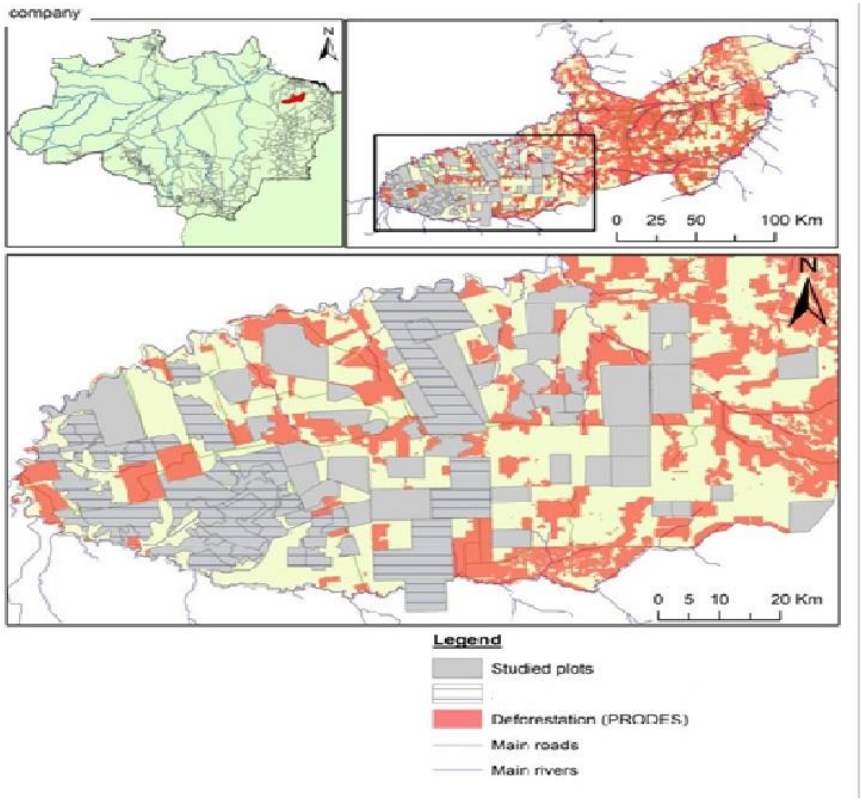
The pioneer frontier is the area of the project boundaries and its immediate vicinity. In this southern part of the RRD, landless people or communities colonize river shores and develop small villages; illegal loggers open penetration roads to access valuable timber resources; squatters (invaders)

clear-cut patches of forest through slash and burn to prove land ownership and attempt a future land re-sale.

Illegal loggers open pioneer roads that form an intricate network that connect with the network of roads that lead to the Paragominas-Belem highway. Once connected to the Paragominas network, pioneer roads function as tertiary roads in the network of the Belem highway. These new tertiary roads allow squatters to enter the area and start an aggressive deforestation process (Figure: 25)

10 (Sambatti, Julianno & Leduc, Raphael & Lübeck, Dieter & Moreira, João & Santos, João. (2012).

Figure 25. Primary, secondary and tertiary road network in and around the project area



Squatters thrive on land speculation and use the network of tertiary roads to encroach the Project Area and clear it to claim ownership. Squatters will implement small-scale grazing to prevent the forest from regenerating and to prove that the land is under productive use, aiming at obtaining land ownership titles. Once ownership is granted, they sale they land to larger-scale ranchers.

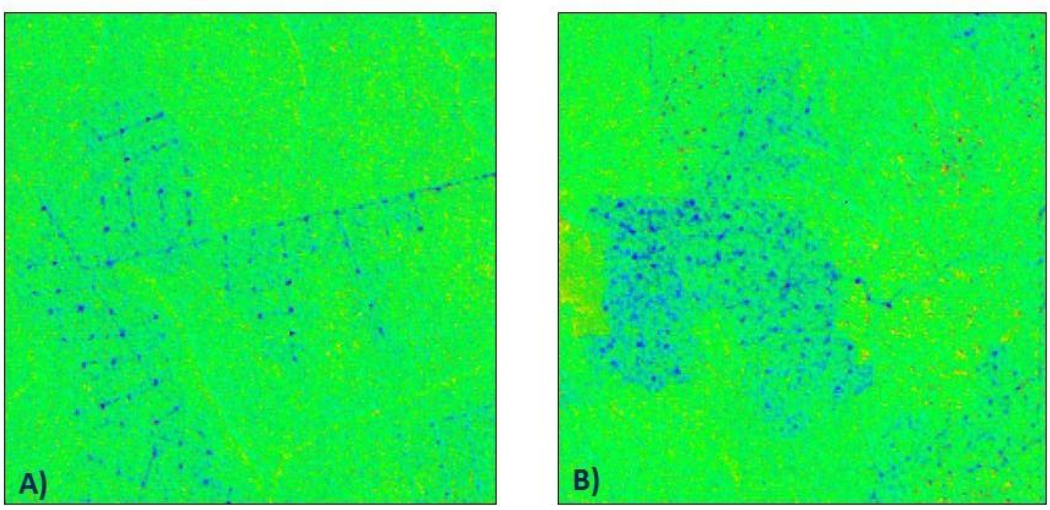
Ranchers will expand pastures and grazing activities not only because it is a profitable activity but also to keep proving land ownership. The use of the network of tertiary roads allows ranchers to speed-up the consolidation process of the pioneer frontier.

Nowadays, the situation has changed. New activities such as tax breaks and high demand for meat, cattle ranchers in this area have become well-capitalized agents that can undertake timber extraction and posterior deforestation if they need more areas to develop pastures. Therefore, these agents clean the forest directly, keeping valuable timber species for sale and applying fire to

what is left thus pushing northwards the deforestation frontier (Fearnside 2001; Margulis 2004; May 2011) (Carrero, G. C., and P. M. Fearnside. 2011. Forest clearing dynamics and the expansion of landholdings in Apuí, a deforestation hotspot on Brazil's Transamazon Highway. Ecology and Society 16(2): 26).

Figure 26. Extract of a spectral un-mixed Landsat image (30 meters spatial resolution) illustrating two different patterns of forest disturbance (displayed in color composite RGB: Soil; Active Photosynthetic Vegetation; Non-photosynthetic Vegetation). A) illustrates a pattern of conventional logging with a symmetric spatial arrangement of the impacts organized around primary and secondary logging roads, B.) represents a pattern of illegal logging with an anarchical spatial organization and high damage in the canopy cover.

Figure 26. Extract of a spectral un-mixed Landsat image (30 meters spatial resolution) illustrating two different patterns of forest disturbance (displayed in colour composite RGB: Soil; Active Photosynthetic Vegetation; Non-photosynthetic Vegetation).



Given the fact that pioneer roads are becoming tertiary roads by connecting with the network of the Paragominas-Belem highway, it is expected that the Project Area will suffer the same pressures and average deforestation rates that affected the consolidated frontier during the historical deforestation period.

In a without project scenario it is likely that deforestation in the area will continue at a conservative rate of 1.7 % per year which can be used for baseline projections.

Four types of soil texture are found in the project area linked with the topography: sand and clayey sand in the bottomlands in the plains and the valleys, mottled clay on the slopes of the valleys, gravel resulting from the dismantling of the duricrust on the convex edge of the plateaus, and clay on the plateaus. These soils are very acidic, with a pH between 3.5 and 5.3. Aluminum saturation is high: usually > 60%, which is the limit of toxicity. Organic carbon contents are low, ranging from

0.1 to 3.8% due to the rapid mineralization of organic matter. Concentrations of exchangeable bases are low, ranging from 0.2 to 1.5 cmole kg−1 , however, they are higher in the topsoil horizon of the clay on the plateaus (from 4.2 to 7.9 cmole kg−1) than in sand and clayey sand (< 4 cmole kg−1) (Marie-Gabrielle Piketty. 2015. Multi-level Governance of Land Use Changes in the Brazilian Amazon: Lessons from Paragominas, State of Pará.6:1516-1536).

Figure 27 and Figure 28 clearly show that up to 2000, deforestation mostly occurred close to rivers, in sandy plains and valleys. Historically, the main proximate cause of deforestation in the territory has been to extend pasture for extensive cattle ranching. Cattle ranching requires good access to surface waters (rivers and small streams), which are concentrated in the plains and valleys. Moreover, the low fertility of sandy soils does not have a negative effect on pasture productivity in these extensive systems.

Figure 27. Deforestation rate of project area from 2000 to 2015

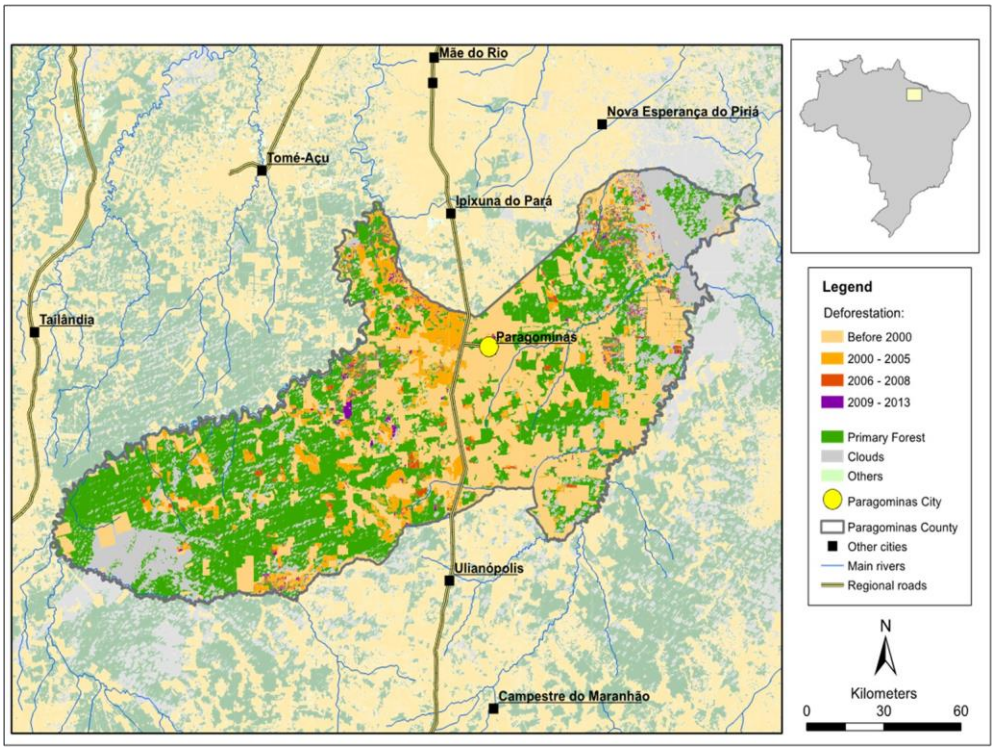
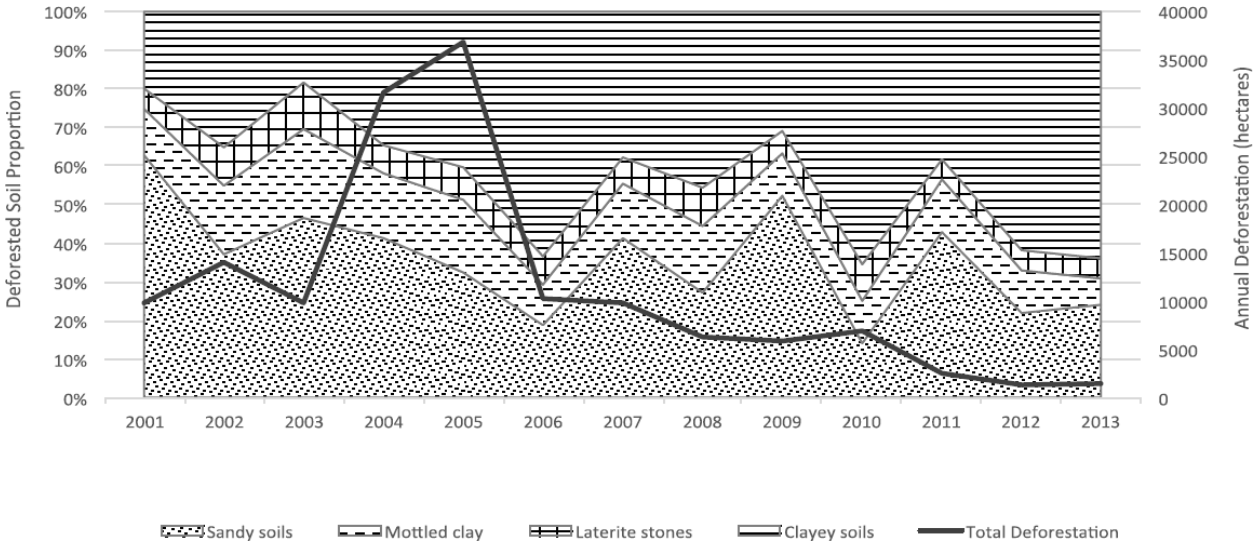


Figure 28. Distribution of annual deforested areas as a function of soils type from 2001–2015



Step 2 of VM0015 - Analysis of Historical Land-Use and Land-Cover Change

Collection of appropriate data sources

For the mapping of the changes in the classes of use and soil cover, data from the PRODES Digital program (INPE, 2014) were used in vector format (shapefile) with spatial resolution of 30 meters. A total of 83 Landsat satellite images were used to map forest, non-forest vegetation, hydrography and anthropogenic vegetation (deforestation) (Table 10). According to the methodology of PRODES Câmara et al. (2006) (Câmara G, Valeriano D, Soares JV (2006) Metodologia para o Cálculo da Taxa Anual de Desmatamento na Amazônia Legal. INPE, Sao Jose dos Campos), these images underwent geometric correction with displacement error less than 1 pixel (30 x 30 m). These images cover the historical reference period (2000 to 2014) and can be located through four Orbits/ Point in the Landsat scene.

Table 10. Data used to identify and map historical LU/LC change analysis in the ARC REDD+ Project (Table 5 of methodology VM0015, page 30)

Vector (Satellite or Airplane)	Sensor	Resolution		Coverage	Acquisition Date	Scene or Point Identifier	
		Spatial	Spectral	(Km²)	(DD/MM/AAA)	Path/ Latitude	Row/ Longitude
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	23-09-2003	226 / 60	
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	11-10-2004	226 / 60	

Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	14-10-2005	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	01-10-2006	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	02-09-2007	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	19-08-2008	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	25-10-2009	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	12-10-2010	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	12-08-2011	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	24-06-2012	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	18-09-2013	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	08-11-2014	226 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	17-09-2001	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	23-09-2003	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	11-10-2004	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	14-10-2005	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	02-11-2006	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	16-07-2007	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	19-08-2008	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	21-07-2009	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	28-10-2010	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	12-08-2011	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	06-08-2012	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	18-09-2013	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	05-09-2014	226 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	16-09-2001	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	05-10-2002	227 / 60

Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	01-11-2003	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	03-11-2004	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	22-11-2005	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	06-09-2006	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	09-09-2007	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	29-10-2008	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	29-08-2009	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	04-11-2010	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	03-08-2011	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	10-11-2012	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	07-07-2013	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	30-10-2014	227 / 60
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	07-10-2000	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	16-09-2001	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	05-10-2002	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	16-10-2003	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	31-08-2004	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	21-10-2005	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	24-10-2006	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	09-09-2007	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	27-09-2008	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	29-08-2009	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	31-07-2010	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	03-08-2011	227 / 61
Satellite	Landsat	30 x 30 m	0,45 – 2,35 µm	185 x 185 km	06-08-2012	227 / 61

Analysis of the historical Land-Use and Land-Cover change

Mapping and deforestation data provided by PRODES were used to analyze the history of changes in land use. The main activities carried out by the PRODES Project to monitor the forest cover of the Brazilian Amazon will be detailed below.

Pre-processing

The procedures of imagery preprocessing performed by the PRODES Project are constituted in the following steps (CÂMARA et al., 2006):

- Selection of images with lower cloud cover and acquisition date closer to dry season in the Amazon and with adequate radiometric quality;

- Georeferencing of 30-meter spatial resolution images in 1:100,000 scale maps and NASA Ortho-rectified MrSID format images.

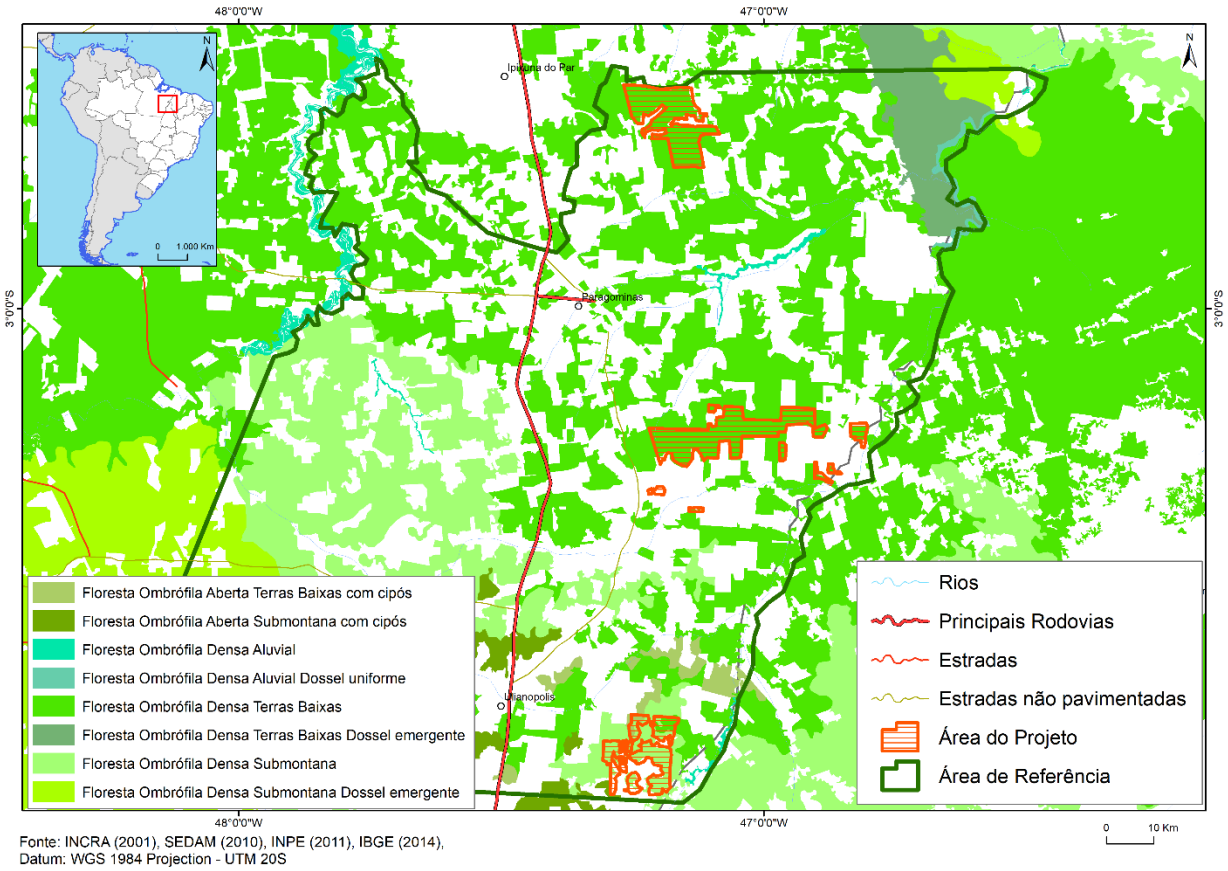
Interpretation and classification

The method of classification of satellite images used by PRODES follows four main steps. First a spectral mixing model is generated identifying the components of vegetation, soil and shade. This technique is known as a linear spectral mixture model (MLME) that aims to estimate the percentage of vegetation, soil and shade components for each cell (pixel) of the satellite 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 segments are categorized individually to identify the forest, non-forest vegetation, hydrography and deforestation classes (anthropic vegetation). Finally, the result of classified segmentation is submitted to the process of editing or auditing the classification, performed by a specialist and ending with the creation of state mosaics.

Post-processing

According to VM0015, the post-processing step includes the use of non-spectral information for the stratification of the carbon density of the land cover classes. This information was generated implicitly during the next steps. The results of the post-processing step are shown in the below represented Figures.

Figure 29: Land-use and Land-cover change map from 2000 to 2014



Fonte: INCRA (2001), SEDAM (2010), INPE (2011), IBGE (2014).
Datum: WGS 1984 Projection - UTM 20S

Map accuracy assessment

PRODES data were validated from a comparison of Landsat images collected in the year 2014, as well as high spatial resolution images available in Google Earth and the soil cover map generated by INPE for the year 2014. About 170 points were randomly distributed in the reference region. For each point a visual interpretation was made in the 1:50,000 scale of the predominant class at the point (classes: Forest, Non-Forest, Water and Deforestation). Then the classification through visual interpretation was compared with the classification generated by INPE through the confusion matrix (Congalton, 1999) (Congalton, R.G. and Green, K. (1999) Assessing the Accuracy of Remotely Sensed Data Principles and Practices. Lewis Publishers, Boca Raton). The overall accuracy of the 170 points evaluated was 91% (Table 11)

Table 11. Matrix of the soil cover map (PRODES, 2014) of the Reference Region generated from satellite images of Google Earth

		Reference				Total	User	Commission
		Water	Deforestation	Forest	Non-Forest		Accuracy	Error
Classified	Water	**3**				3	100%	0%
	Deforestation		**31**	3		34	91%	9%
	Forest	1	6	**102**	4	113	90%	10%
	Non-Forest		1	1	**18**	20	90%	10%
Total		4	38	106	22	**170**		
Producer Accuracy		75%	82%	96%	82%			
Omission Error		25%	18%	4%	18%			
Map Accuracy								91%

Results in change history analysis in Land-Use and Land-Cover

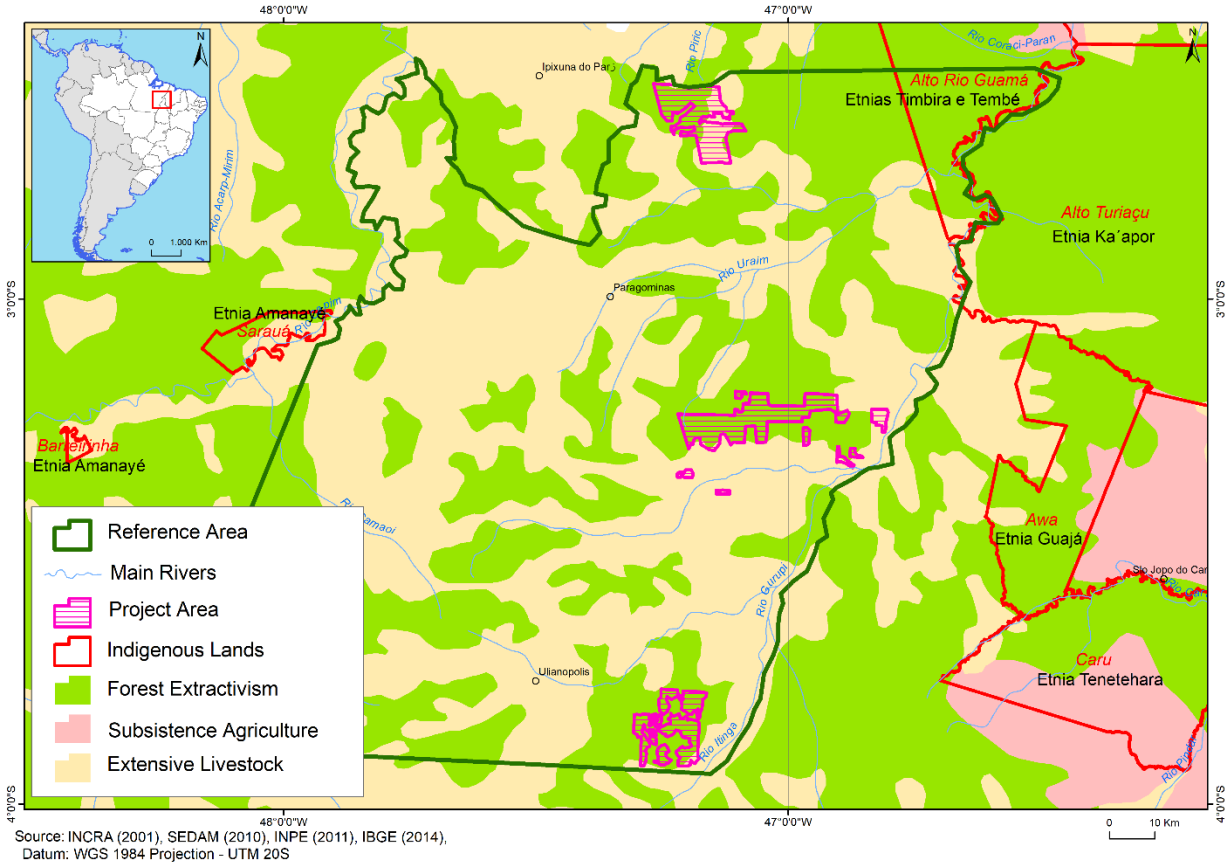
Based on the data obtained in the previous steps, the analysis of the historical change in land cover between 2000 and 2014 was carried out in the Reference Region of the ARC REDD+ Project Area. The subtraction map analysis resulted in a deforested area between 2000 and 2014 of approximately 96,209 ha (5% of forest remnant in 2000).

Step 3 of VM0015 - Analysis of agents, drivers and underlying causes of deforestation and their likely future development

Identification of agents of deforestation

a) *Name of the agents of deforestation in the Reference Region: the main agents of deforestation are squatters for grazing, agriculture and other activities.*
b) *Relative importance of the amount of historical deforestation assigned to each agent or group: The identified squatters account for 100% of the unplanned deforestation observed in the Reference Region.*
c) *Brief Description: the deforestation agents of the ARC region are mostly migrants who came especially from other cities in the northern region of the country and the northeast region. These agents are historically attracted to the region by enterprises such as those linked to the ARC Project, infrastructure projects, mining, among others. In addition to the possibility of job offer, such agents are attracted by the possibility of taking on indefinite or theoretically disputed areas. Such agents usually invade areas belonging to the ARC/TFA claiming to be in lands that belong to the state government or federal government. They clean up areas aims to take ownership, build improvements, and initiate small-scale plantations and small-scale animal husbandry. Through these activities, which impact and change the forest cover, the squatters seek to legitimize their occupation (LIMA and POZZOBON,2005) (LIMA, Deborah and POZZOBON, Jorge . Socio-environmental Amazon : ecological sustainability and social diversity . Estud. av. [online]. 2005, vol.19, n.54, pp.45-76. ISSN 0103-4014).*

Figure 30: Location of squatters and deforestation agents



Identification of deforestation drivers

a) <u>Driver variables that explain the quantity (hectares) of deforestation</u>

- *Population growth;*
- *Demand for new areas for agriculture and small pasture.*

Conclusion

Based on the data and information presented in the socioeconomic diagnoses carried out by the project (FAO, 2018) and other survey studies used as reference, deforestation data (PRODES, 2014), land use after deforestation (INPE and EMBRAPA, 2014) and consultations with local experts, it was possible to find conclusive evidence explaining the relationships among agents, drivers, underlying causes and the deforestation pressure in the Reference Region. Thus, the hypothesis presented is that population growth influenced by infrastructure projects and undertakings projects in the region, coupled with the inefficiency of the government for regularization and monitoring of rural properties, the precariousness of public services and the weak performance of the State to curb illegal activities, contribute to the deforestation scenario observed during the period analyzed. Considering these evidences, the tendency for the baseline in the future is to maintain the influence of the agents, drivers and underlying causes evidenced during the historical period analyzed in the Reference Region.

Step 4 of VM0015 - Projection of Future Deforestation

Projection of the quantity of future deforestation

The Reference Region is not stratified, since the characteristics of the agents, drivers and causes of deforestation are the same throughout its area.

Selection of the baseline approach

The methodology VM0015 suggests the use of three approaches to forecast the amount of future deforestation: (1) historical average of deforestation; (2) deforestation as a function of time; (3) modeling the rate of deforestation. After analyzing the evidences indicated in step three and the conclusions obtained, the modeling approach of the historical mean of deforestation (method 1) was adopted. Approach 1 was selected because the rate of deforestation analyzed does not show a significant trend (R^2 <80%) of increase or decrease in the future, that is, is higher than the average rate observed between 2000 and 2014. The R2 found from PRODES annual deforestation rates was 0.10%.

In addition, a correlation analysis was performed among the data collected for different variables (IBGE/SIDRA) of the project region during the historical reference period and deforestation evidenced in the same period. These variables could be used to perform a modeling, however in this analysis no variable had an adequate correlation index. Therefore, the evaluation of variables explaining deforestation (Figure 35, Figure 32 and Figure 33) showed low correlation index, it was chosen the "a" approach (historical average) to design the baseline of future deforestation.

Figure 31. Correlation between the variables of Deforestation and cattle herd (grazing)

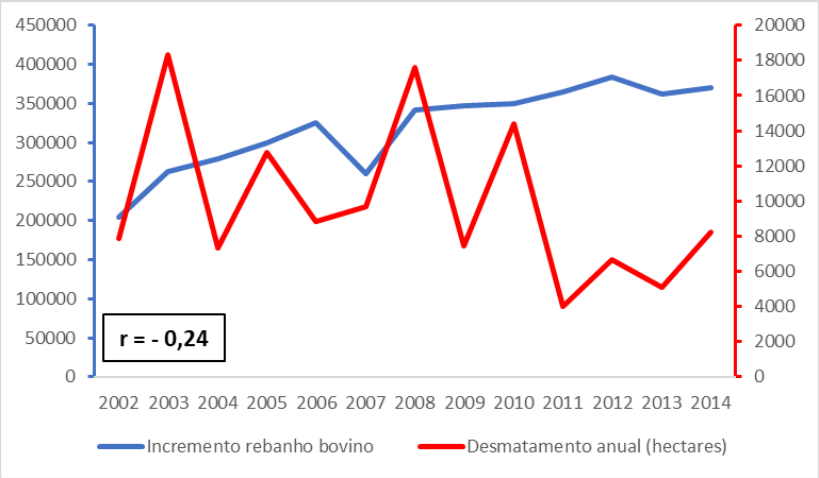


Figure 32. Correlation between the variables of Deforestation and timber production

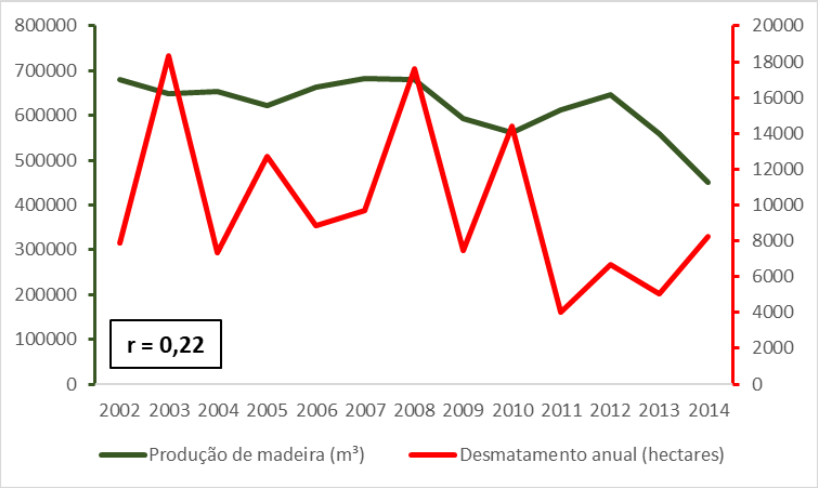
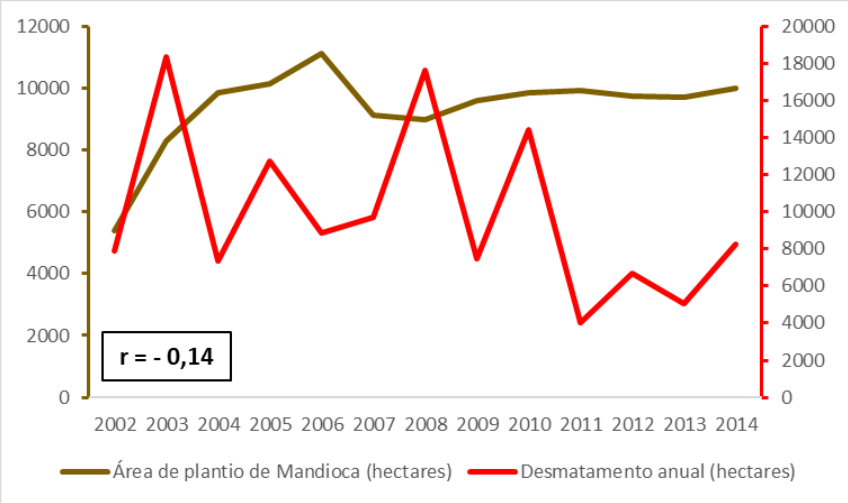


Figure 33. Correlation between the variables of Deforestation and Area for plantations



Quantitative projection of future deforestation

Projection of the annual areas of baseline deforestation in the Reference Region

As presented in the previous item, method 1 (historical average) was selected to estimate future deforestation and to design the annual deforestation areas in the baseline in the Reference Region. The annual area of deforestation at baseline in year t within the Reference Region was calculated according to Equation 2 of methodology VM0015 version 1.1 (page 44):

$$ABSLRRi,t = ARRi,t-1 * RBSLRRi,t \quad (2)$$

Where:

ABSLRRi,t: annual area of baseline deforestation in stratum I within the Reference

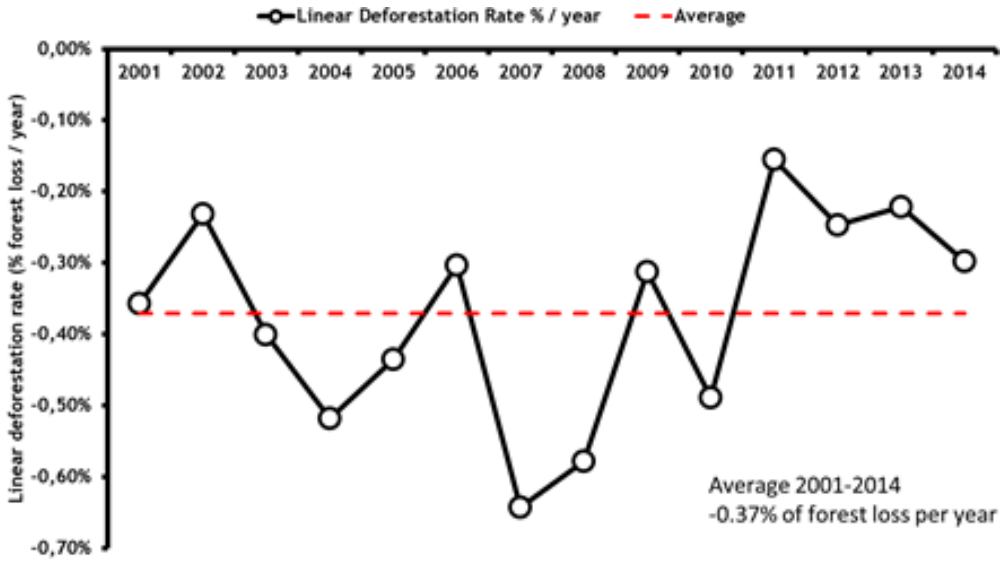
Region at year t (ha/year);

ARR$_{i,t-1}$: area with forest cover in stratum i within the Reference Region at year t^{-1} (ha); RBSLRR^{i,t}: deforestation rate applicable to stratum i within the Reference Region at year t (%); t: 1, 2, 3 ... T, a year of the proposed project crediting period (dimensionless);

i: 1, 2, 3 ... IRR, a stratum within the Reference Region (dimensionless).

The rate of deforestation observed between 2000 and 2014 was obtained using Equation 7 in Puyravaud (2003) (Jean-Philippe Puyravaud,Standardizing the calculation of the annual rate of deforestation, Forest Ecology and Management, Volume 177, Issues 1–3,2003,Pages 593-596.), and the value obtained was -0.37% (Figure 34). The projected deforestation over the 30-year period (2015-2044) in the Reference Region is presented in calculation sheet.

Figure 34. Historical deforestation rate



Projection of the annual areas of baseline deforestation in the Project Area and Leakage Belt

Spatially designed deforestation was used for the entire Reference Region for baseline estimation in the Project Area and in the Leakage Belt produced in step 4.2.4 of methodology VM0015 (page 54).

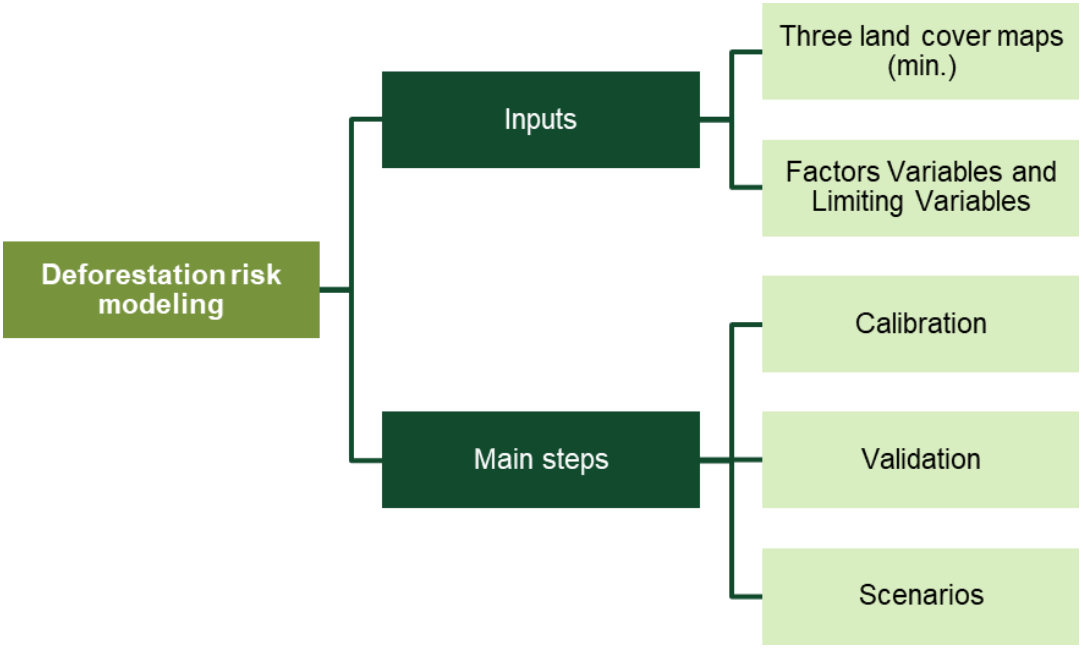
Projection of the location of future deforestation

In this section, projection of the future location of the risk of deforestation for the year 2044 as of the preparation of the factors maps, or that encourage the occurrence of deforestation. This was done using the TerrSet software, Land Change Modeler (LCM) module.

Preparation of deforestation risk maps

The deforestation risk models are developed from a series of minimum inputs and main steps (Figure 35). The minimum inputs are at least three land cover maps covering the beginning, an intermediate point and the end of the historical period and the factors variables and limiting variables to the occurrence of deforestation. Among key steps include calibration, validation, and scenario generation.

Figure 35. Scheme for the generation of deforestation risk models



Calibration

In the calibration step the first two land cover maps are combined with factors variables and limiting variables using a mathematical model. The objective of this phase is to find out about what conditions deforestation occurs and to represent these conditions through an equation or a set of equations. In this project we used the the Land Change Modeler (LCM) module that conducts this calibration phase as follows.

The first step is to identify the importance of the factors variables for the occurrence of deforestation. This was done using the method called Similarity Weight (SANGERMANO et al., 2010) (Sangermano, Florencia & Eastman, Ronald & Zhu, Honglei. (2010). Similarity Weighted Instance-based Learning for the Generation of Transition Potentials in Land Use Change Modeling. T. GIS. 14. 569-580). The method uses the closest neighborhood K logic to identify the relevance of each variable that is considered as a vector to predict locations with the potential for occurrence of the Forest-Deforestation transition. The logic used by SimWeight initially consists of the analysis of the relevance of each variable for the occurrence of deforestation, calculating the importance weight of the variable by the following equation (Equation 3).

Formula to calculate the Importance Weight of Independent Variables (PI):

$$PI = 1 - (DPchange/DPStudyArea) \quad (3)$$

Where:

PI = importance weight;
DPchange = standard deviation of the vector variable in the cells/pixels of change;
DPStudyArea = standard deviation of the vector variable in the cells/pixels of the entire study area.

Then SimWeight calculates the risk of deforestation by combining change cells and persistence. For this was used only the information of the variables with PI greater than 0.1. This information was combined by the following formula adapted from Sangermano et al. (2010) (Equation 4):

Formula to calculate the Deforestation Risk:

$$R\ RiscoDesm = \frac{\sum_{i=1}^{c}\left(1.0 - \frac{1}{1+e^{\frac{1}{d_i}}}\right)}{k};\ (c \leq k)$$

Where:
RiscoDesm = risk value of occurrence of change ranging from 0 (low) to 1 (high);
c = number of cells/pixels of change;
d = distance in cells/pixels between the pixels of change;
i = change pixel identifier;
k = distance in cells/pixels of neighbors closest to the change pixel.

The use of Equation 4 results in a map with transition potential, which detects the areas with favorable conditions of deforestation occurrence over areas with the Forest class (Figure 36). This map is given as the starting point for allocating future rates of deforestation, and from this the annual rates are allocated along with some dynamic variables. The accessibility variable of old deforestation is an example of a dynamic variable.

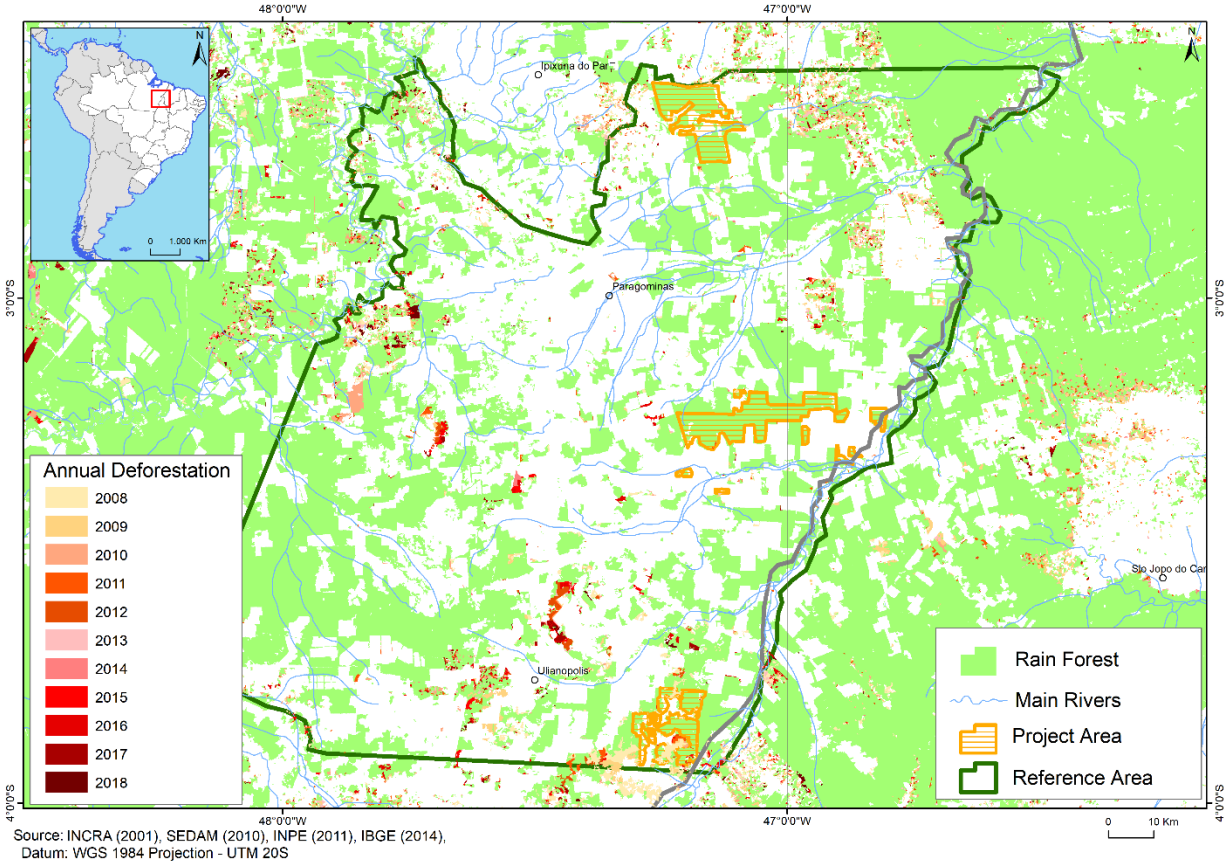
Validation

The validation consists of comparing the result of the already calibrated mathematical model with the factors variables with a real data. It is generated in this phase, a land cover map simulated of the third point of time of the historical period. The next step is to compare this simulated map with the actual land cover map from the third point of time.

Scenarios

In the scenario step the future deforestation rates are projected for a given time horizon and some main assumptions are assumed. In this REDD+ Project the projection period of deforestation is from 2016 to 2045 and the assumed assumption was that the annual rate of historical deforestation occurred between 2000 and 2014 would reproduce steadily.

Figure 36. Transition potential map for the occurrence of deforestation in the Reference Region

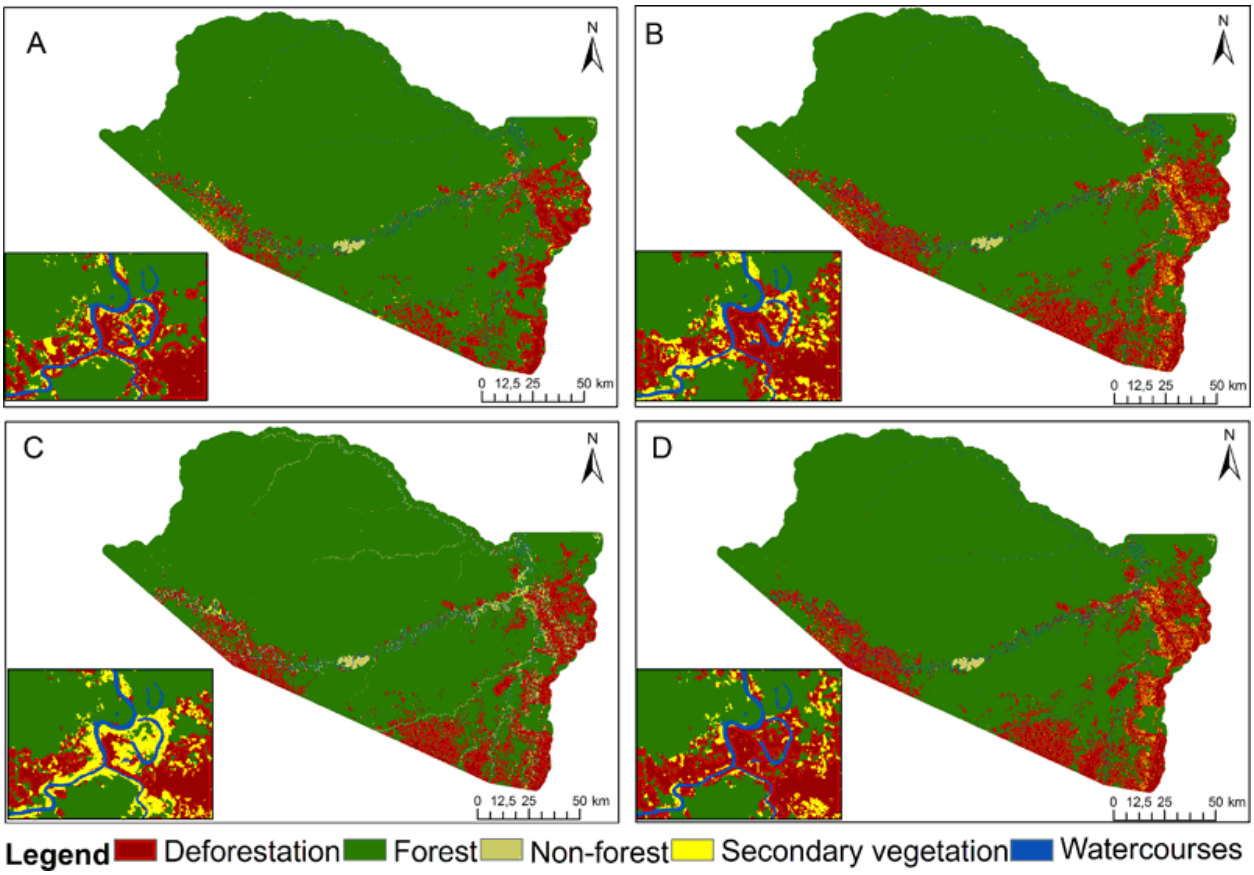


Mapping of the locations of future deforestation

For the projection of future deforestation, the whole historical period of the project (2000-2014) was considered, with annual deforestation maps projected between 2014 and 2044. The deforestation rate calculated for the historical period was projected until the year 2044. For the spatial allocation of deforestation the starting point was the combination of the auxiliary variables identified in the model calibration.

The old deforestation distance variable was calculated dynamically in each model interaction. The entire process was conducted in TerrSet software. Figure 37 below shows deforestation in the Reference Regions, Project Area and Leakage Belt (Tables 9b and 9c of methodology VM0015, pages 49 and 50). Index A – Reference region, B – Project area, C- Leakage area and D – Future deforestation rate.

Figure 37: Deforestation in the Reference Regions



3.1.5 Additionality

For the additionality analysis the most recent version of the VCS "Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities - VT0001", Version 3.0, is used. The steps defined by the tool for this analysis are then developed.

The tool is applicable under the following conditions:

a) AFOLU activities the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced;	All project activities are legal and do not lead to violation of any applicable law. The national and sectoral policies relevant to this project are those derived from laws pertaining to natural resources and forestry activities in Brazil.

b) The use of this tool to determine additionality requires the baseline methodology to provide for a stepwise approach justifying the determination of the most plausible baseline scenario. Project proponent(s) proposing new baseline methodologies shall ensure consistency between the determination of a baseline scenario and the determination of additionality of a project activity.	The most plausible baseline scenario is determined following the stepwise approach of the VCS Tool for the demonstration and assessment of Additionality, Ver 3.0. The determination of the baseline scenario was done using determined literatures, public available date from authentic sources, direct field observation, GIS information and scientific research.

The possible identified scenarios are evaluated taking into account investment barriers, historical context, cultural practices, and sector policies in Brazil. Such analysis aims to prove that the Project activity is not the most financially attractive or technically feasible land-use scenario to develop in the Project Area.

Step 1. Identification of the alternative scenarios of land use to the activities of the Project.

This step includes identifying the credible land-use scenarios for the Project Area and assessing the consistency of each scenario based on local regulations.

Sub-step 1a: Identification of alternative land use scenarios for proposed REDD project activities.

Land-use scenarios for this Project have been identified using primary and secondary sources of information. Primary sources include social assessment activities undertaken on the Project Boundaries through the months of December 2016 and June 2017.

Using these sources of information, three possible scenarios have been identified. These scenarios are:

1. Forest encroachment by pioneer activities (real estate) followed by deforestation to implement pastures

The baseline scenario is a continuation of Business As Usual (BAU) activities in the region if the landowner doesn't implement any type of monitoring or productive activity in the Project Area. Many threats such as deforestation, illegal logging, man made fires and losing land ownership by illegal means and many other problems has to be faced by the land owner.

Cattle ranching is the main deforestation activity in the RRD. Cattle ranchers can expand their activities by their own means (in the case of well-capitalized agents) or as part of a process that includes pioneer agents such as selective loggers and squatters (in the case of small and medium size ranchers). Interactions among these agents are the result of common drivers and underlying forces of deforestation that are based mostly on securing land ownership and also in economic profits.

Interaction between pioneer and final agents, looked from the standpoint of biological interaction, can one of mutualism or at least of commensalism. For example, in the case of loggers and

ranchers, loggers can act independently from the existence of grazing activities. However, grazing activities take advantage of the network of penetration roads built by loggers and usually the revenues from timber extraction are used to finance the implementation of cattle (Margulis 2004)

Intermediary agents with low opportunity costs (squatters) who precede cattle ranching, are probably the direct responsible for much of the deforestation (Margulis 2004). For most of the agents the main driver of deforestation in the area is land speculation , followed by generation of economic revenue (Barreto 2011) Land speculation arises from the expectation of a future re-sale of land. Such speculation is generated by widespread unclear land tenure, bizarre regulations that do not provide security for landowners (Araujo, Bonjean et al. 2009) (Araujo, Claudio & Araujo Bonjean) and from known corruption and weak enforcement at local-level institutions (Larson 2008). Economic revenue is generated by the extraction and sale of timber, changes in land-use from forest to pasture (and implementation of grazing activities) and the sale of meat in the domestic rather than in the international market (Hecht 1993).

11 (Margulis 2004) (Margulis, Sergio. 2004. Causes of Deforestation of the Brazilian Amazon. World Bank Working Paper;No. 22. Washington, DC: World Bank).

12 (Kirby, K.R., W.F. Laurance, A.K. Albernaz, G. Schroth, P.M. Fearnside, S. Bergen, E.M.Venticinque and C. da Costa. 2006. The future of deforestation in the Brazilian Amazon. Futures 38: 432-453)

13 (Manuela Barreto. 2011. CORPORATE SOCIAL RESPONSIBILITY AS A SOURCE OF ORGANIZATIONAL MORALITY, EMPLOYEE COMMITMENT AND SATISFACTION.Journal of Organizational Moral Psychology.1:2(97-124)

14 Catherine & Combes, Jean-Louis & Combes Motel, Pascale & Reis, Eustaquio. (2009). Property rights and deforestation the Brazilian Amazon. Ecological Economics. 68. 2461-2468. 10.1016/j.ecolecon.2008.12.015.

15 (Michael L.HechtMichael V.SedanoSodeny R.Ribeau.1993.Understanding culture, communication, and research: Applications to Chicanos and Mexican Americans.International Journal of Intercultural Relations.17(2):157-165).

Land speculation and associated deforestation have their origin on economic incentives given the fact that a cleared area is worth 5 to 10 times more than the same forested area (Kirby, Laurance et al. 2006) and that squatters operate under the expectation of future land resale (Margulis 2004). At the same time, the Brazilian Constitution of 1988 incentivizes squatters to invade and clear forested land. Under this provision, squatters have the right to claim public or private land that is not under productive use. The Constitution indicates that it is a legal activity to encroach private property if this is not under use, so a squatter can get land-use rights after one year of occupation and full-ownership after proving 5 years of continuous use, as long as the landowner does not manifest legal opposition (Araujo, Bonjean et al.2009).

Land encroachment by squatters is facilitated by the use of the network of unplanned roads developed by illegal loggers that operate in the area. As confirmed by the analysis of the historical reference period using Landsat TM imagery, loggers will continue to build new roads as long as these provide access to profitable timber, moving the logging pressure far from primary roads into areas where the forest resources are abundant (Christoper P Barber (2014). Roads, deforestation, and the mitigating effect of protected areas in the Amazon. Biological Conservation.177:203–209) and regardless increasing distances to selling points (Pfaff 2009) (Joppa LN, Pfaff A (2009) High and Far: Biases in the Location of Protected Areas. PLoS ONE 4(12): e8273). Also, the historical reference period analysis shows that old pioneer roads linger over time and given the fact that any

road will resist so much time in the forest without maintenance (Margulis 2004), it can be inferred that these roads are being used by pioneer agents.

From the literature it is known that, although there is a time gap of 10 or more years between the implementation of logging activities and the development of cattle ranching, the use of the pioneer roads network by ranchers quickly consolidates a pioneer frontier and make it evolve (Mertens, Poccard-Chapuis et al. 2002. Crossing spatial analyses and livestock economics to understand deforestation processes in the Brazilian Amazon: the case of Sao Felix do Xingu in South Para. Agricultural Economics 27:269-294), thus reducing the time the gap for the creation of a consolidated deforestation frontier (Margulis 2004).

Nowadays, these pioneer roads have begun to connect with the network of tertiary and secondary roads that lead to the Paragominas-Belem highway, which has been verified by on-the ground testimonies, the results from the PRA and through the analysis of Alos Palsar imagery from 2012. By doing so, pioneer roads cannot longer be differentiated from tertiary roads thus becoming part of one single network.

Now, keeping a cleared land in the Amazonia is a high-maintenance and costly activity. Cattle ranching is a very cheap and self-sustained mean to keep forest from re-growing, to prove land ownership and to generate revenues in the short and medium term. Therefore, although cattle ranching is a highly productive activity (mostly for large and well-capitalized agents) because of its low implementation/operational costs, the financial and tax benefits this activity receives and the growing demand of meat in the domestic market (Margulis 2004), it is an activity mostly implemented as an effective way to claim land ownership (Hecht 1993).

Therefore, depending on the scale of the agent, cattle ranching can be present at an area far from primary roads or “pioneer frontier” or in an area close to primary roads or “consolidated frontier” (Margulis 2004). In our case, the baseline scenario presents deforestation happening simultaneously in two fronts.

1. Timber extraction by the legal landowner

The forest in the Project Area is rich in valuable species that could be easily extracted and commercialized by the landowner.

According to the current Forest Code, the landowner could extract timber in all his area, including the 80% that should be kept as legal reserve. The provision under the legal reserve indicated that a landowner must keep 80% of his land as forest (Government 2012) (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5530639/).

The issue is that as long as the landowner keeps 80% of his land under the Brazilian definition of forest, any exploratory activity will be legal. However, such definition won’t prevent the forest ecosystem to become fragmented thus loosing biological richness.

1. Proposed AUD activities under REDD+ Project

The Project’s main activity is to continue monitoring to remove and prevent unplanned logging and encroaching activities, which results in a prevention of deforestation. In order to improve monitoring

results, local villages within the Project's Boundary will be offered the opportunity to participate as paid monitoring staff.

At the same time, it is a fact that the lack of land ownership promotes deforestation, so the Project –in and around the project area – in an agreement and in close participation with the landowner, will provide legal land titles to villagers within the Project's Boundary who develop their activities in the LMA and actively participate –and provide proven results- on forest conservation.

Detailed description of each activity follows as below;

i) Providing training on forest and biodiversity monitoring and management and opportunities to work as a monitoring/enforcement staff

The Project will have monitoring and enforcement brigades that are responsible for protecting sub-sectors of the Project Area, running demonstrational activities and performing biodiversity monitoring. A leader that is a trained technician or park ranger and a group of local villagers from within or around the Project Boundary will form such brigades. Eventually, brigade leaders will be local villagers that demonstrate exceptional capabilities and proved commitment to forest conservation.

Monitoring staff will communicate any sightseeing of illegal activities to the brigade leader who in turn will be in charge of communicating all events to a base office in Paragominas. The staff at the Paragominas office will make the appropriate reports to local authorities for them to go to the Project Area and deal with agents encroaching the Project Area.

Training for monitoring staff

Local villagers who wish to participate in the monitoring program will receive free training in methodologies and procedures to monitor the Project Area and to report any findings. Monitoring staff will be divided in groups dedicated to the surveillance of the Project Area, groups in charge of running demonstrational activities/social surveys and a group in charge of performing biodiversity monitoring.

In order to offer the same chances for all local villagers willing to engage in the monitoring activities, monitoring staff position will be rotational in the case that the supply of workforce is higher than the available jobs. The rotation period should be determined once Project's activities are implemented and the supply of work forced in adequately determined based on the census information. Figure 38 shows how brigades will be organized and Figure 39 shows the process to report illegal activities in the Project Area.

Figure 38. Local organization of monitoring tasks

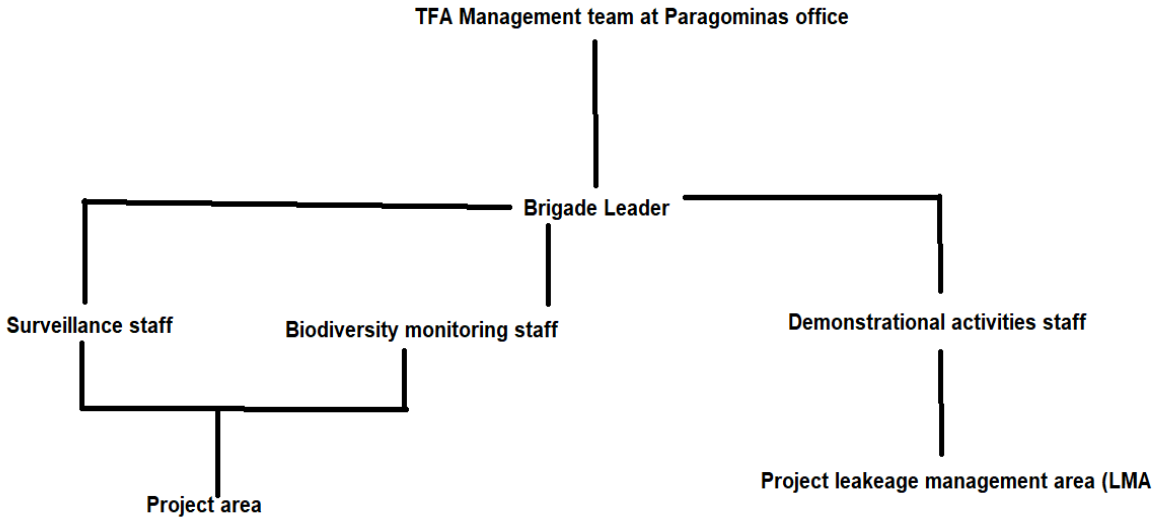
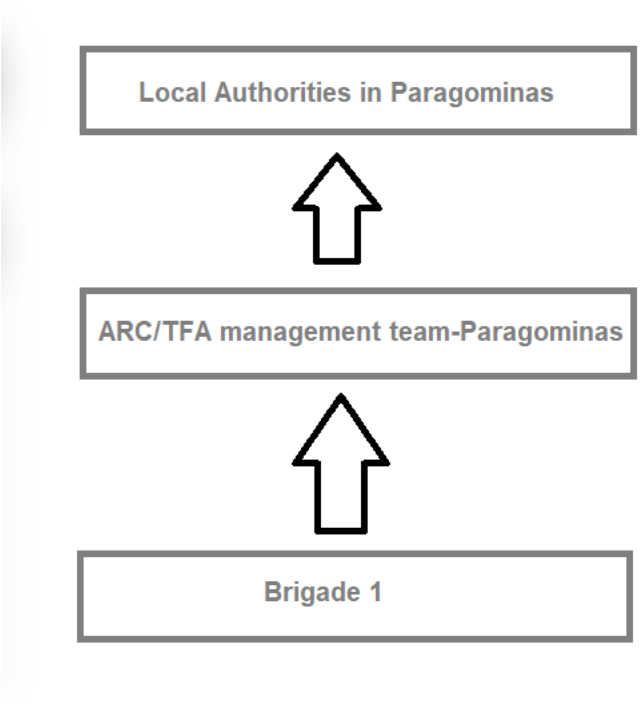


Figure 39: Reporting sequence for illegal activities in the Project Area



ii) Enhancing community's organizational capabilities

The Project management team will support local villages that wish to improve their level of organization and governance. To do this, the management team will engage local leaders to assess the best way on how to develop an organization system that works best, given the particular needs and economic activities of the villagers.

Villagers in the area usually see local priests, either Christian or Evangelic, as leaders. Therefore, developing and maintaining a good relation with local priests will be the first step to develop this proposed activity.

iii) Provide legal land-ownership rights versus results for conservation

The main objective of this activity is to create a sense of ownership and respect over the forest resource through an incentive as evidence shows that secured land tenure is a main factor to reduce deforestation.

The Project's Management Team in cooperation with the landowner have put forward a proposal to regularize land tenure status of those villagers living in the LMA. The landowner has signed an agreement to provide official land-use rights to villagers in the LMA with the hopes that they will own these lands in 40 years. Requirements to participate in this activity will be clearly explained to local villagers through workshops as part of the FPIC process during the census.

As a requirement to receive a land title, each villager will have to sign a conservation agreement that will mainly state that granted lands cannot be sold, productive activities cannot expand into the Project Area and that the land-use of the land cannot change into mining or pasture implementation. Such conservation agreement will be drafted collaboratively with local villagers under several PRA workshops as part of the census process.

Villagers in the LMA will be offered the opportunity to receive legally recognized land-use rights against the provision of conservation services to the Project such as (but not limited to) surveillance of illegal activities in the area and the premise of not encroaching the Project Area. Such land-use rights will be renewed every year accordingly to effective conservation results. At the end of the Project' lifetime each villager actively and effectively engaged in the proposed activity will receive an official title over his/her land under the binding conditions of the conservation agreement.

iv) Providing capacity building on steps to gain land use rights over Government owned forests

The Project cannot sign agreements as those explained in the aforementioned item number three with families living outside the Project Boundaries. However, the Project aims at providing guidance to these families on how to achieve land-use rights on lands that are not privately owned.

The idea is that the Project will provide capacity building in many areas not only to those families living within the LMA but also to those families in the proximities to help reduce the risk of leakage and to promote sustainable development in the area. So, it doesn't make any sense to provide all this training to families if they feel insecure about their rights over land, thus moving somewhere else. The Project will invest resources in training all these families in order to have them realize the benefits of it and making them to stay and support the Project protecting the forest.

Although the Project cannot guarantee that all families living outside the LMA will achieve a land-use permit, the management team will make the best effort to engage local authorities in Portel and to coordinate with local leaders to develop the best approach to solve this issue.

v) Providing capacity building in agroforestry techniques and implement agroforestry pilots

The Project LMA will be used as a showcase for local families to receive capacity training and to participate on agroforestry techniques. The Project will provide economic support to train and to implement agroforestry schemes such as home gardens, improved fallows, forest gardening and forest farming.

Through agroforestry it can be possible to diversify crops and to enhance productivity. This in turn will reduce the amount of land required to practice agriculture, which in turn reduces the risk of deforestation due to small-scale agriculture. Also, through forest gardening and forest farming villagers will come to see how the forest can provide benefits other than timber.

Agroforestry systems can be very simple to implement and can require low-maintenance. Also, such systems help diversifying food production and increases food security in areas of low productivity such as the acidic soils of the Amazon.

vi) Providing capacity building on improved efficiency cook stoves and implement cook stove pilots

In order to reduce the amount of firewood needed to produce cassava, the Project LMA will be used as a showcase for local families to receive capacity training and to participate on demonstrative activities on how to implement an energy efficient cook stove. The Project will provide economic support to train and to build such efficient cook stoves to those families willing to participate in the activities both in and outside the LMA.

Different types and sizes of energy efficient cook stoves will be tested to find the one that fits best for the necessities of local families. With this learning curve it will be easier to replicate the experience among other conservation Projects in the region.

vii) Providing capacity building to develop small sustainable business

The Project Proponent will set a trust fund setting aside a percentage of the net income from the sale of carbon credits. Such fund will be additional to the budget envisioned for the Project activities.

The Project will provide – in partnership with local comunities- capacity building to local families to develop and submit business plans (individually or in groups) to apply for funding to start small sustainable business that take advantage from non-timber products in the Project Area and LMA (i.e. based on agroforestry production, seed collection, etc.). The idea is to replace their dependence on timber extraction and sale for sustainable activities that can provide the same or better level of annual income.

viii) Providing capacity building to cattle ranchers that move inside the Project Boundary

Although is not possible to control the decisions of stakeholders in the area it is possible to influence them if they find some benefit in changing their business as usual behaviour.

The Project cannot offset the opportunity cost of cattle ranchers so the best it can do is to prevent leakage by providing training on the benefits and techniques of improved pastures managements. Brigades will conduct regular visits made around the perimeter of the project area to neighboring invader origins to meet and invite participation in leakage preventive measure activities.

This way, it is expected that cattle ranchers will internalize the benefits of making their activities more efficient in terms of land use thus requiring less area and in turn reducing the risk of deforestation outside the Project Area.

Consistency of credible land-use scenarios with enforced mandatory applicable laws and regulations

We base our consistency analysis in the laws and regulations which is presented in Table 12 below:

Table 12: Relevant Laws and Regulations Applicable to the Project to Demonstrate Baseline Scenarios Consistency

Law / Regulations	Description Relevant to the Project
Forest Code, Law 12.651, May 25th 2012	The Forest Code indicates that all landowners of forestlands in the Legal Amazonia should preserve 80% of their land as a legal reserve. However, a landowner can explore the legal reserve of his property as long as the legal reserve stays as forest (according to Brazil's definition).
Constitution of the Federative Republic of Brazil, 1988	Chapter II Indicates that is legal to occupy unused (or not under a productive activity) either public or private land. Such land can be expropriated for the benefit of that who put it to generate benefits for the society.
Normative instruction number 5, December 11th 2006	Provides technical procedures for development, presentation, execution and feasibility assessment for Sustainable Forest Management Plan (PMFSs) in primary forest and its successions in Legal Amazon.
Resolution number 406, February 2nd 2009 – Minister of environment – National council for environment	Article 1st establish technical parameters for development, presentation, implementation and technical evaluation of Sustainable Forest Management Plans PMFS with timber processing purposes from native forests and its succession in the Amazon biome. It will have to be applied by any level of competence by the units of the National System for the Environment – SISNAMA observing what is written in this resolution

Normative Instruction number 2, June 27 2007 – MMA	It provides modifications on the Normative instruction number 5, December 2006. Article 1st. The articles 8th, 28th and 43rd of the Normative Instruction No 5, December 5 2006, published in the official daily noticed of December 13th 2006, section 1, page 155 and 159, now has the following written: "I – maintenance of at least 10% of the number of tress per species, in the exploration area UPA, which attend the criteria of selection for harvest previously indicated in the PMFS, respecting the limits of at least 3 trees per species per 100 ha, in each UT; and II – maintenance of all tress which abundance of trees with DBH is superior to the DMC is the same or below 3 trees per 100 hectares in the UPA area, for each UT."
Normative Instruction number 012, November 30th 2006 – SECTAM	Establish norms and procedures to guide the use of the Forest Guidance note – GFPA. For transport of products and/or sub-products from forest in Pará. Article 1st – the use of Forest guidance note – GF – PA for the transport of products and or sub-products from forest in Pará, which is written in article 6th item V, of State decree number 2592, November 27 2006. Article 2nd – Forest Guidance note – GF-PA will be issued on the following models for the diverse modalities defined in this Normative Instruction: I. GF Model 1 – GF1- PA; II. GF Modelo 2 – GF2-PA; III. GF Model 3 – GF3-PA; e IV. GF Model 4 – GF4-PA
Normative Instruction number 014, November 30 2006 – SECTAM	Defines the requirements to register activities in a database for activities for technical defense – CTDAM. Considering the necessity to regulate item I, from article 1st, from decree number 5741, December 19th 2002, that established the activities for technical environment defense database, considering the necessity to publish the list of professionals able to develop the environmental Projects in the state of Pará; AGREE: Article 1st – define the necessary documents for the annual

	registry of the database for the activities for technical environment defense.
Normative Instruction number 7/2006, September 27 2006 – SEMA, regarding the Sustainable Forest Management Plan (PMFS)	Article 10, The Sustainable Forest Management Plan (PMFS) must follow. I – the intensity of harvest no higher than 30 m3/hectare in case machines are used for harvest. In this case the initial rotation is 35 years; II – harvest intensity no higher to 10 m3/hectare in case no machine is used for harvesting. It is understood by harvest intensity: the commercial volume of the harvest trees, estimated by volumetric equations presented in the PMFS base on the inventory 100%, expressed in cubic meters per unit of work (UT). Article 20, The PMFS must follow the criteria for tree selection: I – diameter at breast high lower than 50cm, except in the cases where technical justification based on forest inventory data; II – present in the forest inventory 100% density equal or below 3 units for 100 hectares.

Now, we present first a consistency analysis for the three scenarios, the two without-project scenarios and the project scenario.

1. Forest encroachment by pioneer activities followed by deforestation to implement pastures

The scenario of pastures implementation consists in two different processes that include a set of activities happening simultaneously within the Reference Region of the Project. For this reason, it is necessary to break it down in its individual components, as presented below:

A. Small-scale slash and burn subsistence agriculture along river shores:

Landless people can occupy, gain land-use rights and eventually land titles over public or private forested land that is under no-productive use (land with forest cover is assumed under no use). In the case of private land invasions, it is legal unless the legal landowner make a claim to INCRA stating his land is being invaded and cannot be expropriated (Araujo, Bonjean et al. 2009).

So, settlements can be created but registration takes time and is not usually done. Settlers can gain legal land-use rights to undertake sustainable land uses after proving five consecutive years of productive use of the land. After this five-year period, settlers can start the process to gain property titles. In both cases, given the long distances to the closest town (Paragominas), it is not common for settlers to undertake such regularization processes (Araujo, Bonjean et al. 2009).

If the landowner doesn't prove that there are productive activities going on in his/her land (either extractive or non-extractive) then settlers are not acting outside the law when developing a village.

Settlement areas allow landless people to establish and develop small-scale productive activities for self-consumption and to make small economic profits (i.e. non-industrial scale agriculture). Thus, settlers use one of the most common practices in tropical forests to prepare the land for agricultural activities, known as slash and burn which requires the clearing of a small patch of forested land and then burning of the trees that have been cut using a controlled fire. Once the land is ready for agriculture, settlers grow mainly cassava (for consumption and to make "farinha") and other crops.

B. Progressive unplanned timber extraction and post-extraction pastures implementation:

As previously explained, when the presence of a landowner is not made evident by monitoring or other activities, private lands are susceptible to invasion. Invaders make a profit by grabbing forested lands that seem to be free or under no-productive use (or with forest cover), claiming land titles and finally selling the land to final deforestation agents. (Fearnside 2001; Margulis 2004).

Squatters are supported by the current Constitution of 1988, under the provision that public or private land that is not under productive use can be claimed by someone else (Araujo, Bonjean et al. 2009).

Unplanned logging activities are not legal, but there is a state-wide lack on enforcement capacity by IBAMA, which is the institution in charge of environmental monitoring (BRITO 2005, Brito, B., Barreto, P. and Rothman, J. 2005 Brazil's new environmental crimes law: an analysis of its effectiveness in protecting the Amazonian forests. Newsletter INECE no. 11, Belém, Brazil); (Millikan et al., 2015, The context of REDD+ in Brazil Drivers, agents and institutions, Center for International Forestry Research). Lack of enforcement in Paragominas and Ulianopolis – which is the smallest administrative unit that encompasses the Project- is made evident by the increasing deforestation area according to INPE (INPE 2012). Also, most of the timber in Brazil is known to come from illegal sources (May, Millikan et al. 2011).

Additionally, logging companies may have forest concessions for sustainable timber extraction but due to corruption and weak law enforcement, come of these companies illegally extract timber from areas outside their concessions with no regards on sustainable forestry practices. As a result, illegal logging is widely spread not only in Paragominas (which is the one of the administrative unit that encompasses the Project) but entirely in the state of Para as well (Henrique M. Pereira,2010,Scenarios for Global Biodiversity in the 21st Century, science. Vol(330)6010:1496-1501).

This is also evident by the fact that forest cover loss is increasing in the Project's reference region while illegal logging rates have been decreasing in the last years. In a study developed by IMAZON, it was reported that 435 authorizations for forest management activities in Pará were issued, spanning 280.000 hectares. From this sum, 90% were proved to have legal issuance documents, while 10% had irregularities, such as: the authorized area for exploration was smaller than the area in which the operation took place, the authorized area for exploration was in an already deforested location, or the income of the commercialized wood did not correspond to the area explored (Pedro et al.2018, Fake legal logging in the Brazilian Amazon. science advances. 4(8): eaat1192).

As for cattle ranching, this is a legal activity to undertake in the area. Cattle ranching will start at small scale with squatters and then will scale-up with the arrival of larger agents. In both cases,

cattle ranching is used to prove land ownership and of course because of the economic revenues that generates.

1. Timber extraction by the legal landowner

   As mentioned before, timber extraction is a legal activity as long as the landowner keeps 80% of his land as a legal reserve. Even so, exploratory activities for timber extraction area allowed to be performed in the legal reserve area as long as this area stays as forest according to the Brazilian definition (1ha with 30% of canopy cover with trees of at least 5 meters high).

   In conclusion, a landowner can legally extract timber from his area as long as 80% of his/her area complies with the country's definition of forest.

2. Proposed AUD Project activities

   The Project activities aim to conserve the forest, generate long-term positive impact on the climate, communities, and biodiversity. Therefore the Project activities comply with national and local regulations like the Forest Code and the Constitution of 1988.

   Conclusion: The Consistency Analysis shows that all three scenarios are in compliance with mandatory legislation and regulations taking into account their enforcement in the region. In the case of unplanned logging that is an agent that precedes deforestation by ranchers, it has been proven that there is lack of enforcement is widely spread not only in Paragominas, Ulianopolis and Nova Esperanca do Piria but also in entire Para.

   STEP 2: Investment analysis to determine that the proposed Project activity is not the most economically or financially attractive of the identified land-use scenarios

   Sub-step 2a. Determine appropriate analysis method

   Due to the fact that the Project is a conservation Project with no other sources of income besides carbon revenues, a simple cost analysis will be applied to prove additionality. Given that carbon credit revenue is the only source of financing for this Project, without this source (or the future expectation of carbon finance) no AUD activities could be implemented and BaU baseline scenarios would take place in the Project Area.

   Consequently, in the absence of VCS-related income, it is expected that the project activity will generate no revenue, and therefore the simple cost analysis is the appropriate method to demonstrate that the project activity is financially less attractive than alternatives.

   Since the beginning of the Project, the AUD activities were envisioned to be feasible only if carbon credits revenue would be available. Furthermore, initial financing for the Project, received exclusively from private investors will cover 100% of the Project's costs over the first years. Again, this is a clear indication that without carbon finance Project activities cannot be undertaken and therefore are additional.

Sub-step 2b. Option 1 – Simple cost analysis

The simple cost analysis is basically a Project cost description along the crediting period. It aims to demonstrate all the costs associated to development and implementation of the Project. When Projects have no other revenue but the carbon credits, it is allowed to use this financial analysis.

Annual ARC operational expenditures (both planned and actual), covering governance and administration as well as protection and management, for the 2015/2016 to and 2018/2019 years are detailed in the table below. Anticipated operational expenditures, with full implementation of the project activity, are expected to be similar to or more than the "planned" budget figures below.

Table 13. Annual ARC operational expenditures

Costs	2015	2015	2016	2016	2017	2017	2018	2018	2019	2019
	planned	*actual*	*planned*	*actual*	*planned*	*actual*	*planned*	*actual*	*planned*	*actual*
	US$	US$	US$	US$	US$	US$	US$	US$	US$	US$
Salary and Allowance for Guards	$ 40,500	$ 43,203	$ 45,000	$ 44,385	$ 45,000	$ 45,245	$ 45,000	$ 47,502	$ 47,500	$ 48,230
Community Equipment	$ 1,23,000	$ 12,345	$ 12,500	$ 12,450	$ 12,750	$ 12,604	$ 13,005	$ 13,432	$ 13,265	$ 15,234
Travel	$ 25,000	$ 24,585	$ 25,500	$ 23,458	$ 26,010	$ 24,240	$ 26,530	$ 25,063	$ 27,061	$ 26,042
Meetings	$ 2,500	$ 2,345	$ 2,500	$ 2,456	$ 2,500	$ 2,450	$ 2,500	$ 2,350	$ 2,500	$ 2,565
Building	$ 15,000	$ 14,506	$ 15,300	$ 14,605	$ 15,606	$ 15,340	$ 15,918	$ 15,200	$ 16,236	$ 15,240
Manager	$ 39,000	$ 39,000	$ 40,560	$ 40,560	$ 42,182	$ 42,182	$ 43,870	$ 43,870	$ 45,624	$ 45,624
Audit of village development projects	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 5,000	$ 25,000	$ 25,000
Cook Stoves	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000
Oil/petrol/	$ 1,500	$ 2,900	$ 3,000	$ 2,850	$ 3,000	$ 2,750	$ 3,000	$ 2,955	$ 3,000	$ 3,030

Transportation equipment	$ 37,500	$ 40,108	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Education/ Workers Teacher	$ 9,750	$ 9,750	$ 10,140	$ 10,140	$ 10,546	$ 10,546	$ 10,967	$ 10,967	$ 11,406	$ 11,406
TOTAL	**$ 2,99,750**	**$1,94,742**	**$1,60,500**	**$ 1,56,904**	**$1,63,594**	**$ 1,61,357**	**$ 1,66,790**	**$ 1,67,339**	**$ 1,92,593**	**$ 1,93,372**

Budget expenditures for ARC REDD, in the absence of carbon revenue, are far below what is needed for the effective protection and management of the area. Actual expenditures ranged from 28% to 33% of planned expenditures for the 2015-2019 period (analysis above in table 13). A "low end" estimate of required annual expenditure of US$138,479 far exceeds actual total annual expenditures for 2015-2019 of ~US$18,56,941 (Table 12, accounting data). As stated, the US$18,56,941 suggested budget is a low-end estimate - effective anti-poaching efforts at the project area costs the equivalent of 150 km^2 which would put the corresponding ARC budget requirement at approximately US$650,000. Not surprisingly, with so little financing available, most (>90%) of ARC expenditures currently go to core governance and administrative costs, and the remainder of only 8.8% is spent on resource management and protection imposing a further constraint on implementation of the ARC REDD.

ARC REDD is uniquely disadvantaged due to its remoteness and difficulty of access, and poor potential for photographic tourism; photo-tourism is a key determining factor in the few "strongly financially viable" forest areas in the state of Para in Brazil. ARC project currently has no accommodation infrastructure to facilitate tourism. While ARC currently has some hope to generate some revenue from VCS which is essential to achieve effective resource protection and effectively carry out the project REDD activity.

Compare annual budget spent from 2015-2019 destined for management of the project, to the estimated required annual budget of US$138,479 on an average; current revenue sources is "zero". And as explained above, other activiites like small scale agriculture, tourism revenue is expected to be zero without effective management and protection measures in place.

In conclusion it is demonstrated that a large amount of initial capital is required for the set-up of the Project.

As demonstrated above, the project without the financial benefits of VCS-related carbon payments is not financially competitive with reasonable alternative economic activities.

STEP 3. Barrier analysis

Not applicable.

STEP 4. Common practice analysis

The project activity, Alternative 2, involving sufficient financing and effective implementation of an ARC REDD project is not common practice. The clearly-demonstrated financial challenges of ARC

are not peculiar to forest areas in Brazil. Most forest areas are not earning sufficient revenue to cover costs. Brazil needs compensation if it is to protect the Amazon

An evaluation from National and Subnational Analysis for the Period 2009 through 2016 from A forest trend REDDX report says that ;

“More financial resources are needed. Over US$2.2 billion has been committed to the development of REDD+ activities in Brazil from 2009 through September 2016, and this helped Brazil to become a global leader in reducing its emissions from deforestation. But in order to continue this progress and meet its current and future deforestation reduction goals, they need to find additional resources that are predictable and can generate a large amount of resources for performance-based payments”.

Similarly, a recent evaluation of the financial viability of forests in Brazil (2016) assessed more than half of those forest types evaluated as “marginally viable” or “non-viable.”

Thus, a native amazon forest with sufficient financing for effective management and protection, in the absence of carbon revenue (or other as yet to be developed alternative revenue sources), cannot be characterized as common practice.

16 (Andreea Leonte, 2019, https://www.ft.com/content/37179794-cef8-11e9-b018-ca4456540ea6.

Results of the Additionality Analysis:

As demonstrated, the project activity, without revenue from carbon credits, faces severe financial constraints, and is not a common practice in the region. Therefore, the project is determined to be additional.

3.1.6 Methodology Deviations

No deviation of methodology was applied in this Project.

3.2 Quantification of GHG Emission Reductions and Removals

3.2.1 Baseline Emissions

Development of the project baseline emissions from unplanned deforestation, both rate and location, was conducted in conformance with the VCS modular REDD methodology VM0015 Ver1.1.

Step 5 of VM0015 - Definition of the Component of Changes in Land Use and Coverage in the Baseline activity data calculation by forest class:

This calculation combined the maps of annual baseline deforestation of each future year produced with the land-use and land-cover map produced for the initial situation in Step 2 to produce a set of maps showing for each forest class the polygons that would be deforested each year in absence of the project activity. Were extract from these maps the number of hectares of each forest class that would be deforested and the results of the baseline projections showed a deforestation of

approximately 31,252 hectares in the Project Area between 2015 and 2045 and 532,387 hectares in the Leakage Belt.

Table 14. Annual areas deforested per forest class icl within the Project Area in the baseline case (Table 11b of VM0015)

Area deforested per forest class *icl* within the project area		Total baseline deforestation in the project area	
ID_{icl}>	1		
Name >	Ombrophile Dense	annual	cumulative
Project year *t*	*ha*	$ABSLPA_t$ ha	*ABSLPA* ha
1	1,061.9	1,061.9	1,061.9
2	1,407.8	1,407.8	2,469.7
3	1,610.3	1,610.3	4,080.0
4	1,539.0	1,539.0	5,619.0
5	1,412.6	1,412.6	7,031.6
6	1,198.0	1,198.0	8,229.6
7	1,219.9	1,219.9	9,449.5
8	1,076.5	1,076.5	10,526.0
9	988.2	988.2	11,514.2
10	906.4	906.4	12,420.5
11	844.8	844.8	13,265.4
12	830.3	830.3	14,095.6
13	788.9	788.9	14,884.6
14	710.4	710.4	15,594.9
15	766.3	766.3	16,361.2
16	779.2	779.2	17,140.4
17	760.6	760.6	17,901.0
18	760.6	760.6	18,661.6

19	757.3	757.3	19,418.9
20	769.5	769.5	20,188.4
21	816.5	816.5	21,004.9
22	798.7	798.7	21,803.6
23	975.2	975.2	22,778.8
24	1,036.8	1,036.8	23,815.6
25	1,022.2	1,022.2	24,837.8
26	1,102.4	1,102.4	25,940.3
27	1,110.5	1,110.5	27,050.8
28	1,181.0	1,181.0	28,231.7
29	1,419.9	1,419.9	29,651.7
30	1,600.6	1,600.6	31,252.2

Table 15. Annual areas deforested per forest class icl within the Leakage Belt in the baseline case (Table 11c of VM0015)

Area deforested per forest class *icl* within the leakage belt		Total baseline deforestation in the leakage belt	
ID_{icl}>	1		
Name >	Ombrophile Dense	annual	cumulative
Project year *t*	*ha*	$ABSLLK_t$ ha	*ABSLLK* ha
1	17,726.0	17,726.0	17,726.0
2	17,380.2	17,380.2	35,106.2
3	17,177.7	17,177.7	52,283.9
4	17,248.9	17,248.9	69,532.8
5	17,375.3	17,375.3	86,908.1
6	17,590.0	17,590.0	1,04,498.1
7	17,568.1	17,568.1	1,22,066.2
8	17,711.5	17,711.5	1,39,777.7
9	17,799.8	17,799.8	1,57,577.4

10	17,881.6	17,881.6	1,75,459.0
11	17,943.1	17,943.1	1,93,402.1
12	17,957.7	17,957.7	2,11,359.8
13	17,999.0	17,999.0	2,29,358.8
14	18,077.6	18,077.6	2,47,436.4
15	18,021.7	18,021.7	2,65,458.1
16	18,008.7	18,008.7	2,83,466.8
17	18,027.4	18,027.4	3,01,494.1
18	18,027.4	18,027.4	3,19,521.5
19	18,030.6	18,030.6	3,37,552.1
20	18,018.4	18,018.4	3,55,570.6
21	17,971.5	17,971.5	3,73,542.0
22	17,989.3	17,989.3	3,91,531.3
23	17,812.7	17,812.7	4,09,344.0
24	17,751.2	17,751.2	4,27,095.2
25	17,765.7	17,765.7	4,44,860.9
26	17,685.5	17,685.5	4,62,546.4
27	17,677.4	17,677.4	4,80,223.9
28	17,607.0	17,607.0	4,97,830.9
29	17,368.0	17,368.0	5,15,198.9
30	17,187.4	17,187.4	5,32,386.3

Calculation of baseline activity data by post-deforestation class:

As available in methodology VM0015, method 1 was used to determine the substitute class of forest cover in the baseline of the Project (indicated as anthropic Vegetation in Balance). Table 16 shows the area of project zone, which comprises the Project area, the leakage belt and the leakage management areas, as well as the corresponding areas of each class of use and coverage after deforestation.

Table 16: Areas of the reference region covering different combinations of potential post-deforestation classes.

Zone		Name		Total of all other LU/LC classes present in the zone		Total area	
		Zone					
		ID_{fcl}	1				
		Area	% of Zone	Area	% of Zone	Area	% of Zone
ID*z*	**Name**	**ha**	**%**	**ha**	**ha**	**ha**	**%**
1	ARC REDD	53,528	100	6,901	12.15%	53,528	100
Total area per class *fcl*		53,528	100	6,901	12.15%	53,528	100

The reference region for rate of deforestation (RRD) has a total area of 751,518 ha and is delineated as shown in Figure 40. It excludes the project area and leakage belt, and all non-forested areas at the start of the historical reference period in the year 2005. Further, the reference region has been defined with knowledge of the drivers of unplanned deforestation in the region. A guiding principle in the delineation of the reference region was, to the extent possible within the requirements of the VM0015 methodology, to reflect political boundaries (districts), to facilitate any eventual alignment with an anticipated Government of Brazil jurisdictional REDD framework. The main agents of deforestation in the RRD are small scale farmers who intend on establishing croplands through conversion of forest land. The proportion of agriculturalist to ranchers is the same in the RRD as is expected in the project area in the baseline case. Landscape factors (i.e., soil type, vegetation type, elevation, and slope) do not drive agricultural decisions for small scale farmers. Maps of the landscape factors, including forest type, soil type, slope, and elevation that were used to help define the reference region and ensure similarity to the project area can be found in the project database. Incorporation of these landscape factors had little effect on delineating the RRD as almost all land in the RRD is suitable for conversion to agricultural land. Land tenure was also used to help delineate the RRD. Specifically, national parks, forest reserves, and game reserve were excluded from the RRD as these areas differ from the privately-owned project area. Comparison of the area covered by landscape factors, transportation networks and human infrastructure are detailed in the Table 17 below.

Figure 40. Reference Region for Rate (RRD) and Reference Region for Location (RRL)

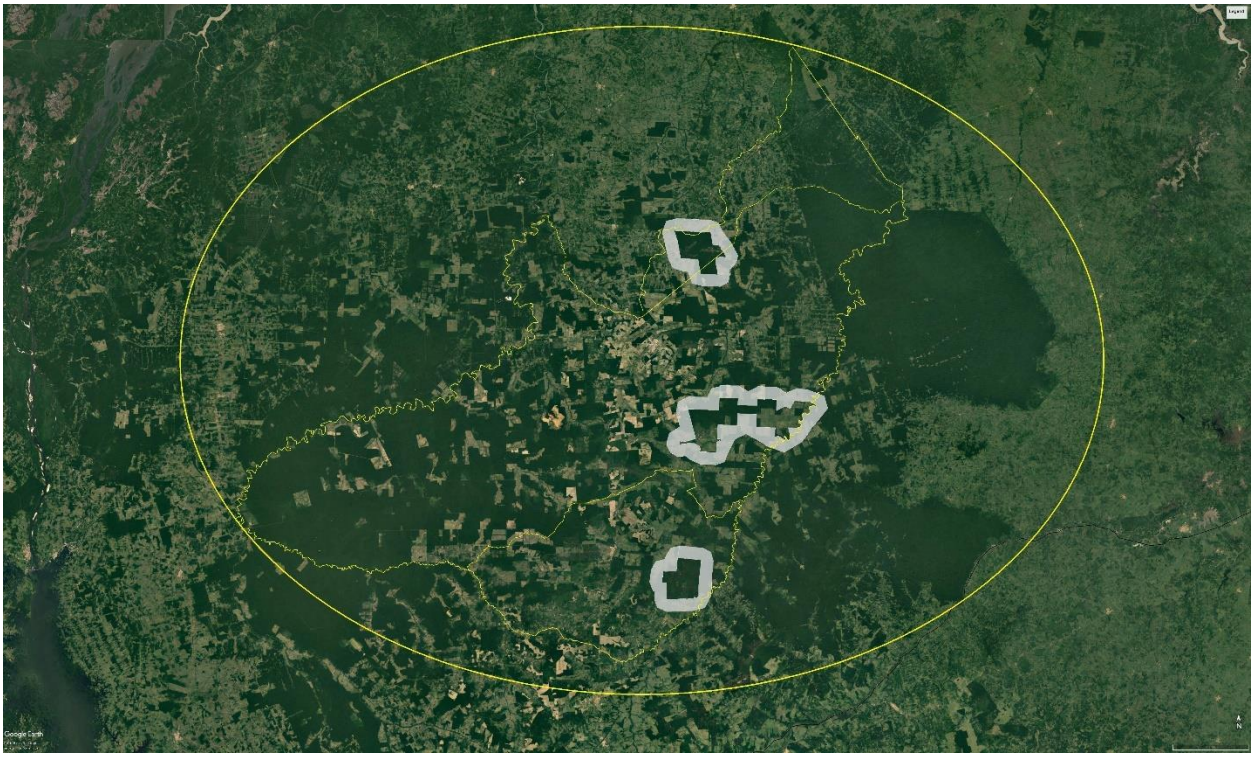


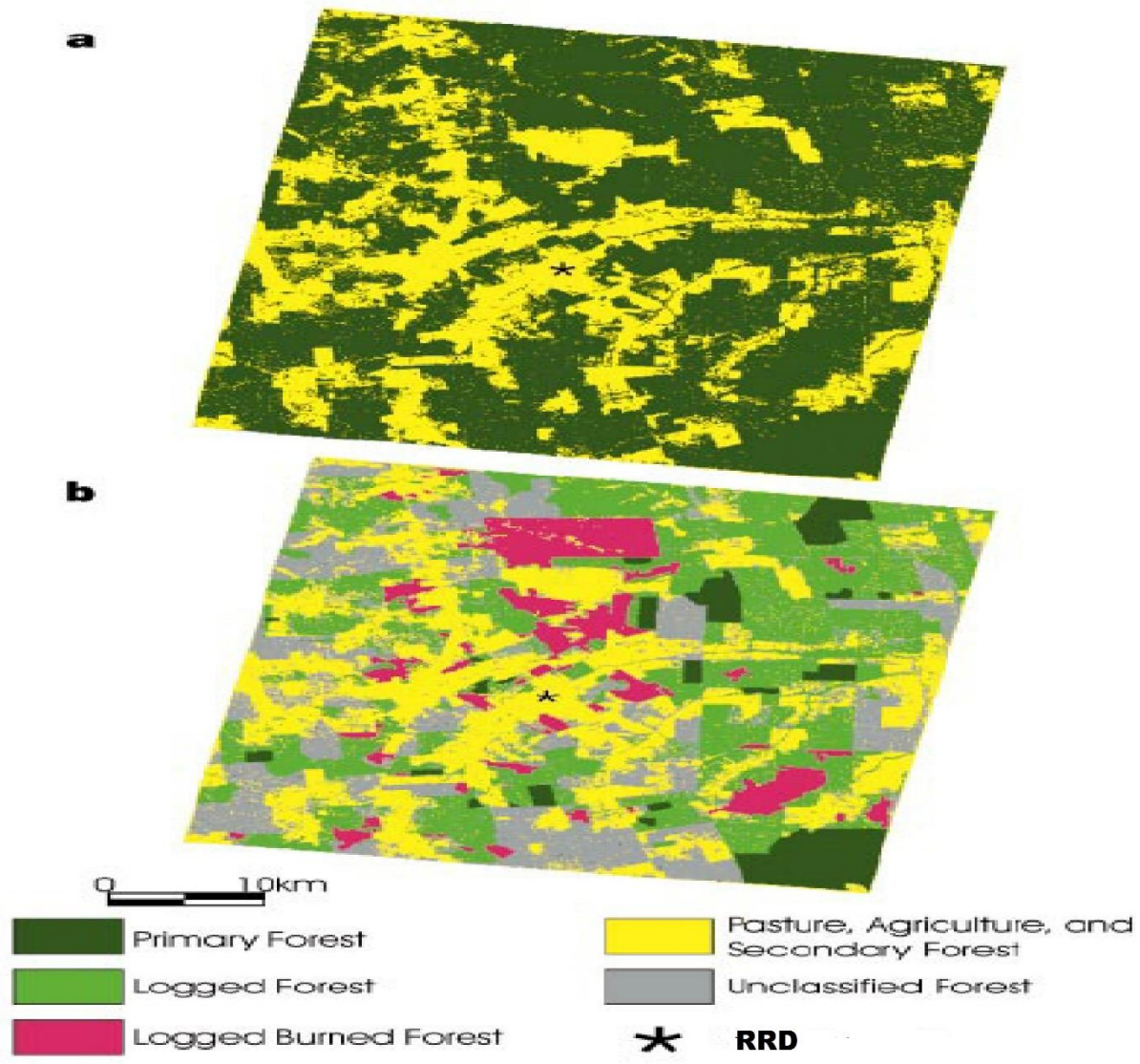
Table 17. Criteria for defining the boundary of the RRD and leakage belt

Class Identifier		Broad class	Trend in Carbon stock	Presence in[2]	Activities in the baseline case[3]		
ID_{cl}	Name				LG	FW	CP
001	Ombrofile Forest	Forest Land	decreasing	RR	yes	no	no
002	Grassland	Grassland	constant	RR	no	no	no
003	Cropland	Crop Land	constant	RR	no	no	no
004	Ombrofile Forest	Forest Land	decreasing	PA	yes	no	no
005	Grassland	Grassland	constant	PA	no	no	no
006	Cropland	Crop Land	constant	PA	no	no	no
007	Ombrofile Forest	Forest Land	decreasing	LK	yes	no	no
008	Grassland	Grassland	constant	LK	no	no	no
009	Cropland	Crop Land	constant	LK	no	no	no

The area of the RRD is larger than the minimum required (MREF). The MREF was calculated to be 2,522,426 ha. The reference region for projecting location of deforestation (RRL) is delineated

as shown in Figure 41. The entire RRL is located within the outer perimeter of the RRD and has an area of 5,044,852 hectares. Conservation lands removed include national parks, forest reserves, and game reserves.

Figure 41. Forest/non-forest map, with the non-forest class



The Table 18 and Table 19 shows the area projected to be deforested in each zone for the Project Area and Leakage Belt, respectively.

Table 18. Annual areas deforested in each zone within the Project Area in the baseline case (Table 13b of VM0015)

Area established after deforestation per zone within the project area		Total baseline deforestation in the project area	
IDz >	1		
Name >	Zone 1	$ABSLPA_t$	*ABSLPA*
Project year *t*	ha	ha	ha
0	0	0	0
1	1,062	1061.91	1061.91
2	1,408	1407.78	2469.69
3	1,610	1610.28	4079.97
4	1,539	1539	5618.97
5	1,413	1412.64	7031.61
6	1,198	1197.99	8229.6
7	1,220	1219.86	9449.46
8	1,076	1076.49	10525.95
9	988	988.2	11514.15
10	906	906.39	12420.54
11	845	844.83	13265.37
12	830	830.25	14095.62
13	789	788.94	14884.56
14	710	710.37	15594.93
15	766	766.26	16361.19
16	779	779.22	17140.41
17	761	760.59	17901
18	761	760.59	18661.59
19	757	757.35	19418.94
20	770	769.5	20188.44
21	816	816.48	21004.92
22	799	798.66	21803.58
23	975	975.24	22778.82
24	1,037	1036.8	23815.62
25	1,022	1022.22	24837.84
26	1,102	1102.41	25940.25
27	1,111	1110.51	27050.76
28	1,181	1180.98	28231.74
29	1,420	1419.93	29651.67
30	1,601	1600.56	31252.23

Table 19. Annual areas deforested in each zone within the Leakage Belt in the baseline case (Table 13c of VM0015)

IDz >	1	Total baseline deforestation in the leakage belt	
Name >	Zone 1	$ABSLLK_t$	*ABSLLK*
Project year *t*	ha	ha	ha
0		0	0
1	17726.04	17726.04	17726.04
2	17380.17	17380.17	35106.21
3	17177.67	17177.67	52283.88
4	17248.95	17248.95	69532.83
5	17375.31	17375.31	86908.14
6	17589.96	17589.96	104498.1
7	17568.09	17568.09	122066.19
8	17711.46	17711.46	139777.65
9	17799.75	17799.75	157577.4
10	17881.56	17881.56	175458.96
11	17943.12	17943.12	193402.08
12	17957.7	17957.7	211359.78
13	17999.01	17999.01	229358.79
14	18077.58	18077.58	247436.37
15	18021.69	18021.69	265458.06
16	18008.73	18008.73	283466.79
17	18027.36	18027.36	301494.15
18	18027.36	18027.36	319521.51
19	18030.6	18030.6	337552.11
20	18018.45	18018.45	355570.56
21	17971.47	17971.47	373542.03
22	17989.29	17989.29	391531.32
23	17812.71	17812.71	409344.03
24	17751.15	17751.15	427095.18
25	17765.73	17765.73	444860.91
26	17685.54	17685.54	462546.45
27	17677.44	17677.44	480223.89
28	17606.97	17606.97	497830.86
29	17368.02	17368.02	515198.88
30	17187.39	17187.39	532386.27

Table 20. Physical boundaries of the project

Reference Region for Deforestation (RRD)	Area: 2,522,426 Ha Historical deforestation rate: 1.7% Vegetation: Ombrophilous Forest Elevation range: 119 m Average slope: 12 Annual average precipitation: 1700 mm Agents and drivers of deforestation: main agents of deforestation are cattle ranchers (98%) followed by smallscale farmers (2%) Land Tenure: both public and private lands Law enforcement on land tenure rights: weak.
Project Boundary (PB)	Refers to the total area under control of the Project Proposer and includes the Project Area and LMA Area: 72,503 Ha Agents and drivers of deforestation: small-scale farmers. Land Tenure: private lands Law enforcement on land tenure rights: weak.
Project Area (PA)	Forested land where GHG emission reduction benefits will be accounted. The Minimum Mapping Unit (MMU) was the Brazilian definition of Forest, which is 1ha with more than 30% forest cover, and 5 meters of tree height. Area: 53,528 Ha Vegetation: Ombrophilous Forest Elevation range: 0-100m Average slope: 6

	Annual average precipitation: 1700 mm Land Tenure: private lands Law enforcement on land tenure rights: weak.
Leakage Belt (LK)	Cumulative of areas that presents the highest risk of deforestation due to displacement of deforestation agents by the Project Activities. Area: 18,975 Ha Agents and drivers of deforestation: illegal loggers, squatters, and small-scale farmers
Leakage Management Areas (LMA)	Non-forest areas within the PB. It is currently in these areas that local population and communities live and where the Project Activities will take place. Area: 18,975 Ha

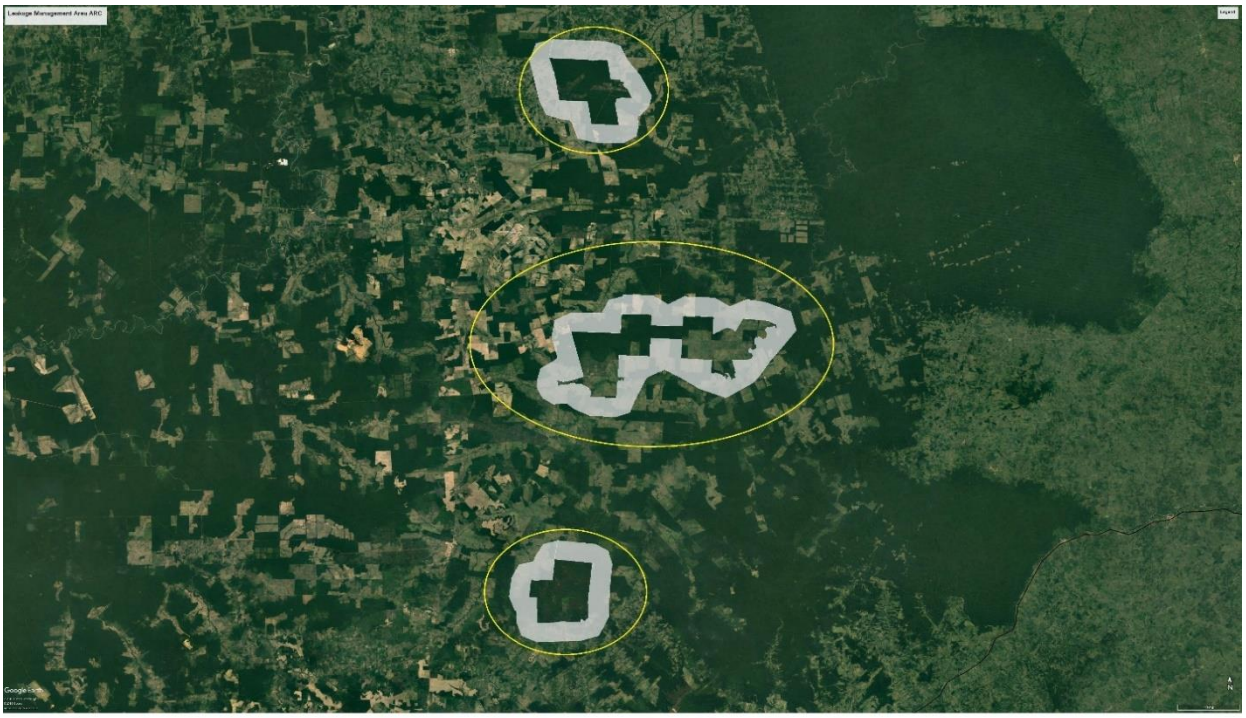
Project Area:

The project area consists of one contiguous parcel of land near the Paragominas and other two municipalities of the Belem boundary in north east Brazil which is under threat of deforestation. The project proponents are undertaking project activities in and around the project area to mitigate deforestation pressures and stop deforestation. The total project area is 53,528 hectares and was 100% forested at the start of the project. The project areas boundaries were delineated and georeferenced as part of the establishment of the REDD project.

Leakage Belt:

The leakage belt is the area surrounding or in the immediate vicinity of the project area where leakage caused by activity displacement is expected to occur. Parts of the leakage belt boundaries were delineated and georeferenced were delineated and georeferenced as part of the establishment of the ARC REDD, as the leakage belt shares a border with the project area.

Figure 42. Leakage Belt Demonstrating Exclusion of Historically Deforested Areas.



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

Does not apply.

Step 6 of VM0015 - Estimation of Changes in Carbon Stocks and Non-CO2 Emissions at Baseline

The estimate of the carbon stock for the Forest class was reached through forest inventory carried out by the technical team of ARC, in the year 2019. The main results found in this study will be described below,

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

The implementation of the forest inventory in the REDD project area adopted the recommendations presented in the VCS approved methodology VM0015, distributing the plots proportionally to the area of each typology and considering a uniform distribution of plots in the management area. Physical Parameters a total of 3 strata were identified in the Project area, which resulted in a total of 75 planned initial sample units. In addition, it was also considered an analysis for the plots implanted in managed areas and unmanaged areas. All plots were evenly distributed to cover much of the Project area.

According to E. Tomppo et al. (eds.), National Forest Inventories (2010), the permanent plots may be have a circular, square or rectangular shape. However, the most used shape is the square in tropical forests. Based on this guideline, the inventory was carried out in 1-hectare square plots, as it was found that with this format and dimension it is possible to obtain greater representativity and less difficulty of operation.

For each plot, data will be collected from the arboreal stratum, collecting individuals with Diameter at the Chest Height (DCH) of more than 15 centimetres and for better ordering each plot was divided into subunits of 0.25 hectares. Each implemented plot received an identification plate with the unit number, this numbering was allocated at the start point of each plot, and was also done for the subunits (Figure 43).

Figure 43. Allocation of sample forest inventory units in the Project Area

Estimated Variables: Biomass and Carbon

Dry Biomass

The above-ground dry biomass of the Project area was estimated using allometric equations, and ten different models were tested (Chave et al., 2005; Tre allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145(1):87-99). All of them adopt the diameter above the soil (DCH> 10 cm) of the trees sampled as an independent variable, while others consider, in addition to the DCH, the basic density of the tree species. DCH values above the maximum value used for the development of the allometric equations tested were truncated to the maximum value. Basic wood density values were obtained from the Global Wood Density Database. Due to the fact that the database reports more than one density value per species, the average of the values reported by species for the Project region was preferably used.

For cases where this information was not present, the global averages of the values reported for the species were adopted. However, when species-specific values were not available, the average

biomass of the arboreal genus was adopted, according to the standard procedure typically reported in the literature (IPCC default values). We emphasize that below-ground biomass is already included in the estimation. To quantify the biomass, we used the allometric equation described by Nogueira et al. (2008) (Euler MeloNogueira, 2008. Estimates of forest biomass in the Brazilian Amazon: New allometric equations and adjustments to biomass from wood-volume inventories. Forest Ecology and Management.256(11):1853-1867), showing more appropriate for the region of study. The following is a description of equation (4):

$$B = \exp(-1.716 + 2.413 * \ln(DAP))$$

Where:

B: dry biomass (kg);

DCH: diameter at breast height (1.30 cm);

Carbon Content

In accordance with the methodology VM0015, the carbon stocks were quantified in tons of carbon dioxide equivalent per hectare (tCO2-e ha-1). For calculations and conservatively, the estimated carbon stocks considered only the biomass reservoirs above and below the ground. The following equation was used for the conversion of the dry biomass into tCO2-e ha-1 based on the sampled trees and their respective plots and subplots (equation 5):

$$C_{i,j,k} = \sum_{i=1}^{N} \left(\frac{B_{i,j,k} \cdot (1+S) \cdot FC \cdot \left(\frac{44}{12}\right)}{1000} \right)$$

Where:
$B_{i,j,k}$: ton of dry biomass per hectare of tree *i* in plot *j* and sub plot *k;*
S: fraction of biomass below the ground in relation to B_i;
FC: fraction of biomass carbon.

The carbon fraction of biomass used for the calculations was 0.485, value reported by Silva (2007) and previously used in other REDD+ Projects implemented in the Brazilian Amazon. The proportion of below-ground biomass was estimated with the standard value reported by Nogueira et al. (2008), corresponding to 25.8% of above-ground biomass.

Sampling Effort

The sampling effort (number of plots to be implanted) was estimated according to the equation A3-1 of the methodology VM0015 (equation 6):

$$n = \frac{t_{st}^2 \cdot CV^2}{E^2 + \frac{t_{st}^2 \cdot CV^2}{N}}$$

Where:

t: value of the *t*-student table at the 95% confidence level;
E: maximum allowed value of sampling error (10%);
CV: coefficient of variation for biomass in tropical forests (%);
N: possible number of sample plots

Furthermore, VM0015 recommends the adoption of different strata in order to reduce sample effort in the area of carbon project. For this purpose, strata were tested based (1) on managed areas and unmanaged areas and (2) based on the different forest typologies present in the study area.

Number of Individuals

A total of 8,668 individuals distributed in 376 species were identified in the 75 inventoried plots. The identified species that presented the greatest wealth were: *Breu vermelho* (4,90%), *Cariperana* (3,97%), *Mandioqueira escamosa* (1,56%) and *Cupiúba* (3,41%).

The 378 identified species are distributed in 58 families, in addition to 2 unidentified class, and the families that showed the greatest diversity were: Fabaceae (23.4%), Sapotaceae (6.5%), Lecythidaceae (7.3%) and Lauraceae (3.7%).

Carbon Stock

The adoption of a single stratum for the Project area is presented as the best sampling strategy for the biomass inventory. Still, this measure proves to be interesting in the context of the study because it tends to improve future calculations related to the baseline modelling of the REDD+ Project area.

For the estimation of the carbon stock an average final stock of total dry biomass 405.89 tCO2-e ha-1, was obtained, considering only one stratum. Considering the strata of forest typology, the typology that presented the highest carbon stock was the Montane Dense Ombrophilous Forest 636,21 tCO2-e ha-1.

Calculation of Reduced Emissions

For the determination of the reduced emissions, the estimated stock in the inventory should be multiplied by 3.6667 (44/12), due to the fact that 1 kg of C corresponds to 3.66667 kg of CO2 (mass of CO2 = 44 and the mass of C = 12; 44/12 = 3.66667). The average carbon values per hectare for each initial class of land use and cover considered for the baseline scenario present in the area of the project and leakage belt can be seen in the table below.

Table 21. Estimated values of carbon stocks per hectare of initial forest classes icl existing in the Project Area and Leakage Belt (Table 15a of VM0015)

Project year *t*	Initial forest class *icl*							
	Name:	1						
	IDicl							
	Average carbon stock per hectare ± 90% CI							
	***Cab*$_{icl}$**		***Cbb*$_{icl}$**		***Cl*$_{icl}$**		***Ctot*$_{cl}$**	
	C stock	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI
	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
0	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39

1	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
2	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
3	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
4	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
5	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
6	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
7	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
8	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
9	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
10	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
11	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
12	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
13	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
14	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
15	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
16	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
17	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
18	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
19	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
20	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
21	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
22	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
23	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
24	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
25	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
26	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
27	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
28	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
29	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39
30	256.82	27.08	57.13	6.02	2.9	0.29	316.85	33.39

Where:

Cab*icl* : Average equivalent carbon stock per hectare for the above-ground biomass reservoir for the initial forest class;

Cbb*icl* : Average equivalent carbon stock per hectare for the below-ground biomass reservoir for the initial forest class;

Cdw*icl* : Average equivalent carbon stock per hectare for the dead biomass reservoir for the initial forest class;

Ctot*icl* : Average carbon stock per hectare for the total biomass reservoir for the initial forest class.

Post-deforestation classes projected for the Project area and leakage belt in the baseline scenario and non-forest classes existing in the areas of leakage management

The methodology VM0015 (Section 6.1.1, page No. 62) allows the use of estimates from local studies, and thus a value of 60.1 tCO2e ha-1 was taken as reference for the carbon stock of the anthropic vegetation class in equilibrium, the class projected to exist in the project area and the leakage belt in the Project scenario. This estimation of carbon stock was obtained by WANDERLLI (Fearnside, P.M. 2015. Deforestation soars in the Amazon. Nature 521:423), through a long-term study of the landscape and average vegetation composition in deforested areas of the Brazilian Amazon, which consists of a matrix composed of pastures, small-scale agriculture and secondary vegetation, usually found in a post-deforestation scenario in the Amazon.

Wanderlli & Fearnside (2015) is a revised scientific literature and represents one of the most updated studies for the Brazilian Amazon on the carbon stock in deforested areas, satisfying the requirements of section 4.5.6 of the VCS Standard:

1. Data were not collected directly from primary sources;

2. The data were collected from secondary sources, by researchers from INPA (renowned research institute for the subject in Brazil), published by an international and reputed scientific journal (*Forest Ecology and Management*, 2015);

3. The data are from a period that accurately reflects the current practice available for the determination of carbon stock;

4. No sampling was applied on these data;

5. The data are available to the public through the website:

http://www.ppginpa.eco.br/documents/teses_dissertacoes/wandelli-fearnside-2015-for-colman_Land-use-history-and-capoeira-growth.pdf. Accessed on June 18, 2018;

6. They are available for independent evaluation of VCSA and VVB;

7. The data are appropriate for the geographic scope of VM0015,

8. Expert review was not necessary;

9. Data are not maintained only in a central storage repository.

Calculation of the carbon stock change factors

The baseline scenario of the Project considers the changes in forest carbon stock replaced by a type of vegetation that may be areas of pasture, small-scale plantations or temporary and permanent agricultural crops. The requirements of the AFOLU VCS document require consideration of the carbon stock decay of carbon reservoirs in organic soil, below-ground biomass, dead wood, and timber products.

To calculate this decay, VM0015 version 1.1 applies a linear function to account for the initial carbon stock decay for the initial forest class (icl) and an increase in the carbon stock in the class after deforestation (fcl). Table 22 show how the carbon stock change factor was calculated.

Table 22. Change factor in carbon stock for the initial forest class icl (Method 1) (Table 20a of VM0015).

Year after deforestation		$\Delta C_{ab\ icl,t}$	$\Delta C_{bb\ icl,t}$	$\Delta C_{l\ icl,t}$
1	t*	-229.74	-5.11	-2.61
2	t*+1	0	-5.11	0
3	t*+2	0	-5.11	0
4	t*+3	0	-5.11	0
5	t*+4	0	-5.11	0
6	t*+5	0	-5.11	0
7	t*+6	0	-5.11	0
8	t*+7	0	-5.11	0
9	t*+8	0	-5.11	0
10	t*+9	0	-5.11	0
11	t*+10	0	0.00	0
12	t*+11	0	0.00	0
13	t*+12	0	0.00	0
14	t*+13	0	0.00	0
15	t*+14	0	0.00	0
16	t*+15	0	0.00	0
17	t*+16	0	0.00	0
18	t*+17	0	0.00	0
19	t*+18	0	0.00	0
20	t*+19	0	0.00	0
21	t*+20	0	0.00	0
22	t*+21	0	0.00	0
23	t*+22	0	0.00	0
24	t*+23	0	0.00	0
25	t*+24	0	0.00	0
26	t*+25	0	0.00	0
27	t*+26	0	0.00	0
28	t*+27	0	0.00	0
29	t*+28	0	0.00	0
30	t*+29	0	0.00	0

Table 23. Carbon stock change factor for forest class fcl or z zones (Method 1) (Table 20b of VM0015).

		Zone 1			
Year after deforestation		$\Delta C_{ab\,z,t}$	$\Delta C_{bb\,z,t}$	$\Delta C_{l\,z,t}$	$\Delta Tot_{z,t}$
1	t*	2.00	2.00	2.00	6.01
2	t*+1	2.00	2.00	2.00	6.01
3	t*+2	2.00	2.00	2.00	6.01
4	t*+3	2.00	2.00	2.00	6.01
5	t*+4	2.00	2.00	2.00	6.01
6	t*+5	2.00	2.00	2.00	6.01
7	t*+6	2.00	2.00	2.00	6.01
8	t*+7	2.00	2.00	2.00	6.01
9	t*+8	2.00	2.00	2.00	6.01
10	t*+9	0.00	0.00	0.00	0.00
11	t*+10	0.00	0.00	0.00	0.00
12	t*+11	0.00	0.00	0.00	0.00
13	t*+12	0.00	0.00	0.00	0.00
14	t*+13	0.00	0.00	0.00	0.00
15	t*+14	0.00	0.00	0.00	0.00
16	t*+15	0.00	0.00	0.00	0.00
17	t*+16	0.00	0.00	0.00	0.00
18	t*+17	0.00	0.00	0.00	0.00
19	t*+18	0.00	0.00	0.00	0.00
20	t*+19	0.00	0.00	0.00	0.00
21	t*+20	0.00	0.00	0.00	0.00
22	t*+21	0.00	0.00	0.00	0.00
23	t*+22	0.00	0.00	0.00	0.00
24	t*+23	0.00	0.00	0.00	0.00
25	t*+24	0.00	0.00	0.00	0.00
26	t*+25	0.00	0.00	0.00	0.00
27	t*+26	0.00	0.00	0.00	0.00
28	t*+27	0.00	0.00	0.00	0.00
29	t*+28	0.00	0.00	0.00	0.00
30	t*+29	0.00	0.00	0.00	0.00

Calculation of baseline changes in carbon stock:

For the calculation of the baseline changes in carbon stock in the Project area (Table 22) and leakage belt (Table 23) for year t was used Method 1 of VM0015 version 1.1, according to equation 10 on page 72 of VM0015 version 1.1.

Baseline of non-CO2 emissions from forest fires:

Non-CO2 emissions were not considered and accounted for the REDD+ Project.

3.2.2 Project Emissions

Step 7 of VM0015 - Ex ante estimation of actual carbon stock changes and non-CO2 emissions in the Project Area

The Project does not account for soil organic carbon thus Tables 18a,b as well as Tables 9a,b,c of the VM0015 methodology do not apply to the Project. Project emissions due to manmade conditions has been calculated and mentioned below in the table.

Table 24. Ex ante estimated actual carbon stock decrease due to manmade fires in the Project Area (Table 23 of Methodology VM0015)

Initial Forest Class		**Parameters**															
IDcl	Name	% *Fburnt* $_{icl}$	$tCO_2e\ ha^{-1}$ *Cab*	$tCO_2e\ ha^{-1}$ *Cdw*	$tCO_2e\ ha^{-1}$ *Cl*	% *Pburnt* $_{ab,icl}$	% *Pburnt* $_{dw,icl}$	% *Pburnt* $_{l,icl}$	% *CE*$_{ab,icl}$	% *CE*$_{dw,icl}$	% *CE*$_{l,icl}$	$tCO_2e\ ha^{-1}$ *ECO2-ab*	$tCO_2e\ ha^{-1}$ *ECO2-dw*	$tCO_2e\ ha^{-1}$ *ECO2-l*	$tCO_2e\ ha^{-1}$ *EBBCO2-tot*	$tCO_2e\ ha^{-1}$ *EBBnN2O*$_{icl}$	$tCO_2e\ ha^{-1}$ *EBBCH4*$_{icl}$	$tCO_2e\ ha^{-1}$ *EBBtot*$_{icl}$
1	Ombrofile Forest	96 %	-229.74	0	-2.61	96 %	0	100 %	0.5	0	0.5	-110.275	0	-1.31	-1107	0	-9.82	-9.816

Above-ground biomass calculations for DBH < 10cm were performed using allometric equations as described below;

Above-ground biomass for a DBH ≥ 10cm was calculated using Overman's equation (Overman, Witte etal. 1994) (Johannes Petrus Maria Overman, Hendrik Johannes Louis Witte and Juan Guillermo Saldarriaga.1994.Journal of Tropical Ecology. 10(2):207-218) corrected for biomass moisture content. Overman's equation is presented below (Figure 37):

Figure 37: Original Overman's equation (Overman 1994)

No.	Regression model	Coefficient symbol	Coefficient value	Standard error	Width of 95% confidence interval	R^2	δB* (%)
1	$DW = \alpha DBH^{\beta}$	α	0.465	0.307	1.23	0.90	39.4
		β	2.202	0.151	0.61		

Araujo tested Overman's equation in a location 250Km from Belem in Para, obtaining predicted results within ±0.6% of the weight determined in the field (Araujo, Higuchi et al. 1999). Overman's equation used for our calculations is:

$DB = \alpha(DBH)_{\beta}$
$DB = 0.465(DBH)^{2.202}$
Where:
Overman's coefficients: 0.465 and 2.202
Biomass results for 1 hectare of forest in the RRD, Project Area and Leakage Belt are showed in Table 25:

Table 25: Biomass results from allometric equations

		All Above(ground Biomass														
		Liiter			DHB< 3cm			3cm<DBH<9.9cm			Trees ≥10cm (Overman 1994)			Total		
		Dense Forest	Degraded Forest	Under Regeneration	Dense Forest	Degraded Forest	Under Regeneration	Dense Forest	Degraded Forest	Under Regeneration	Dense Forest	Degraded Forest	Under Regeneration	Dense Forest	Degraded Forest	Under Regeneration
	No. of cases	63	15	5	63	15	5	63	15	5	63	15	5	64	15	5
	Min	1.29	1.66	4.47	0.06	0.03	0.74	1.73	2.81	2.21	67.34	81.08	46.41	70.41	85.6	53.84
Biomass (tdm/ha)	Max	11.93	7.89	8.83	4.85	2.21	1.56	15.67	14.51	17.97	583.66	541.6	162.68	616.1	566	191
	Mean	4.73	4.89	6.5	1.14	0.9	1.06	7.46	7.22	7.48	247.55	243.4	104.29	260.9	256	119.3
	SD	2.22	1.75	1.6	0.85	0.55	0.36	3.23	3.24	6.09	118.9	118.8	47.8	125.2	124	55.85
	CI 90 %	0.46	0.74	1.18	0.18	0.23	0.27	0.67	1.38	4.48	24.64	50.46	35.16	25.74	52.8	41.08

Average carbon stock per hectare of forest in the RRD, Project Area and Leakage Belt was obtained through a weighted-average calculation (table 26).

Table 26: Area proportion factors for forest classes

	Area Proportion Factors		
	Dense Forest	Degraded Forest	Total
Sample area	8,30,631.10	75,368.04	9,05,999.14
Area weight	92%	8%	100%

An uncertainty assessment was done for the results as required by the VM0015 methodology. The methodology requires that "*If the uncertainty of the total average carbon stock ($Ctot_{cl}$) of a class cl is less than 10% of the average value, the average carbon stock value can be used. If the uncertainty is higher than 10%, the lower boundary of the 90% confidence interval must be considered in the calculations if the class is an initial forest class in the project area or a final non-forest class in the leakage belt, and the higher boundary of the 90% confidence interval if the class is an initial forest class in the leakage belt or a final non-forest class in the project area*." (The VM0015 methodology requires that an uncertainty assessment should be performed following the method described in appendix 2, Box 2. Nevertheless neither the first nor the second version of this methodology provides such Box 2. For this reason, the uncertainty assessment was performed

following the method described in the REDD Methodological Module: Estimation of Uncertainty for REDD Project Activities from VCS' VMD0017 methodology.)

An uncertainty assessment at 95% Confidence Interval was applied to the results from the Carbon Inventory (Table 27).

Table 27: Uncertainty assessment results for carbon stocks in initial forest classes

UNCERTAINTY ASSESSMENT 95% CONFIDENCE								
	Litter		DHB< 3cm		3cm<DBH<9.9cm		Trees ≥10cm (Overman 1994)	
	Dense Forest	Degraded Forest	Dense Forest	Degraded Forest	Dense Forest	Degraded Forest	Dense Forest	Degraded Forest
CI 95%	0.54847344	0.548473436	0.209111236	0.276068641	0.797738585	1.64027681	29.35927328	60.12672819
((CI 95%)/ Mean)%	12%	12%	18%	31%	11%	23%	12%	25%
Mean	4.73388562	4.888202835	1.144291054	0.903595726	7.464591616	7.218896533	247.5482955	243.439203

$Uncertainty_{BSL,SS,i}$	$\Sigma_n(U_{BCL,CC,i,pool\#} \times E_{BCL,CC,i,pool\#})$	862.9478649	3618.31092
	$J\Sigma_1 (U_{BCL,CC,i,pool\#} \times E_{BCL,CC,i,pool\#})$	29.37597428	60.15239746
	$J\Sigma_n(U_{BCL,CC,i,pool\#} \times E_{BCL,CC,i,pool\#})$	11%	23%
		Fails	**Fails**

None of the initial values (Table 28) for the forest classes passed the uncertainty assessment threshold so values were modified to account for the lowest boundary of the 90% Confidence Interval (Table 29):

Table 28: Carbon stocks per hectare of initial forest classes icl existing in the project area and leakage belt (Refer to Table 15.a – VM0015 methodology)

Project year *t*	Initial forest class *icl*							
	Name:	1						
	IDicl							
	Average carbon stock per hectare ± 90% CI							
	***Cab*$_{icl}$**		***Cbb*$_{icl}$**		***Cl*$_{icl}$**		***Ctot*$_{cl}$**	
	C stock	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI
	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
0	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
1	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
2	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
3	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
4	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
5	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
6	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
7	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
8	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
9	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
10	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
11	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
12	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
13	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
14	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
15	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
16	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
17	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
18	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
19	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
20	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
21	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
22	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
23	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
24	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
25	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
26	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
27	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
28	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91

29	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91
30	256.82	27.56	57.14	6.06	2.9	0.29	316.86	33.91

Table 29: Values to be used after discounts for uncertainties (Refer to Table 15.b – VM0015 methodology)

Project year *t*	Initial forest class *icl* Name: 1 IDicl							
	Average carbon stock per hectare ± 90% CI							
	***Cab*$_{icl}$**		***Cbb*$_{icl}$**		***Cl*$_{icl}$**		***Ctot*$_{cl}$**	
	C stock	*C stock change*	*C stock*	*C stock change*	*C stock*	*C stock change*	*C stock*	*C stock change*
	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
0	229.26		51.08		2.61		282.95	
1	229.26		51.08		2.61		282.95	
2	229.26		51.08		2.61		282.95	
3	229.26		51.08		2.61		282.95	
4	229.26		51.08		2.61		282.95	
5	229.26		51.08		2.61		282.95	
6	229.26		51.08		2.61		282.95	
7	229.26		51.08		2.61		282.95	
8	229.26		51.08		2.61		282.95	
9	229.26		51.08		2.61		282.95	
10	229.26		51.08		2.61		282.95	
11	229.26		51.08		2.61		282.95	
12	229.26		51.08		2.61		282.95	
13	229.26		51.08		2.61		282.95	
14	229.26		51.08		2.61		282.95	
15	229.26		51.08		2.61		282.95	
16	229.26		51.08		2.61		282.95	
17	229.26		51.08		2.61		282.95	
18	229.26		51.08		2.61		282.95	
19	229.26		51.08		2.61		282.95	
20	229.26		51.08		2.61		282.95	
21	229.26		51.08		2.61		282.95	
22	229.26		51.08		2.61		282.95	
23	229.26		51.08		2.61		282.95	
24	229.26		51.08		2.61		282.95	
25	229.26		51.08		2.61		282.95	
26	229.26		51.08		2.61		282.95	

27	229.26		51.08		2.61		282.95	
28	229.26		51.08		2.61		282.95	
29	229.26		51.08		2.61		282.95	
30	229.26		51.08		2.61		282.95	

Carbon stock in post-deforestation class was obtained from the default values from IPCC 2003. This value was increased in 75% to account for the highest boundary of the error range table 30:

Table 30: Long-term (20-years) average carbon stocks per hectare of post-deforestation LU/LC classes present in the reference region (Refer to Table 16 – VM0015 methodology)

	Post deforestation class *fcl*							
	Name:	Grassland						
	ID*fcl*	´002						
	Average carbon stock per hectare ± 90% CI							
	***Cab*$_{fcl}$**		***Cbb*$_{fcl}$**		***Cl*$_{fcl}$**		***Ctot*$_{fcl}$**	
Project year *t*	*C stock* tCO$_2$e ha^{-1}	± 90% CI tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}	± 90% CI tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}	± 90% CI tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}	± 90% CI tCO$_2$e ha^{-1}
Average to be used in calculations							51.65	

As mentioned before the Project assumes only one Zone and one post-deforestation land-use class that is grassland Table 31:

Table 31: Long-term (20-years) area weighted average carbon stock per zone (Refer to Table 17 – VM0015 methodology)

Zone		**Post - deforestation LU/LC - classe *fcl***						**Area weighted long-term (20 years average carbon stocks per zone *z***			
		Name:	Cropland								
		ID *fcl*	´003								
		***Cab*$_{fcl}$**		***Cbb*$_{fcl}$**		***Cl*$_{fcl}$**		***Cab*$_z$**	***Cbb*$_z$**	***Cl*$_z$**	***Ctot* $_z$**
IDz	Name	*C stock* tCO$_2$e ha^{-1}	± 90% CI tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}	± 90% CI tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}	± 90% CI tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}	*C stock* tCO$_2$e ha^{-1}
1	Zone 1										**51.65**

As a result, the net emissions per ha from LULC-change in the Project Area is 473.84 tCO2e/ha for Dense Forest and 403.82 tCO2e/ha for Degraded Forest.

Carbon stock changes factors calculated with Method 1 are presented below (Tables 25 and 26). Table 20c of the vm0015 methodology does not apply to the Project because it is only used when carbon stock change factor is calculated using Method 2.

Because the IPCC 2003 value for carbon stock in Grassland is a total, the value was divided by three to account for above-ground, below-ground and litter carbon pools. All three pools are required to undertake linear decay over a 10-year period, so there is no mathematical difference in how the total carbon stock is allocated among these three pools (Table 32);

Table 32: Carbon stock change factors for initial forest classes icl (Refer to Table 20.a – VM0015 methodology)

Year after deforestation		$\Delta C_{AB\ icl,t}$	$\Delta C_{BB\ icl,t}$	$\Delta C_{L\ icl,t}$
1	t*	-229.74	-5.11	-2.61
2	t*+1	0	-5.11	0
3	t*+2	0	-5.11	0
4	t*+3	0	-5.11	0
5	t*+4	0	-5.11	0
6	t*+5	0	-5.11	0
7	t*+6	0	-5.11	0
8	t*+7	0	-5.11	0
9	t*+8	0	-5.11	0
10	t*+9	0	-5.11	0
11	t*+10	0	0.00	0
12	t*+11	0	0.00	0
13	t*+12	0	0.00	0
14	t*+13	0	0.00	0
15	t*+14	0	0.00	0
16	t*+15	0	0.00	0
17	t*+16	0	0.00	0
18	t*+17	0	0.00	0
19	t*+18	0	0.00	0
20	t*+19	0	0.00	0
21	t*+20	0	0.00	0
22	t*+21	0	0.00	0
23	t*+22	0	0.00	0
24	t*+23	0	0.00	0
25	t*+24	0	0.00	0
26	t*+25	0	0.00	0
27	t*+26	0	0.00	0
28	t*+27	0	0.00	0
29	t*+28	0	0.00	0
30	t*+29	0	0.00	0

Table 33: Carbon stock change factors for final forest classes icl (Refer to Table 20.b – VM0015 methodology)

		Zone 1			
Year after deforestation		$\Delta C_{ab\,z,t}$	$\Delta C_{bb\,z,t}$	$\Delta C_{l\,z,t}$	$\Delta Tot_{z,t}$
1	t*	1.72	1.72	1.72	5.17
2	t*+1	1.72	1.72	1.72	5.17
3	t*+2	1.72	1.72	1.72	5.17
4	t*+3	1.72	1.72	1.72	5.17
5	t*+4	1.72	1.72	1.72	5.17
6	t*+5	1.72	1.72	1.72	5.17
7	t*+6	1.72	1.72	1.72	5.17
8	t*+7	1.72	1.72	1.72	5.17
9	t*+8	1.72	1.72	1.72	5.17
10	t*+9	0.00	0.00	0.00	0.00
11	t*+10	0.00	0.00	0.00	0.00
12	t*+11	0.00	0.00	0.00	0.00
13	t*+12	0.00	0.00	0.00	0.00
14	t*+13	0.00	0.00	0.00	0.00
15	t*+14	0.00	0.00	0.00	0.00
16	t*+15	0.00	0.00	0.00	0.00
17	t*+16	0.00	0.00	0.00	0.00
18	t*+17	0.00	0.00	0.00	0.00
19	t*+18	0.00	0.00	0.00	0.00
20	t*+19	0.00	0.00	0.00	0.00
21	t*+20	0.00	0.00	0.00	0.00
22	t*+21	0.00	0.00	0.00	0.00
23	t*+22	0.00	0.00	0.00	0.00
24	t*+23	0.00	0.00	0.00	0.00
25	t*+24	0.00	0.00	0.00	0.00
26	t*+25	0.00	0.00	0.00	0.00
27	t*+26	0.00	0.00	0.00	0.00
28	t*+27	0.00	0.00	0.00	0.00
29	t*+28	0.00	0.00	0.00	0.00
30	t*+29	0.00	0.00	0.00	0.00

Baseline carbon stocks calculated with Method 1 for the RRD, Project Area and Leakage Belt are presented below (Tables 34, 35, 36, 37, 38, 39, 40, 41 and 42). Tables 22a,b,c of the vm0015 methodology do not apply to the Project because those are meant for baseline carbon stocks calculated with Method 2.

Table 34: Baseline carbon stock change in above-ground biomass in the reference region (Refer to Table 21.a.1 – VM0015 methodology)

Carbon stock changes in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of the initial forest classes in the reference region	
ID icl>	*1*	$\triangle Cab\ BSLRR_{icl,t}$	$\triangle Cab\ BSLRR_{icl}$
Name >		annual	cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e
-	-	-	-
1	(43,16,344)	(43,16,344)	(43,16,344)
2	(43,16,344)	(43,16,344)	(86,32,687)
3	(43,16,344)	(43,16,344)	(1,29,49,031)
4	(43,16,344)	(43,16,344)	(1,72,65,375)
5	(43,16,344)	(43,16,344)	(2,15,81,718)
6	(43,16,344)	(43,16,344)	(2,58,98,062)
7	(43,16,344)	(43,16,344)	(3,02,14,405)
8	(43,16,344)	(43,16,344)	(3,45,30,749)
9	(43,16,344)	(43,16,344)	(3,88,47,093)
10	(43,16,344)	(43,16,344)	(4,31,63,436)
11	(43,16,344)	(43,16,344)	(4,74,79,780)
12	(43,16,344)	(43,16,344)	(5,17,96,124)
13	(43,16,344)	(43,16,344)	(5,61,12,467)
14	(43,16,344)	(43,16,344)	(6,04,28,811)
15	(43,16,344)	(43,16,344)	(6,47,45,154)

Carbon stock changes in the above-ground biomass per post deforestation zone *z*		Total carbon stock change in the above-ground biomass of post-deforestation zones in the reference region	
ID iz>	*1*	$\triangle Cab\ BSLRR_{z,t}$	$\triangle Cab\ BSLRR_{z}$
Name >		annual	cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e
-	-	-	-
1	32,347	32,347	32,347
2	32,347	32,347	64,693
3	32,347	32,347	97,040
4	32,347	32,347	1,29,386
5	32,347	32,347	1,61,733
6	32,347	32,347	1,94,080
7	32,347	32,347	2,26,426
8	32,347	32,347	2,58,773
9	32,347	32,347	2,91,119
10	32,347	32,347	3,23,466
11	32,347	32,347	3,55,812
12	32,347	32,347	3,88,159
13	32,347	32,347	4,20,506
14	32,347	32,347	4,52,852
15	32,347	32,347	4,85,199

Total net carbon stock change in the above-ground biomass of the reference region	
$\triangle Cab\ BSLRR_{t}$	$\triangle Cab\ BSLRR$
annual	cumulative
tCO_2-e	tCO_2-e
-	-
(43,48,690)	(43,48,690)
(43,48,690)	(86,97,380)
(43,48,690)	(1,30,46,071)
(43,48,690)	(1,73,94,761)
(43,48,690)	(2,17,43,451)
(43,48,690)	(2,60,92,141)
(43,48,690)	(3,04,40,832)
(43,48,690)	(3,47,89,522)
(43,48,690)	(3,91,38,212)
(43,48,690)	(4,34,86,902)
(43,48,690)	(4,78,35,592)
(43,48,690)	(5,21,84,283)
(43,48,690)	(5,65,32,973)
(43,48,690)	(6,08,81,663)
(43,48,690)	(6,52,30,353)

16	(43,16,344)	(43,16,344)	(6,90,61,498)	16	32,347	32,347	5,17,545		(43,48,690)	(6,95,79,044)
17	(43,16,344)	(43,16,344)	(7,33,77,842)	17	32,347	32,347	5,49,892		(43,48,690)	(7,39,27,734)
18	(43,16,344)	(43,16,344)	(7,76,94,185)	18	32,347	32,347	5,82,239		(43,48,690)	(7,82,76,424)
19	(43,16,344)	(43,16,344)	(8,20,10,529)	19	32,347	32,347	6,14,585		(43,48,690)	(8,26,25,114)
20	(43,16,344)	(43,16,344)	(8,63,26,873)	20	32,347	32,347	6,46,932		(43,48,690)	(8,69,73,804)
21	(43,16,344)	(43,16,344)	(9,06,43,216)	21	32,347	32,347	6,79,278		(43,48,690)	(9,13,22,495)
22	(43,16,344)	(43,16,344)	(9,49,59,560)	22	32,347	32,347	7,11,625		(43,48,690)	(9,56,71,185)
23	(43,16,344)	(43,16,344)	(9,92,75,904)	23	32,347	32,347	7,43,972		(43,48,690)	(10,00,19,875)
24	(43,16,344)	(43,16,344)	(10,35,92,247)	24	32,347	32,347	7,76,318		(43,48,690)	(10,43,68,565)
25	(43,16,344)	(43,16,344)	(10,79,08,591)	25	32,347	32,347	8,08,665		(43,48,690)	(10,87,17,256)
26	(43,16,344)	(43,16,344)	(11,22,24,934)	26	32,347	32,347	8,41,011		(43,48,690)	(11,30,65,946)
27	(43,16,344)	(43,16,344)	(11,65,41,278)	27	32,347	32,347	8,73,358		(43,48,690)	(11,74,14,636)
28	(43,16,344)	(43,16,344)	(12,08,57,622)	28	32,347	32,347	9,05,704		(43,48,690)	(12,17,63,326)
29	(43,16,344)	(43,16,344)	(12,51,73,965)	29	32,347	32,347	9,38,051		(43,48,690)	(12,61,12,016)
30	(43,16,344)	(43,16,344)	(12,94,90,309)	30	32,347	32,347	9,70,398		(43,48,690)	(13,04,60,707)

Table 35: Baseline carbon stock change in below-ground biomass in the reference region (Refer to Table 21.a.2 – VM0015 methodology)

Carbon stock changes in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of the initial forest classes in the reference region		**Carbon stock changes in the below-ground biomass per post deforestation zone *z***		Total carbon stock change in the below-ground biomass of post-deforestation zones in the reference region		Total net carbon stock change in the below-ground biomass of the reference region	
ID icl>	*1*	$\triangle Cab\ BSLRR_{icl,t}$	$\triangle Cab\ BSLRR_{icl}$	*ID iz>*	*1*	$\triangle Cab\ BSLRR_{z,t}$	$\triangle Cab\ BSLRR_{z}$	$\triangle Cab\ BSLRR_{t}$	$\triangle Cab\ BSLRR$
Name >		annual	cumulative	Name >		annual	cumulative	annual	cumulative

Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e
0	-	-	-
1	(96,025)	(96,025)	(96,025)
2	(96,025)	(96,025)	(1,92,050)
3	(96,025)	(96,025)	(2,88,076)
4	(96,025)	(96,025)	(3,84,101)
5	(96,025)	(96,025)	(4,80,126)
6	(96,025)	(96,025)	(5,76,151)
7	(96,025)	(96,025)	(6,72,176)
8	(96,025)	(96,025)	(7,68,202)
9	(96,025)	(96,025)	(8,64,227)
10	(96,025)	(96,025)	(9,60,252)
11	(96,025)	(96,025)	(10,56,277)
12	(96,025)	(96,025)	(11,52,303)
13	(96,025)	(96,025)	(12,48,328)
14	(96,025)	(96,025)	(13,44,353)
15	(96,025)	(96,025)	(14,40,378)
16	(96,025)	(96,025)	(15,36,403)
17	(96,025)	(96,025)	(16,32,429)
18	(96,025)	(96,025)	(17,28,454)
19	(96,025)	(96,025)	(18,24,479)
20	(96,025)	(96,025)	(19,20,504)
21	(96,025)	(96,025)	(20,16,529)
22	(96,025)	(96,025)	(21,12,555)
23	(96,025)	(96,025)	(22,08,580)
24	(96,025)	(96,025)	(23,04,605)
25	(96,025)	(96,025)	(24,00,630)
26	(96,025)	(96,025)	(24,96,656)
27	(96,025)	(96,025)	(25,92,681)
28	(96,025)	(96,025)	(26,88,706)
29	(96,025)	(96,025)	(27,84,731)
30	(96,025)	(96,025)	(28,80,756)

Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e
0	-	-	-
1	32,347	32,347	32,347
2	32,347	32,347	64,693
3	32,347	32,347	97,040
4	32,347	32,347	1,29,386
5	32,347	32,347	1,61,733
6	32,347	32,347	1,94,080
7	32,347	32,347	2,26,426
8	32,347	32,347	2,58,773
9	32,347	32,347	2,91,119
10	32,347	32,347	3,23,466
11	32,347	32,347	3,55,812
12	32,347	32,347	3,88,159
13	32,347	32,347	4,20,506
14	32,347	32,347	4,52,852
15	32,347	32,347	4,85,199
16	32,347	32,347	5,17,545
17	32,347	32,347	5,49,892
18	32,347	32,347	5,82,239
19	32,347	32,347	6,14,585
20	32,347	32,347	6,46,932
21	32,347	32,347	6,79,278
22	32,347	32,347	7,11,625
23	32,347	32,347	7,43,972
24	32,347	32,347	7,76,318
25	32,347	32,347	8,08,665
26	32,347	32,347	8,41,011
27	32,347	32,347	8,73,358
28	32,347	32,347	9,05,704
29	32,347	32,347	9,38,051
30	32,347	32,347	9,70,398

tCO_2-e	tCO_2-e
-	-
(63,679)	(63,679)
(63,679)	(1,27,357)
(63,679)	(1,91,036)
(63,679)	(2,54,715)
(63,679)	(3,18,393)
(63,679)	(3,82,072)
(63,679)	(4,45,750)
(63,679)	(5,09,429)
(63,679)	(5,73,108)
(63,679)	(6,36,786)
(63,679)	(7,00,465)
(63,679)	(7,64,144)
(63,679)	(8,27,822)
(63,679)	(8,91,501)
(63,679)	(9,55,179)
(63,679)	(10,18,858)
(63,679)	(10,82,537)
(63,679)	(11,46,215)
(63,679)	(12,09,894)
(63,679)	(12,73,573)
(63,679)	(13,37,251)
(63,679)	(14,00,930)
(63,679)	(14,64,608)
(63,679)	(15,28,287)
(63,679)	(15,91,966)
(63,679)	(16,55,644)
(63,679)	(17,19,323)
(63,679)	(17,83,002)
(63,679)	(18,46,680)
(63,679)	(19,10,359)

Table 36: Baseline carbon stock change in litter biomass in the reference region (Refer to Table 21.a.3 – VM0015 methodology)

Carbon stock changes in litter per initial forest class *icl*		Total carbon stock change in litter of the initial forest classes in the reference region		**Carbon stock changes in litter per post deforestation zone *z***		Total carbon stock change in litter of post-deforestation zones in the reference region		Total net carbon stock change in litter of the reference region	
ID icl> Name >	*1*	$\triangle Cab\ BSLRR_{icl,t}$ annual	$\triangle Cab\ BSLRR_{icl}$ cumulative	*ID iz>* Name >	*1*	$\triangle Cab\ BSLRR_{z,t}$ annual	$\triangle Cab\ BSLRR_{z}$ cumulative	$\triangle Cab\ BSLRR_{t}$ annual	$\triangle Cab\ BSLRR$ cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
0	0	0	0	0	0	0	0	0	0
1	(49,037)	(49,037)	(49,037)	1	32,347	32,347	32,347	(16,690)	(16,690)
2	(49,037)	(49,037)	(98,073)	2	32,347	32,347	64,693	(16,690)	(33,380)
3	(49,037)	(49,037)	(1,47,110)	3	32,347	32,347	97,040	(16,690)	(50,070)
4	(49,037)	(49,037)	(1,96,146)	4	32,347	32,347	1,29,386	(16,690)	(66,760)
5	(49,037)	(49,037)	(2,45,183)	5	32,347	32,347	1,61,733	(16,690)	(83,450)
6	(49,037)	(49,037)	(2,94,219)	6	32,347	32,347	1,94,080	(16,690)	(1,00,140)
7	(49,037)	(49,037)	(3,43,256)	7	32,347	32,347	2,26,426	(16,690)	(1,16,830)
8	(49,037)	(49,037)	(3,92,292)	8	32,347	32,347	2,58,773	(16,690)	(1,33,520)
9	(49,037)	(49,037)	(4,41,329)	9	32,347	32,347	2,91,119	(16,690)	(1,50,210)
10	(49,037)	(49,037)	(4,90,365)	10	32,347	32,347	3,23,466	(16,690)	(1,66,900)
11	(49,037)	(49,037)	(5,39,402)	11	32,347	32,347	3,55,812	(16,690)	(1,83,590)
12	(49,037)	(49,037)	(5,88,439)	12	32,347	32,347	3,88,159	(16,690)	(2,00,280)
13	(49,037)	(49,037)	(6,37,475)	13	32,347	32,347	4,20,506	(16,690)	(2,16,970)
14	(49,037)	(49,037)	(6,86,512)	14	32,347	32,347	4,52,852	(16,690)	(2,33,659)
15	(49,037)	(49,037)	(7,35,548)	15	32,347	32,347	4,85,199	(16,690)	(2,50,349)
16	(49,037)	(49,037)	(7,84,585)	16	32,347	32,347	5,17,545	(16,690)	(2,67,039)
17	(49,037)	(49,037)	(8,33,621)	17	32,347	32,347	5,49,892	(16,690)	(2,83,729)
18	(49,037)	(49,037)	(8,82,658)	18	32,347	32,347	5,82,239	(16,690)	(3,00,419)
19	(49,037)	(49,037)	(9,31,694)	19	32,347	32,347	6,14,585	(16,690)	(3,17,109)
20	(49,037)	(49,037)	(9,80,731)	20	32,347	32,347	6,46,932	(16,690)	(3,33,799)
21	(49,037)	(49,037)	(10,29,768)	21	32,347	32,347	6,79,278	(16,690)	(3,50,489)
22	(49,037)	(49,037)	(10,78,804)	22	32,347	32,347	7,11,625	(16,690)	(3,67,179)
23	(49,037)	(49,037)	(11,27,841)	23	32,347	32,347	7,43,972	(16,690)	(3,83,869)
24	(49,037)	(49,037)	(11,76,877)	24	32,347	32,347	7,76,318	(16,690)	(4,00,559)

25	(49,037)	(49,037)	(12,25,914)	25	32,347	32,347	8,08,665	(16,690)	(4,17,249)
26	(49,037)	(49,037)	(12,74,950)	26	32,347	32,347	8,41,011	(16,690)	(4,33,939)
27	(49,037)	(49,037)	(13,23,987)	27	32,347	32,347	8,73,358	(16,690)	(4,50,629)
28	(49,037)	(49,037)	(13,73,023)	28	32,347	32,347	9,05,704	(16,690)	(4,67,319)
29	(49,037)	(49,037)	(14,22,060)	29	32,347	32,347	9,38,051	(16,690)	(4,84,009)
30	(49,037)	(49,037)	(14,71,096)	30	32,347	32,347	9,70,398	(16,690)	(5,00,699)

Table 37: Baseline carbon stock change in above-ground biomass in the project area (Refer to Table 21.b.1 – VM0015 methodology)

Carbon stock changes in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of the initial forest classes in the project area		**Carbon stock changes in the above-ground biomass per post-deforestation zone *z***		Total carbon stock change in the above-ground biomass of post-deforestation zones in the project area		Total net carbon stock change in the above-ground biomass of the project area	
ID icl>	*1*	$\triangle Cab\ BSLPA_{icl,t}$	$\triangle Cab\ BSLPA_{icl}$	*ID iz*>	*1*	$\triangle Cab\ BSLPA_{z,t}$	$\triangle Cab\ BSLPA_{z}$	$\triangle Cab\ BSLPA_{t}$	$\triangle Cab\ BSLPA$
Name >		annual	cumulative	Name >		annual	cumulative	annual	cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
0	0	0	0	0	0	0	0	0	0
1	(2,43,963)	(2,43,963)	(2,43,963)	1	-	-	-	(2,43,963)	(2,43,963)
2	(3,23,423)	(3,23,423)	(5,67,387)	2	1,828	1,828	1,828	(3,25,252)	(5,69,215)
3	(3,69,946)	(3,69,946)	(9,37,332)	3	4,252	4,252	6,080	(3,74,198)	(9,43,413)
4	(3,53,570)	(3,53,570)	(12,90,902)	4	7,024	7,024	13,105	(3,60,594)	(13,04,007)
5	(3,24,540)	(3,24,540)	(16,15,442)	5	9,674	9,674	22,779	(3,34,214)	(16,38,221)
6	(2,75,226)	(2,75,226)	(18,90,668)	6	12,106	12,106	34,885	(2,87,332)	(19,25,553)
7	(2,80,251)	(2,80,251)	(21,70,919)	7	14,169	14,169	49,053	(2,94,419)	(22,19,972)
8	(2,47,313)	(2,47,313)	(24,18,232)	8	16,269	16,269	65,322	(2,63,582)	(24,83,554)
9	(2,27,029)	(2,27,029)	(26,45,261)	9	18,122	18,122	83,444	(2,45,151)	(27,28,705)
10	(2,08,234)	(2,08,234)	(28,53,495)	10	19,824	19,824	1,03,268	(2,28,058)	(29,56,763)
11	(1,94,091)	(1,94,091)	(30,47,586)	11	21,384	21,384	1,24,652	(2,15,475)	(31,72,238)
12	(1,90,742)	(1,90,742)	(32,38,328)	12	22,839	22,839	1,47,490	(2,13,580)	(33,85,818)
13	(1,81,251)	(1,81,251)	(34,19,579)	13	24,268	24,268	1,71,758	(2,05,519)	(35,91,337)
14	(1,63,200)	(1,63,200)	(35,82,779)	14	25,626	25,626	1,97,385	(1,88,827)	(37,80,164)
15	(1,76,041)	(1,76,041)	(37,58,820)	15	26,849	26,849	2,24,234	(2,02,890)	(39,83,054)
16	(1,79,018)	(1,79,018)	(39,37,838)	16	28,169	28,169	2,52,402	(2,07,187)	(41,90,240)

17	(1,74,738)	(1,74,738)	(41,12,576)	17	29,510	29,510	2,81,912		(2,04,248)	(43,94,488)
18	(1,74,738)	(1,74,738)	(42,87,314)	18	30,820	30,820	3,12,732		(2,05,558)	(46,00,046)
19	(1,73,994)	(1,73,994)	(44,61,307)	19	32,129	32,129	3,44,861		(2,06,123)	(48,06,168)
20	(1,76,785)	(1,76,785)	(46,38,092)	20	33,433	33,433	3,78,294		(2,10,218)	(50,16,386)
21	(1,87,578)	(1,87,578)	(48,25,670)	21	34,758	34,758	4,13,052		(2,22,336)	(52,38,722)
22	(1,83,484)	(1,83,484)	(50,09,154)	22	36,163	36,163	4,49,215		(2,19,648)	(54,58,370)
23	(2,24,052)	(2,24,052)	(52,33,206)	23	37,538	37,538	4,86,754		(2,61,590)	(57,19,960)
24	(2,38,194)	(2,38,194)	(54,71,401)	24	39,218	39,218	5,25,971		(2,77,412)	(59,97,372)
25	(2,34,845)	(2,34,845)	(57,06,245)	25	41,003	41,003	5,66,974		(2,75,847)	(62,73,219)
26	(2,53,268)	(2,53,268)	(59,59,513)	26	42,762	42,762	6,09,736		(2,96,030)	(65,69,249)
27	(2,55,129)	(2,55,129)	(62,14,642)	27	44,660	44,660	6,54,397		(2,99,789)	(68,69,038)
28	(2,71,318)	(2,71,318)	(64,85,960)	28	46,572	46,572	7,00,969		(3,17,891)	(71,86,929)
29	(3,26,215)	(3,26,215)	(68,12,175)	29	48,606	48,606	7,49,575		(3,74,820)	(75,61,749)
30	(3,67,713)	(3,67,713)	(71,79,887)	30	51,050	51,050	8,00,625		(4,18,763)	(79,80,512)

Table 38: Baseline carbon stock change in below-ground biomass in the project area (Refer to Table 21.b.2 – VM0015 methodology)

Carbon stock changes in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of the initial forest classes in the project area		**Carbon stock changes in the below-ground biomass per post-deforestation zone *z***		Total carbon stock change in the below-ground biomass of post-deforestation zones in the project area		Total net carbon stock change in the below-ground biomass of the project area	
ID icl>	*1*	$\triangle Cab\ BSLPA_{icl,t}$	$\triangle Cab\ BSLPA_{icl}$	*ID iz>*	*1*	$\triangle Cab\ BSLPA_{z,t}$	$\triangle Cab\ BSLPA_{z}$	$\triangle Cab\ BSLPA_{t}$	$\triangle Cab\ BSLPA$
Name >		annual	cumulative	Name >		annual	cumulative	annual	cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
0	0	0	0	0	0	0	0	0	0
1	(5,427)	(5,427)	(5,427)	1	-	-	-	(5,427)	(5,427)
2	(12,623)	(12,623)	(18,050)	2	1,828	1,828	1,828	(10,794)	(16,222)
3	(20,853)	(20,853)	(38,903)	3	4,252	4,252	6,080	(16,601)	(32,822)
4	(28,719)	(28,719)	(67,621)	4	7,024	7,024	13,105	(21,694)	(54,517)
5	(35,939)	(35,939)	(1,03,560)	5	9,674	9,674	22,779	(26,265)	(80,781)
6	(42,061)	(42,061)	(1,45,621)	6	12,106	12,106	34,885	(29,955)	(1,10,737)
7	(48,296)	(48,296)	(1,93,918)	7	14,169	14,169	49,053	(34,128)	(1,44,864)
8	(53,798)	(53,798)	(2,47,716)	8	16,269	16,269	65,322	(37,529)	(1,82,394)

9	(58,849)	(58,849)	(3,06,564)	9	18,122	18,122	83,444		(40,727)	(2,23,120)
10	(63,481)	(63,481)	(3,70,046)	10	19,824	19,824	1,03,268		(43,658)	(2,66,778)
11	(62,372)	(62,372)	(4,32,418)	11	21,384	21,384	1,24,652		(40,988)	(3,07,766)
12	(64,848)	(64,848)	(4,97,265)	12	22,839	22,839	1,47,490		(42,009)	(3,49,775)
13	(67,845)	(67,845)	(5,65,110)	13	24,268	24,268	1,71,758		(43,577)	(3,93,352)
14	(71,840)	(71,840)	(6,36,950)	14	25,626	25,626	1,97,385		(46,214)	(4,39,565)
15	(76,402)	(76,402)	(7,13,352)	15	26,849	26,849	2,24,234		(49,553)	(4,89,118)
16	(81,482)	(81,482)	(7,94,834)	16	28,169	28,169	2,52,402		(53,313)	(5,42,431)
17	(85,257)	(85,257)	(8,80,091)	17	29,510	29,510	2,81,912		(55,747)	(5,98,179)
18	(89,877)	(89,877)	(9,69,968)	18	30,820	30,820	3,12,732		(59,058)	(6,57,236)
19	(94,200)	(94,200)	(10,64,168)	19	32,129	32,129	3,44,861		(62,070)	(7,19,307)
20	(98,551)	(98,551)	(11,62,719)	20	33,433	33,433	3,78,294		(65,118)	(7,84,425)
21	(1,03,038)	(1,03,038)	(12,65,757)	21	34,758	34,758	4,13,052		(68,280)	(8,52,705)
22	(1,07,195)	(1,07,195)	(13,72,951)	22	36,163	36,163	4,49,215		(71,031)	(9,23,736)
23	(1,12,390)	(1,12,390)	(14,85,342)	23	37,538	37,538	4,86,754		(74,852)	(9,98,588)
24	(1,18,091)	(1,18,091)	(16,03,433)	24	39,218	39,218	5,25,971		(78,873)	(10,77,461)
25	(1,23,030)	(1,23,030)	(17,26,463)	25	41,003	41,003	5,66,974		(82,027)	(11,59,489)
26	(1,28,598)	(1,28,598)	(18,55,061)	26	42,762	42,762	6,09,736		(85,836)	(12,45,324)
27	(1,34,369)	(1,34,369)	(19,89,430)	27	44,660	44,660	6,54,397		(89,709)	(13,35,033)
28	(1,40,405)	(1,40,405)	(21,29,835)	28	46,572	46,572	7,00,969		(93,833)	(14,28,865)
29	(1,47,679)	(1,47,679)	(22,77,514)	29	48,606	48,606	7,49,575		(99,073)	(15,27,939)
30	(1,55,797)	(1,55,797)	(24,33,311)	30	51,050	51,050	8,00,625		(1,04,747)	(16,32,686)

Table 39: Baseline carbon stock change in litter biomass in the project area (Refer to Table 21.b.3 – VM0015 methodology)

Carbon stock changes in litter per initial forest class *icl*		Total carbon stock change in litter of the initial forest classes in the project area		**Carbon stock changes in litter per post-deforestation zone *z***		Total carbon stock change in litter of post-deforestation zones in the project area		Total net carbon stock change in litter of the project area	
ID icl>	*1*	$\triangle Cab\ BSLPA_{icl,t}$	$\triangle Cab\ BSLPA_{icl}$	*ID iz>*	*1*	$\triangle Cab\ BSLPA_{z,t}$	$\triangle Cab\ BSLPA_{z}$	$\triangle Cab\ BSLPA_{t}$	$\triangle Cab\ BSLPA$
Name >		annual	cumulative	Name >		annual	cumulative	annual	cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
0	0	0	0	0	0	0	0	0	0
1	(2,772)	(2,772)	(2,772)	1	-	-	-	(2,772)	(2,772)
2	(3,674)	(3,674)	(6,446)	2	1,828	1,828	1,828	(1,846)	(4,618)

3	(4,203)	(4,203)	(10,649)	3	4,252	4,252	6,080	49	(4,568)
4	(4,017)	(4,017)	(14,666)	4	7,024	7,024	13,105	3,008	(1,561)
5	(3,687)	(3,687)	(18,353)	5	9,674	9,674	22,779	5,987	4,426
6	(3,127)	(3,127)	(21,479)	6	12,106	12,106	34,885	8,979	13,405
7	(3,184)	(3,184)	(24,663)	7	14,169	14,169	49,053	10,985	24,390
8	(2,810)	(2,810)	(27,473)	8	16,269	16,269	65,322	13,459	37,849
9	(2,579)	(2,579)	(30,052)	9	18,122	18,122	83,444	15,543	53,392
10	(2,366)	(2,366)	(32,418)	10	19,824	19,824	1,03,268	17,458	70,850
11	(2,205)	(2,205)	(34,623)	11	21,384	21,384	1,24,652	19,179	90,029
12	(2,167)	(2,167)	(36,790)	12	22,839	22,839	1,47,490	20,672	1,10,701
13	(2,059)	(2,059)	(38,849)	13	24,268	24,268	1,71,758	22,209	1,32,910
14	(1,854)	(1,854)	(40,703)	14	25,626	25,626	1,97,385	23,772	1,56,682
15	(2,000)	(2,000)	(42,703)	15	26,849	26,849	2,24,234	24,849	1,81,531
16	(2,034)	(2,034)	(44,736)	16	28,169	28,169	2,52,402	26,135	2,07,666
17	(1,985)	(1,985)	(46,722)	17	29,510	29,510	2,81,912	27,525	2,35,191
18	(1,985)	(1,985)	(48,707)	18	30,820	30,820	3,12,732	28,834	2,64,025
19	(1,977)	(1,977)	(50,683)	19	32,129	32,129	3,44,861	30,152	2,94,178
20	(2,008)	(2,008)	(52,692)	20	33,433	33,433	3,78,294	31,425	3,25,602
21	(2,131)	(2,131)	(54,823)	21	34,758	34,758	4,13,052	32,627	3,58,229
22	(2,085)	(2,085)	(56,907)	22	36,163	36,163	4,49,215	34,079	3,92,308
23	(2,545)	(2,545)	(59,453)	23	37,538	37,538	4,86,754	34,993	4,27,301
24	(2,706)	(2,706)	(62,159)	24	39,218	39,218	5,25,971	36,511	4,63,812
25	(2,668)	(2,668)	(64,827)	25	41,003	41,003	5,66,974	38,335	5,02,147
26	(2,877)	(2,877)	(67,704)	26	42,762	42,762	6,09,736	39,885	5,42,032
27	(2,898)	(2,898)	(70,602)	27	44,660	44,660	6,54,397	41,762	5,83,794
28	(3,082)	(3,082)	(73,685)	28	46,572	46,572	7,00,969	43,490	6,27,284
29	(3,706)	(3,706)	(77,391)	29	48,606	48,606	7,49,575	44,900	6,72,184
30	(4,177)	(4,177)	(81,568)	30	51,050	51,050	8,00,625	46,873	7,19,057

Table 40: Baseline carbon stock change in above-ground biomass in the leakage belt (Refer totable 21.c.1 – VM0015 methodology)

Carbon stock changes in the above-ground biomass per initial forest class *icl*		Total carbon stock change in the above-ground biomass of the initial forest classes in the project area		**Carbon stock changes in the above-ground biomass per post-deforestation zone *z***		Total carbon stock change in the above-ground biomass of post-deforestation zones in the project area		Total net carbon stock change in the above-ground biomass of the project area	
ID icl> Name >	*1*	$\triangle Cab\ BSLLK_{icl,t}$ annual	$\triangle Cab\ BSLLK_{icl}$ cumulative	*ID iz>* Name >	*1*	$\triangle Cab\ BSLLK_{z,t}$ annual	$\triangle Cab\ BSLLK_{z}$ cumulative	$\triangle Cab\ BSLLK_{t}$ annual	$\triangle Cab\ BSLLK$ cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
0	-	-	-	0	-	-	-	-	-
1	(50,32,422.76)	(50,32,422.76)	(50,32,422.76)	1	-	-	-	(50,32,422.76)	(50,32,422.76)
2	(49,34,230.26)	(49,34,230.26)	(99,66,653.02)	2	4,360	4,360.11	4,360.11	(49,38,590.38)	(99,71,013.13)
3	(48,76,740.51)	(48,76,740.51)	(1,48,43,393.53)	3	4,275	4,275.04	8,635.15	(48,81,015.55)	(1,48,52,028.68)
4	(48,96,976.90)	(48,96,976.90)	(1,97,40,370.44)	4	4,225	4,225.23	12,860.38	(49,01,202.13)	(1,97,53,230.82)
5	(49,32,850.51)	(49,32,850.51)	(2,46,73,220.95)	5	4,243	4,242.76	17,103.14	(49,37,093.27)	(2,46,90,324.09)
6	(49,93,789.64)	(49,93,789.64)	(2,96,67,010.59)	6	4,274	4,273.84	21,376.99	(49,98,063.49)	(2,96,88,387.58)
7	(49,87,580.75)	(49,87,580.75)	(3,46,54,591.34)	7	4,327	4,326.64	25,703.63	(49,91,907.39)	(3,46,80,294.97)
8	(50,28,283.49)	(50,28,283.49)	(3,96,82,874.83)	8	4,321	4,321.26	30,024.89	(50,32,604.76)	(3,97,12,899.73)
9	(50,53,349.02)	(50,53,349.02)	(4,47,36,223.86)	9	4,357	4,356.53	34,381.42	(50,57,705.55)	(4,47,70,605.28)
10	(50,76,574.88)	(50,76,574.88)	(4,98,12,798.74)	10	4,378	4,378.24	38,759.66	(50,80,953.13)	(4,98,51,558.41)
11	(50,94,051.77)	(50,94,051.77)	(5,49,06,850.51)	11	4,398	4,398.37	43,158.03	(50,98,450.14)	(5,49,50,008.54)
12	(50,98,191.03)	(50,98,191.03)	(6,00,05,041.54)	12	4,414	4,413.51	47,571.54	(51,02,604.54)	(6,00,52,613.08)
13	(51,09,918.94)	(51,09,918.94)	(6,51,14,960.48)	13	4,417	4,417.10	51,988.63	(51,14,336.03)	(6,51,66,949.12)
14	(51,32,224.96)	(51,32,224.96)	(7,02,47,185.44)	14	4,427	4,427.26	56,415.89	(51,36,652.22)	(7,03,03,601.33)
15	(51,16,357.79)	(51,16,357.79)	(7,53,63,543.23)	15	4,447	4,446.58	60,862.47	(51,20,804.37)	(7,54,24,405.71)
16	(51,12,678.45)	(51,12,678.45)	(8,04,76,221.68)	16	4,433	4,432.84	65,295.31	(51,17,111.28)	(8,05,41,516.99)
17	(51,17,967.50)	(51,17,967.50)	(8,55,94,189.18)	17	4,430	4,429.65	69,724.96	(51,22,397.15)	(8,56,63,914.14)
18	(51,17,967.50)	(51,17,967.50)	(9,07,12,156.69)	18	4,434	4,434.23	74,159.19	(51,22,401.73)	(9,07,86,315.88)
19	(51,18,887.34)	(51,18,887.34)	(9,58,31,044.03)	19	4,434	4,434.23	78,593.42	(51,23,321.57)	(9,59,09,637.44)
20	(51,15,437.95)	(51,15,437.95)	(10,09,46,481.98)	20	4,435	4,435.03	83,028.44	(51,19,872.98)	(10,10,29,510.43)
21	(51,02,100.33)	(51,02,100.33)	(10,60,48,582.32)	21	4,432	4,432.04	87,460.48	(51,06,532.37)	(10,61,36,042.80)
22	(51,07,159.43)	(51,07,159.43)	(11,11,55,741.75)	22	4,420	4,420.48	91,880.96	(51,11,579.91)	(11,12,47,622.71)
23	(50,57,028.37)	(50,57,028.37)	(11,62,12,770.12)	23	4,425	4,424.87	96,305.83	(50,61,453.23)	(11,63,09,075.95)
24	(50,39,551.48)	(50,39,551.48)	(12,12,52,321.60)	24	4,381	4,381.43	1,00,687.26	(50,43,932.92)	(12,13,53,008.86)
25	(50,43,690.75)	(50,43,690.75)	(12,62,96,012.35)	25	4,366	4,366.29	1,05,053.55	(50,48,057.04)	(12,64,01,065.90)
26	(50,20,924.81)	(50,20,924.81)	(13,13,16,937.16)	26	4,370	4,369.88	1,09,423.43	(50,25,294.68)	(13,14,26,360.58)

27	(50,18,625.22)	(50,18,625.22)	(13,63,35,562.37)	27	4,350	4,350.15	1,13,773.58		(50,22,975.37)	(13,64,49,335.95)
28	(49,98,618.78)	(49,98,618.78)	(14,13,34,181.15)	28	4,348	4,348.16	1,18,121.74		(50,02,966.94)	(14,14,52,302.89)
29	(49,30,780.88)	(49,30,780.88)	(14,62,64,962.03)	29	4,331	4,330.83	1,22,452.56		(49,35,111.70)	(14,63,87,414.59)
30	(48,79,500.02)	(48,79,500.02)	(15,11,44,462.05)	30	4,272	4,272.05	1,26,724.61		(48,83,772.07)	(15,12,71,186.67)

Table 41: Baseline carbon stock change in below-ground biomass in the leakage belt (Refer to Table 21.c.2 – VM0015 methodology)

Carbon stock changes in the below-ground biomass per initial forest class *icl*		Total carbon stock change in the below-ground biomass of the initial forest classes in the project area		**Carbon stock changes in the below-ground biomass per post-deforestation zone *z***		Total carbon stock change in the below-ground biomass of post-deforestation zones in the project area		Total net carbon stock change in the below-ground biomass of the project area	
ID icl> Name >	*1*	$\triangle Cab\ BSLLK_{icl,t}$ annual	$\triangle Cab\ BSLLK_{icl}$ cumulative	*ID iz>* Name >	*1*	$\triangle Cab\ BSLLK_{z,t}$ annual	$\triangle Cab\ BSLLK_{z}$ cumulative	$\triangle Cab\ BSLLK_{t}$ annual	$\triangle Cab\ BSLLK$ cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
0	-	-	-	0	-	-	-	-	-
1	(1,11,939.94)	(1,11,939.94)	(1,11,939.94)	1	-	-	-	(1,11,939.94)	(1,11,939.94)
2	(2,21,695.72)	(2,21,695.72)	(3,33,635.66)	2	4,360	4,360.11	4,360.11	(2,17,335.60)	(3,29,275.55)
3	(3,30,172.70)	(3,30,172.70)	(6,63,808.36)	3	8,635	8,635.15	12,995.27	(3,21,537.55)	(6,50,813.10)
4	(4,39,099.82)	(4,39,099.82)	(11,02,908.18)	4	12,860	12,860.38	25,855.65	(4,26,239.44)	(10,77,052.53)
5	(5,48,824.90)	(5,48,824.90)	(16,51,733.09)	5	17,103	17,103.14	42,958.79	(5,31,721.76)	(16,08,774.29)
6	(6,59,905.50)	(6,59,905.50)	(23,11,638.59)	6	21,377	21,376.99	64,335.78	(6,38,528.51)	(22,47,302.81)
7	(7,70,847.99)	(7,70,847.99)	(30,82,486.58)	7	25,704	25,703.63	90,039.41	(7,45,144.36)	(29,92,447.17)
8	(8,82,695.86)	(8,82,695.86)	(39,65,182.44)	8	30,025	30,024.89	1,20,064.30	(8,52,670.97)	(38,45,118.13)
9	(9,95,101.28)	(9,95,101.28)	(49,60,283.72)	9	34,381	34,381.42	1,54,445.72	(9,60,719.86)	(48,05,838.00)
10	(11,08,023.33)	(11,08,023.33)	(60,68,307.05)	10	38,760	38,759.66	1,93,205.39	(10,69,263.67)	(58,75,101.67)
11	(11,09,394.19)	(11,09,394.19)	(71,77,701.24)	11	43,158	43,158.03	2,36,363.42	(10,66,236.16)	(69,41,337.83)
12	(12,24,981.24)	(12,24,981.24)	(84,02,682.48)	12	43,211	43,211.43	2,79,574.84	(11,81,769.81)	(81,23,107.64)

13	(13,39,923.77)	(13,39,923.77)	(97,42,606.25)	13	47,714	47,713.60	3,27,288.44		(12,92,210.18)	(94,15,317.82)	
14	(14,53,633.56)	(14,53,633.56)	(1,11,96,239.81)	14	52,191	52,190.66	3,79,479.10		(14,01,442.90)	(1,08,16,760.71)	
15	(15,66,642.57)	(15,66,642.57)	(1,27,62,882.38)	15	56,620	56,619.71	4,36,098.81		(15,10,022.86)	(1,23,26,783.57)	
16	(16,79,012.18)	(16,79,012.18)	(1,44,41,894.56)	16	61,021	61,021.47	4,97,120.28		(16,17,990.72)	(1,39,44,774.28)	
17	(17,92,993.07)	(17,92,993.07)	(1,62,34,887.63)	17	65,398	65,398.31	5,62,518.59		(17,27,594.75)	(1,56,72,369.04)	
18	(19,05,930.47)	(19,05,930.47)	(1,81,40,818.09)	18	69,838	69,837.92	6,32,356.51		(18,36,092.54)	(1,75,08,461.58)	
19	(20,19,236.15)	(20,19,236.15)	(2,01,60,054.25)	19	74,237	74,236.89	7,06,593.40		(19,44,999.26)	(1,94,53,460.84)	
20	(21,32,506.03)	(21,32,506.03)	(2,22,92,560.28)	20	78,650	78,650.20	7,85,243.60		(20,53,855.84)	(2,15,07,316.68)	
21	(22,45,607.12)	(22,45,607.12)	(2,45,38,167.40)	21	83,062	83,062.11	8,68,305.72		(21,62,545.00)	(2,36,69,861.68)	
22	(23,59,117.41)	(23,59,117.41)	(2,68,97,284.81)	22	87,467	87,467.45	9,55,773.17		(22,71,649.96)	(2,59,41,511.64)	
23	(24,71,343.80)	(24,71,343.80)	(2,93,68,628.61)	23	91,889	91,888.73	10,47,661.90		(23,79,455.07)	(2,83,20,966.71)	
24	(25,82,946.14)	(25,82,946.14)	(3,19,51,574.75)	24	96,260	96,260.00	11,43,921.91		(24,86,686.14)	(3,08,07,652.85)	
25	(26,95,489.67)	(26,95,489.67)	(3,46,47,064.43)	25	1,00,607	1,00,606.97	12,44,528.88		(25,94,882.71)	(3,34,02,535.55)	
26	(28,07,255.70)	(28,07,255.70)	(3,74,54,320.13)	26	1,04,991	1,04,990.59	13,49,519.47		(27,02,265.11)	(3,61,04,800.66)	
27	(29,18,771.09)	(29,18,771.09)	(4,03,73,091.22)	27	1,09,344	1,09,343.93	14,58,863.40		(28,09,427.16)	(3,89,14,227.82)	
28	(30,29,959.10)	(30,29,959.10)	(4,34,03,050.32)	28	1,13,688	1,13,687.51	15,72,550.90		(29,16,271.59)	(4,18,30,499.41)	
29	(31,39,617.69)	(31,39,617.69)	(4,65,42,668.01)	29	1,18,018	1,18,018.33	16,90,569.24		(30,21,599.36)	(4,48,52,098.77)	
30	(32,48,232.78)	(32,48,232.78)	(4,97,90,900.79)	30	1,22,290	1,22,289.59	18,12,858.82		(31,25,943.20)	(4,79,78,041.97)	

Table 42: Baseline carbon stock change in litter biomass in the leakage belt (Refer to Table 21.c.3 – VM0015 methodology)

Carbon stock changes in litter per initial forest class *icl*		Total carbon stock change in litter of the initial forest classes in the project area		**Carbon stock changes in litter per post-deforestation zone *z***		Total carbon stock change in litter of post-deforestation zones in the project area		Total net carbon stock change in litter of the project area	
ID icl>	*1*	$\triangle Cab\ BSLLK_{icl,t}$	$\triangle Cab\ BSLLK_{icl}$	*ID iz>*	*1*	$\triangle Cab\ BSLLK_{z,t}$	$\triangle Cab\ BSLLK_{z}$	$\triangle Cab\ BSLLK_{t}$	$\triangle Cab\ BSLLK$
Name >		annual	cumulative	Name >		annual	cumulative	annual	cumulative

Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e
0	-	-	-
1	4,360	4,360.11	4,360.11
2	4,275	4,275.04	8,635.15
3	4,225	4,225.23	12,860.38
4	4,243	4,242.76	17,103.14
5	4,274	4,273.84	21,376.99
6	4,327	4,326.64	25,703.63
7	4,321	4,321.26	30,024.89
8	4,357	4,356.53	34,381.42
9	4,378	4,378.24	38,759.66
10	4,398	4,398.37	43,158.03
11	4,414	4,413.51	47,571.54
12	4,417	4,417.10	51,988.63
13	4,427	4,427.26	56,415.89
14	4,447	4,446.58	60,862.47
15	4,433	4,432.84	65,295.31
16	4,430	4,429.65	69,724.96
17	4,434	4,434.23	74,159.19
18	4,434	4,434.23	78,593.42
19	4,435	4,435.03	83,028.44
20	4,432	4,432.04	87,460.48

Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e
0	-	-	-
1	-	-	-
2	4,360	4,360.11	4,360.11
3	8,635	8,635.15	12,995.27
4	12,860	12,860.38	25,855.65
5	17,103	17,103.14	42,958.79
6	21,377	21,376.99	64,335.78
7	25,704	25,703.63	90,039.41
8	30,025	30,024.89	1,20,064.30
9	34,381	34,381.42	1,54,445.72
10	38,760	38,759.66	1,93,205.39
11	43,158	43,158.03	2,36,363.42
12	47,572	47,571.54	2,83,934.96
13	51,989	51,988.63	3,35,923.59
14	56,416	56,415.89	3,92,339.48
15	60,862	60,862.47	4,53,201.95
16	65,295	65,295.31	5,18,497.26
17	69,725	69,724.96	5,88,222.22
18	74,159	74,159.19	6,62,381.41
19	78,593	78,593.42	7,40,974.82
20	83,028	83,028.44	8,24,003.26

tCO_2-e	tCO_2-e
-	-
4,360.11	4,360.11
8,635.15	12,995.27
12,860.38	25,855.65
17,103.14	42,958.79
21,376.99	64,335.78
25,703.63	90,039.41
30,024.89	1,20,064.30
34,381.42	1,54,445.72
38,759.66	1,93,205.39
43,158.03	2,36,363.42
47,571.54	2,83,934.96
51,988.63	3,35,923.59
56,415.89	3,92,339.48
60,862.47	4,53,201.95
65,295.31	5,18,497.26
69,724.96	5,88,222.22
74,159.19	6,62,381.41
78,593.42	7,40,974.82
83,028.44	8,24,003.26
87,460.48	9,11,463.75

21	4,420	4,420.48	91,880.96	21	87,460	87,460.48	9,11,463.75	91,880.96	10,03,344.71
22	4,425	4,424.87	96,305.83	22	91,881	91,880.96	10,03,344.71	96,305.83	10,99,650.54
23	4,381	4,381.43	1,00,687.26	23	96,306	96,305.83	10,99,650.54	1,00,687.26	12,00,337.80
24	4,366	4,366.29	1,05,053.55	24	1,00,687	1,00,687.26	12,00,337.80	1,05,053.55	13,05,391.35
25	4,370	4,369.88	1,09,423.43	25	1,05,054	1,05,053.55	13,05,391.35	1,09,423.43	14,14,814.78
26	4,350	4,350.15	1,13,773.58	26	1,09,423	1,09,423.43	14,14,814.78	1,13,773.58	15,28,588.35
27	4,348	4,348.16	1,18,121.74	27	1,13,774	1,13,773.58	15,28,588.35	1,18,121.74	16,46,710.09
28	4,331	4,330.83	1,22,452.56	28	1,18,122	1,18,121.74	16,46,710.09	1,22,452.56	17,69,162.65
29	4,272	4,272.05	1,26,724.61	29	1,22,453	1,22,452.56	17,69,162.65	1,26,724.61	18,95,887.27
30	4,228	4,227.62	1,30,952.23	30	1,26,725	1,26,724.61	18,95,887.27	1,30,952.23	20,26,839.50

Non-CO2 emissions from fires area accounted because fire is the main technology used to clear the forest (slash and burn). Parameters (Table 43) and baseline non-CO2 emissions from forest fires in the project area (Table 44) are presented below:

Table 43: Parameters used to calculate non-CO2 emissions from forest fires (Refer to Table 23 – VM0015 methodology)

Initial Forest Class		**Parameters**																
ID cl	Name	% *Fburnt* $_{icl}$	$tCO_2e\ ha^{-1}$ *Cab*	$tCO_2e\ ha^{-1}$ *Cdw*	$tCO_2e\ ha^{-1}$ *Cl*	% *Pburnt* $_{ab,icl}$	% *Pburnt* $_{dw,icl}$	% *Pburnt* $_{l,icl}$	% $CE_{ab,icl}$	% $CE_{dw,icl}$	% $CE_{l,icl}$	$tCO_2e\ ha^{-1}$ *ECO2-ab*	$tCO_2e\ ha^{-1}$ *ECO2-dw*	$tCO_2e\ ha^{-1}$ *ECO2-l*	$tCO_2e\ ha^{-1}$ *EBBCO2-tot*	$tCO_2e\ ha^{-1}$ *EBBnN2O*$_{icl}$	$tCO_2e\ ha^{-1}$ *EBBCH4*$_{icl}$	$tCO_2e\ ha^{-1}$ *EBBtot*$_{icl}$
1	Ombrofile Forest	96 %	-229.74	0	-2.61	96 %	0	100 %	0.5	0	0.5	-110.275	0	-1.31	-107	0	-9.82	-9.8816

Table 44: Baseline non-CO2 emissions from forest fires in the project area (Refer to Table 24 – VM0015 methodology)

Project year *t*	Emissions of non-CO_2 gasses from baseline forest fires $ID_{icl} = 1$		Total baseline non-CO2 emissions from forest fires in the project area	
			annual	cumulative
	$ABSLPA_{icl,t}$	$EBBBSLtot_{icl}$	$EBBBSLPA_t$	$EBBBSLPA$
	ha	tCO_2-e ha^{-1}	tCO_2-e	tCO_2-e
1	1,062	(10)	(10,424)	(10,424)
2	1,408	(10)	(13,819)	(24,242)
3	1,610	(10)	(15,806)	(40,048)
4	1,539	(10)	(15,107)	(55,155)
5	1,413	(10)	(13,866)	(69,021)
6	1,198	(10)	(11,759)	(80,780)
7	1,220	(10)	(11,974)	(92,754)
8	1,076	(10)	(10,567)	(1,03,321)
9	988	(10)	(9,700)	(1,13,021)
10	906	(10)	(8,897)	(1,21,918)
11	845	(10)	(8,293)	(1,30,210)
12	830	(10)	(8,150)	(1,38,360)
13	789	(10)	(7,744)	(1,46,104)
14	710	(10)	(6,973)	(1,53,077)
15	766	(10)	(7,521)	(1,60,598)
16	779	(10)	(7,649)	(1,68,247)
17	761	(10)	(7,466)	(1,75,713)

18	761	(10)	(7,466)	(1,83,179)
19	757	(10)	(7,434)	(1,90,613)
20	770	(10)	(7,553)	(1,98,166)
21	816	(10)	(8,014)	(2,06,180)
22	799	(10)	(7,839)	(2,14,020)
23	975	(10)	(9,573)	(2,23,593)
24	1,037	(10)	(10,177)	(2,33,770)
25	1,022	(10)	(10,034)	(2,43,804)
26	1,102	(10)	(10,821)	(2,54,625)
27	1,111	(10)	(10,901)	(2,65,525)
28	1,181	(10)	(11,592)	(2,77,117)
29	1,420	(10)	(13,938)	(2,91,055)
30	1,601	(10)	(15,711)	(3,06,766)

Total ex ante estimated actual emissions of non-CO2 gasses due to forest fires in the project area

The Project does not include planned deforestation, logging or fuel wood collection and charcoal production activities thus Tables 25a,b,c,d and 26a,b,c,d of the vm0015 methodology do not apply to the Project.

The Project has been effective in identifying illegal logging operations and invasion attempts since 2014 by undertaking on-site patrolling and reporting (FAO, 2019). As mentioned through the PD (particularly in Sections 1.10, 2.4.1, and 2.4.6.3) unplanned deforestation is a process that requires loggers to open roads and squatters to invade the land. For this to happen the management team should have left unspotted illegal logging operations and squattering in the PA to the point that significant extensions of forest are slashed and burned to implement pastures (because squatters will not invade small areas as they are driven by the expectation of selling the land to ranchers). Given the experience gained since 2014 on in-site monitoring and enforcement (which is proven by the fact that squattering initiatives have been stopped over the years as proved in the patrolling reports and no ranching operations can be spotted in the PA during field visits) plus the additional funding to scale-up these activities and involvement of local villagers (the Project has secured funding for implementation for the first three years), the Project is conservative in assuming that it will prevent at least 95% of the deforestation in the project area.

In conclusion, the Project assumes an Effectiveness Index (EI) 0.95. Ex ante estimation of carbon stock changes due to unavoidable unplanned deforestation within the project area are presented below (Table 45):

Table 45: Ex ante estimated net carbon stock change in the project area under the project scenario (Refer to Table 27 – VM0015 methodology)

Project year *t*	Total carbon stock decrease due to planned activities		Total carbon stock increase due to planned activities		Total carbon stock decrease due to unavoided unplanned deforestation		Total carbon stock change in the project case	
	annual	cumulative	annual	cumulative	annual	cumulative	annual	cumulative
	$\triangle CPAdPA_t$	$\triangle CPAdPA$	$\triangle CPAiPA_t$	$\triangle CPAiPA$	$\triangle CUDdPA_t$	$\triangle CUDdPA$	$\triangle CPSPA_t$	$\triangle CPSPA$
	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
0	0	0	0	0	0	0	0	0
1	0	0	0	0	(12,608)	(12,608)	(12,608)	(12,608)
2	0	0	0	0	(16,895)	(29,503)	(16,895)	(16,895)
3	0	0	0	0	(19,537)	(49,040)	(19,537)	(19,537)
4	0	0	0	0	(18,964)	(68,004)	(18,964)	(18,964)
5	0	0	0	0	(17,725)	(85,729)	(17,725)	(17,725)
6	0	0	0	0	(15,415)	(1,01,144)	(15,415)	(15,415)
7	0	0	0	0	(15,878)	(1,17,022)	(15,878)	(15,878)
8	0	0	0	0	(14,383)	(1,31,405)	(14,383)	(14,383)
9	0	0	0	0	(13,517)	(1,44,922)	(13,517)	(13,517)
10	0	0	0	0	(12,713)	(1,57,635)	(12,713)	(12,713)
11	0	0	0	0	(11,864)	(1,69,499)	(11,864)	(11,864)
12	0	0	0	0	(11,746)	(1,81,245)	(11,746)	(11,746)
13	0	0	0	0	(11,344)	(1,92,589)	(11,344)	(11,344)
14	0	0	0	0	(10,563)	(2,03,152)	(10,563)	(10,563)
15	0	0	0	0	(11,380)	(2,14,532)	(11,380)	(11,380)
16	0	0	0	0	(11,718)	(2,26,250)	(11,718)	(11,718)
17	0	0	0	0	(11,624)	(2,37,874)	(11,624)	(11,624)
18	0	0	0	0	(11,789)	(2,49,663)	(11,789)	(11,789)
19	0	0	0	0	(11,902)	(2,61,565)	(11,902)	(11,902)
20	0	0	0	0	(12,196)	(2,73,760)	(12,196)	(12,196)

21	0	0	0	0	(12,899)	(2,86,660)	(12,899)	(12,899)
22	0	0	0	0	(12,830)	(2,99,490)	(12,830)	(12,830)
23	0	0	0	0	(15,072)	(3,14,562)	(15,072)	(15,072)
24	0	0	0	0	(15,989)	(3,30,551)	(15,989)	(15,989)
25	0	0	0	0	(15,977)	(3,46,528)	(15,977)	(15,977)
26	0	0	0	0	(17,099)	(3,63,627)	(17,099)	(17,099)
27	0	0	0	0	(17,387)	(3,81,014)	(17,387)	(17,387)
28	0	0	0	0	(18,412)	(3,99,426)	(18,412)	(18,412)
29	0	0	0	0	(21,450)	(4,20,875)	(21,450)	(21,450)
30	0	0	0	0	(23,832)	(4,44,707)	(23,832)	(23,832)

3.2.3 Leakage

Step 8 of VM0015 - Ex-ante leakage estimate

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

The Project's activities won't generate GHG emissions thus there won't be GHG emissions from leakage prevention activities. Tables 30a,b,c as well as Tables 34 and 35 of the vm0015 methodology do not apply to the Project. In the same way, the Project will not implement grazing activities in the LMA thus Tables 31, 32, and 33 of the vm0015 methodology do not apply.

GHG emissions by activity displacement could only be considered as leakage if such emissions are located within the leakage belt (LK) and happen above baseline projections. A mobility analysis was used to calculate the extent of the leakage belt of the Project and results from this analysis are presented in Section 3.1.3. (As indicated in the footnote in page 101 of the VCS vm0015 methodology "If deforestation agents do not participate in leakage prevention activities and project activities, the Displacement Factor shall be 100%. Where leakage prevention activities are implemented the factor shall be equal to the proportion of the baseline agents estimated to be given the opportunity to participate in leakage prevention activities and project activities" thus if all the agents are given the opportunity to participate in the activities of the Project, then the LDF should be zero).

Starting from 2012 the cattle were gradually sold as they reached maturity for the marketing of the meat. Since January 2016, of the beginning of the Project until today there are no cattle in the farm, except several milk cows owned by the farm keeper for his self-consumption. Because of that, no leakage management zone was identified.

Also, the VM0015 methodology indicates that the amount of leakage will depend on the Leakage Displacement Factor (LDF) which is equal to the proportion of agents of deforestation that do not participate in the Project's activities.

Following these guidelines, the Project will not generate displacement leakage as the Project's activities are designed to provide all the deforestation agents that arrive to the Project's Boundary with the opportunity to participate.

3.2.4 Net GHG Emission Reductions and Removals

Step 9 if VM0015 - Net ex-ante net reduction in anthropogenic GHG emissions significance assessment

Calculation of ex ante estimates of total net GHG emission reductions

The equation 19 suggested by VM0015 was used for the ex-ante estimation of the project emissions reductions.

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

Where:

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

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

$EBBBSLPA_t$: Sum of baseline emissions from biomass burning in the project area at year t (tCO2e);

$\Delta CPSPA_t$: Sum of ex ante estimated actual carbon stock changes in the project area at year *t* (tCO_2e); $EBBPSPA_t$: Sum of (ex ante estimated) actual emissions from biomass burning in the project area at year *t* (tCO_2e);

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

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

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

Ex-ante calculation of Verified Carbon Units (VCUs)

To estimate the number of VCUs, we used equation 20 of VM0015. The Risk Factor parameter of the Project was estimated through the document *VCS AFOLU Non-Permanence Risk Tool*, resulting in 11.75%.

$$VCU_t = \Delta REDD_t - VBC_t$$

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

Where:

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

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

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

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

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

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

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

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated Buffer credits	Estimated net GHG emission reductions or removals (tCO_2e)
1	2,62,585.72	13,129	0	28,086	2,21,370
2	3,51,710.52	17,586	0	37,636	2,96,489
3	4,06,555.51	20,328	0	43,525	3,42,703
4	3,94,387.39	19,719	0	42,248	3,32,420
5	3,68,357.68	18,418	0	39,489	3,10,451
6	3,20,067.62	16,003	0	34,346	2,69,718
7	3,29,535.95	16,477	0	35,378	2,77,682
8	2,98,218.38	14,911	0	32,047	2,51,260
9	2,80,034.90	14,002	0	30,119	2,35,914
10	2,63,154.52	13,158	0	28,329	2,21,668
11	2,45,576.80	12,279	0	26,438	2,06,860
12	2,43,067.17	12,153	0	26,175	2,04,739
13	2,34,631.18	11,732	0	25,281	1,97,619
14	2,18,240.94	10,912	0	23,542	1,83,787
15	2,35,114.74	11,756	0	25,361	1,97,998
16	2,42,013.64	12,101	0	26,116	2,03,797
17	2,39,936.13	11,997	0	25,906	2,02,034
18	2,43,246.79	12,162	0	26,275	2,04,809
19	2,45,474.75	12,274	0	26,528	2,06,673
20	2,51,464.21	12,573	0	27,182	2,11,709

21	2,66,004.00	13,300	0	28,751	2,23,953
22	2,64,439.37	13,222	0	28,597	2,22,620
23	3,11,021.57	15,551	0	33,593	2,61,878
24	3,29,950.91	16,498	0	35,635	2,77,818
25	3,29,574.02	16,479	0	35,610	2,77,486
26	3,52,801.56	17,640	0	38,110	2,97,051
27	3,58,636.15	17,932	0	38,752	3,01,952
28	3,79,825.64	18,991	0	41,036	3,19,798
29	4,42,931.72	22,147	0	47,805	3,72,981
30	4,92,347.85	24,617	0	53,112	4,14,618
Total	9,200,907	460,045	0	991,006	7,749,856

3.3 Monitoring

3.3.1 Data and Parameters Available at Validation

Below is the description of the data and parameters available in the validation.

Data / Parameter	**Deforestation**
Data unit	*Hectare (ha)*
Description	*Maps of forest cover areas converted into non-forest cover areas*
Source of data	*Measured through data from the PRODES/INPE Project*
Value applied	*0.40%/year on average (2000-2014)*
Justification of choice of data or description of measurement methods and procedures applied	*Data from the PRODES Digital program (official mapping satellite of Brazilian Amazon Forest) were used to map the deforestation and production of the Forest Cover Excellence Brand Map. During the analyzed period, a total of 46 Landsat images were used. And for the classification of the images in the mapping of forest classes, non-forest vegetation, hydrography and deforestation, the ISOSEG method of unsupervised classification was used*
Purpose of data	• *- Determination of baseline scenario* • *- Calculation of baseline emissions* • *- Calculation of project emissions* *- Calculation of leakage*
Comments	*View the documents:* *- Câmara et al. 2006. Methodology for the calculation of the annual rate of deforestation in the Legal Amazon* *- Determination of the Forest Carbon Stock for the REDD+ Project*

Data / Parameter	**CF**
Data unit	*T*
Description	*Carbon contained in dry biomass*
Source of data	*Nogueira et al. (2008). Estimates of forest biomass in the Brazilian Amazon: New allometric equations and biomass adjustments of wood volume inventories. Forest Ecology and Management, v. 256, n. 11, p. 1853-1867, 2008*
Value applied	*0.485*

Justification of choice of data or description of measurement methods and procedures applied	*Value found in scientific literature*
Purpose of data	• *- Determination of baseline scenario* • *- Calculation of baseline emissions* • *- Calculation of project emissions* *- Calculation of leakage*
Comments	

Data / Parameter	ABSLRRt
Data unit	*Ha*
Description	*Annual area of baseline deforestation within the RR at year t*
Source of data	Calculated, see Annex VM0015 tables
Value applied	*Table 9a, 11a Annex VM0015 tables*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of the VM0015 v1.1.*
Purpose of data	Calculation of baseline emissions
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	ABSLRR
Data unit	*Ha*
Description	*Cumulative area of baseline deforestation in the reference region at year t*
Source of data	Calculated, see calculation sheet
Value applied	*Table 9a, 11a Annex VM0015 tables*

Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of the VM0015 v1.1.*
Purpose of data	Calculation of baseline emissions
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	ABSLPAt
Data unit	*Ha*
Description	*Annual area of baseline deforestation in the project area at year t*
Source of data	Calculated, see calculation sheet
Value applied	*Table 9b, 11b, 13b of Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of the VM0015 v1.1.*
Purpose of data	Calculation of baseline emissions
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	ABSLPAicl,t
Data unit	*Ha*
Description	*Area of initial (pre-deforestation) forest class icl deforested at time t within the project area in the baseline*
Source of data	Calculated, see calculation sheet
Value applied	*Table 11b of Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of VM0015 v1.1, 5.1 by applying land cover map to the result of Table 9b*

Purpose of data	Calculation of baseline emissions
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	ABSLPAi,t
Data unit	*Ha*
Description	Annual area of baseline deforestation within stratum (i) of the project area at year t
Source of data	Calculated, see VCS Annex
Value applied	*Table 9b of Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of VM0015 v1.1, 4.1.2.2*
Purpose of data	Calculation of baseline emissions
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	ABSLPA
Data unit	*Ha*
Description	Cumulative area of baseline deforestation within the project area at year t
Source of data	Calculated, see VCS Annex
Value applied	*Table 9b, Table 11b, Table 13b of Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of the VM0015 v1.1.*
Purpose of data	Calculation of baseline emissions
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	ABSLPAz,t
Data unit	*Ha*
Description	Area of the zone z "deforested" at time t within the project area in the baseline case; ha
Source of data	Calculated, see VCS Annex
Value applied	*Table 13b of Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Equal to values of Table 11b grouped by zones.*
Purpose of data	Calculation of baseline emissions
Comments	*Calculating net GHG emissions via post-deforestation C-stocks*

Data / Parameter	ABSLLKt
Data unit	*Ha*
Description	Annual area of baseline deforestation within the leakage belt at year t
Source of data	Calculated, see VCS Annex
Value applied	*Table 9c, 11c, 13c of Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of VM0015 v1.1.*
Purpose of data	Calculation of leakage
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	$ABSLLK_{icl,t}$
Data unit	*Ha*
Description	Area of initial (post-deforestation) forest class fcl deforested at time t within the leakage belt in the baseline case
Source of data	Calculated, see calculation sheet
Value applied	*Table 11c of Annex VM0015*

Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of VM0015 v1.1, 5.1 by applying land cover map to the result of Table 9c*
Purpose of data	Calculation of leakage
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	$ABSLLK_{l,t}$
Data unit	*Ha*
Description	Annual area of deforestation in stratum (i) within the leakage belt at year t
Source of data	Calculated. See VCS annex – section 4
Value applied	*Table 9c, 11c, 13c of Annex VM0015.*
Justification of choice of data or description of measurement methods and procedures applied	*Activity data for calculating GHG emissions. Calculated according to requirements of VM0015 v1.1.*
Purpose of data	Calculation of leakage
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	ABSLLK
Data unit	*Ha*
Description	Cumulative area of baseline deforestation within the leakage belt at year t
Source of data	Calculated
Value applied	*Table 9c, 11c, 13c of Annex VM0015.*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of VM0015 v1.1.*

Purpose of data	Calculation of leakage
Comments	*Activity data for calculating GHG emissions in the baseline scenario*

Data / Parameter	CFj
Data unit	*Dimensionless*
Description	Carbon fraction for tree tr, of species, group of species or forest type j
Source of data	IPCC GPG 2006 Chapter 6
Value applied	*forest classes: 0.5 Post-deforestation classes: 0.47*
Justification of choice of data or description of measurement methods and procedures applied	*Default values IPCC GPG 2006, Chapter 6*
Purpose of data	Calculation of baseline emission
Comments	Conversion from biomass to CO2e

Data / Parameter	Cabcl
Data unit	t CO_2e ha^{-1}
Description	Average carbon stock per hectare in the above-ground biomass carbon pool of LU/LC class cl
Source of data	Calculated, see calculation sheet
Value applied	*forest class: bh-M: 250.75* *bh-MB: 350.22* *bh-PM: 196.63* *bmh-M: 216.28* *bmh-MB: 448.24* *bmh-PM and and bmh-PMt: 460.92* *bms-T: 169.23* *bp-M: 183.36* *bp-MB: 181.47* *bp-PM: 398.95* *bs-MB: 165.78*

Justification of choice of data or description of measurement methods and procedures applied	*Derived from forest inventory data, IDEAM. See VCS Annex.*
Purpose of data	Calculation of baseline emission
Comments	Emissions factors for estimating GHG emissions from deforestation.

Data / Parameter	Rj
Data unit	*Relation factor*
Description	Root shoot ratio
Source of data	IPCC/Literature value
Value applied	*0.24*
Justification of choice of data or description of measurement methods and procedures applied	*Default value of 0.24 from IPCC Guidelines for National Greenhouse Gas Inventories. 2006. Table 4.3/Mokany 2006*
Purpose of data	Calculation of baseline emission
Comments	Belowground biomass estimation

Data / Parameter	Cbbcl
Data unit	t CO_2e ha^{-1}
Description	Average carbon stock per hectare in the below-ground biomass carbon pool of LU/LC class cl
Source of data	Calculated, see calculation sheet
Value applied	*forest class:* *bh-M=60.18* *bh-MB=122.05* *bh-PM=47.19* *bmh-M=51.91* *bmh-MB=107.58* *bmh-PM and bmh-PMt=75.65*

	bms-T=40.62 *bp-M=44.01* *bp-MB=43.55* *bp-PM=95.75* *bs-T=39.79*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated by applying the default value of 0.24 from IPCC Guidelines for National Greenhouse Gas Inventories. 2006. Table Table 4.3/Mokany 2006*
Purpose of data	Calculation of baseline emission
Comments	Emissions factors for estimating GHG emissions from deforestation.

Data / Parameter	Ctot(icl)
Data unit	t CO_2e ha^{-1}
Description	Average carbon stock per hectare in the below-ground biomass carbon pool of LU/LC class cl
Source of data	Calculated, see Table Biomass, Annex GEI DB
Value applied	*forest class:* *bh-M=310.92* *bh-MB=630.61* *bh-PM=243.82* *bmh-M=268.19* *bmh-MB=555.82* *bmh-PM y bmh-PMt=390.85* *bms-T=209.85* *bp-M=227.37* *bp-MB=225.02* *bp-PM=494.70* *bs-T=205.57*
Justification of choice of data or description of measurement methods and procedures applied	*Derived from various forest inventory data. See Table Biomass, Annex GEI DB.*
Purpose of data	Calculation of baseline emission

Comments	Emissions factors for estimating GHG emissions from deforestation.

Data / Parameter	$Ctot_{icl,t}$
Data unit	t CO_2e ha^{-1}
Description	Average carbon stock of all accounted carbon pools in forest class icl at time t
Source of data	Calculated, see Table Significancia, Annex VM0015
Value applied	*Deemed de-minimus*
Justification of choice of data or description of measurement methods and procedures applied	*Significance analysis.*
Purpose of data	Calculation of baseline emission
Comments	N.A

Data / Parameter	Cabfcl
Data unit	t CO_2e ha^{-1}
Description	Average carbon stock per hectare in the above-ground biomass carbon pool of final post-deforestation class fcl
Source of data	Calculated, see table CarbonPostdef, Annex GEI DB
Value applied	*Grassland: 17.95* *Heterogeneous farmland: 23.74* *Crops: 21.78*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated according to requirements of VM0015 v1.1.*
Purpose of data	Calculation of baseline emission
Comments	Calculate GHG emissions from deforestation

Data / Parameter	Cp
Data unit	t CO_2e ha^{-1}
Description	Average carbon stock per hectare in the carbon pool p
Source of data	Table 20.a
Value applied	*Table 20.a. Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Requirements of the VM0015 sec. 6.1.2.*
Purpose of data	Calculation of baseline emission
Comments	Baseline GHG emissions estimates

Data / Parameter	$Ctot_{fcl, t}$
Data unit	t CO_2e ha^{-1}
Description	Average carbon stock of all accounted carbon pools in non-forest class fcl at time t;
Source of data	N.A
Value applied	*N.A*
Justification of choice of data or description of measurement methods and procedures applied	*Leakage management activities do not decrease carbon stocks.*
Purpose of data	Calculation of baseline emission
Comments	N.A

Data / Parameter	ΔCabABSLKK
Data unit	t CO_2e
Description	Cumulative baseline carbon stock changes for the above-ground biomass pool in the leakage belt
Source of data	Table 21.c.1, Annex VM0015
Value applied	*See Table 21.c.1, Annex VM0015*

Justification of choice of data or description of measurement methods and procedures applied	*GHG accounting in the leakage belt.*
Purpose of data	Calculation of leakage
Comments	N.A

Data / Parameter	ΔCbbABSLKK
Data unit	t CO_2e
Description	Cumulative baseline carbon stock changes for the below-ground biomass pool in the leakage belt
Source of data	Table 21.c.1 Annex VM0015
Value applied	*See Table 21.c.1 Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*GHG accounting in the leakage belt.*
Purpose of data	Calculation of leakage
Comments	N.A

Data / Parameter	ΔCabBSLPA
Data unit	t CO_2e
Description	Cumulative baseline carbon stock changes for the above-ground biomass pool in the project area
Source of data	Table 21.b.1 Annex VM0015
Value applied	*See Table 21.b.1 Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*GHG accounting in the project area.*
Purpose of data	Calculation of baseline emissions

Comments	N.A

Data / Parameter	ΔCbbABSLPA
Data unit	t CO_2e
Description	Cumulative baseline carbon stock changes for the below-ground biomass pool in the project area
Source of data	Table 21.b.1 Annex VM0015
Value applied	*See Table 21.b.1 Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*GHG accounting in the project area.*
Purpose of data	Calculation of baseline emissions
Comments	N.A

Data / Parameter	ΔCADLK
Data unit	t CO_2e
Description	Cumulative total decrease in carbon stocks due to displaced deforestation
Source of data	Table 34, 35, Annex VM0015
Value applied	*See Table 34, 35, Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*GHG accounting from displaced leakage*
Purpose of data	Calculation of leakage
Comments	N.A

Data / Parameter	ΔCBSLPA
Data unit	t CO2-e
Description	Total baseline carbon stock changes in the project area

Source of data	Table 36, Annex VM0015
Value applied	*See Table 36, Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*GHG accounting in the project area*
Purpose of data	Calculation of leakage
Comments	N.A

Data / Parameter	ΔCPSPA
Data unit	t CO2-e
Description	Cumulative project carbon stock change within the project area at year t
Source of data	See Tables 27 and 36, Annex VM0015
Value applied	*Tables 27 and 36, Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Calculation of net GHG emissions reductions*
Purpose of data	Calculation of baseline emissions
Comments	N.A

Data / Parameter	ΔCUDdPA
Data unit	t CO2-e
Description	Cumulative actual carbon stock change due to unavoided unplanned deforestation at year t in the project area
Source of data	Table 27, Annex VM0015.
Value applied	*Effectiveness index: 40%*

Justification of choice of data or description of measurement methods and procedures applied	*Measure of project effectiveness*
Purpose of data	Calculation of project emissions
Comments	N.A

Data / Parameter	ΔREDDt
Data unit	t CO2-e
Description	Net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t
Source of data	See Table 36, Annex VM0015
Value applied	*Table 36, Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*The cumulative result of applying the VM0015 methodology*
Purpose of data	Calculation of project emissions
Comments	Final GHG calculations

Data / Parameter	DLF
Data unit	%
Description	Displacement leakage factor
Source of data	Table 34, Annex VM0015
Value applied	*5*
Justification of choice of data or description of measurement methods and procedures applied	*ex-ante leakage*
Purpose of data	Calculation of leakage

Comments	N.A

Data / Parameter	EI
Data unit	%
Description	ex-ante estimated Effectiveness Index
Source of data	Estimate generated by the project
Value applied	*0.40*
Justification of choice of data or description of measurement methods and procedures applied	*Estimate generated by the project*
Purpose of data	Calculation of project emissions
Comments	N.A

Data / Parameter	ELK
Data unit	t CO2-e
Description	Cumulative sum of ex-ante estimated leakage emissions at year t
Source of data	Table 35, 36 Annex VM0015
Value applied	*Table 35, 36 Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*The cumulative result of applying the VM0015 methodology*
Purpose of data	Calculation of leakage
Comments	N.A

Data / Parameter	RFt
Data unit	%
Description	Risk factor used to calculate VCS buffer credits
Source of data	VCS Non Permanence Risk analysis

Value applied	*11.75*
Justification of choice of data or description of measurement methods and procedures applied	*see VCS Non-Permanence Risk Analysis*
Purpose of data	Calculation of project emissions
Comments	N.A

Data / Parameter	VBCt
Data unit	t CO2-e
Description	Number of Buffer Credits deposited in the VCS Buffer at time t;
Source of data	See Table 36, Annex VM0015
Value applied	*Table 36, Annex VM0015*
Justification of choice of data or description of measurement methods and procedures applied	*Calculated*
Purpose of data	Buffer calculation
Comments	N.A

3.3.2 Data and Parameters Monitored

The description of the data and monitored parameters subsequent to validation follows.

Data / Parameter	ABSLLKt
Data unit	*Ha*
Description	*Annual area of deforestation within the leakage belt at year t*
Source of data	*Satellite images*

Description of measurement methods and procedures to be applied	*ARC will be in charged for the climate monitoring according to the methodology VM0015 v1.1. Table 9c, 11c, 13c of Annex VM0015.*
Frequency of monitoring/recording	*At each verification period*
Value applied	*0*
Monitoring equipment	*GIS software*
QA/QC procedures to be applied	*Quality control/quality assurance (QA/QC) procedures will be performed by ARC*
Purpose of data	Activity data for calculating GHG emissions. Calculated according to requirements of VM0015 v1.1.
Calculation method	*Calculation of leakage*
Comments	*N.A*

Data / Parameter	ABSLPA
Data unit	*Ha*
Description	*Cumulative area of deforestation within the project area at year t*
Source of data	*Satellite images*
Description of measurement methods and procedures to be applied	*ARC will be in charged for the climate monitoring according to the methodology VM0015 v1.1. Table 9b, 11b, 13b of Annex VM0015.*
Frequency of monitoring/recording	*At each verification period*
Value applied	*0*
Monitoring equipment	*GIS software*

QA/QC procedures to be applied	*Quality control/quality assurance (QA/QC) procedures will be performed by ARC*
Purpose of data	Activity data for calculating GHG emissions. Calculated according to requirements of VM0015 v1.1.
Calculation method	*Calculation of project emissions*
Comments	*N.A*

Data / Parameter	ABSLPAt
Data unit	*Ha*
Description	*Annual area of deforestation in the project area at year t*
Source of data	*Satellite images*
Description of measurement methods and procedures to be applied	*ARC will be in charged for the climate monitoring according to the methodology VM0015 v1.1. Table 9b, 11b, 13b of Annex VM0015.*
Frequency of monitoring/recording	*At each verification period*
Value applied	*0*
Monitoring equipment	*GIS software*
QA/QC procedures to be applied	*Quality control/quality assurance (QA/QC) procedures will be performed by ARC*
Purpose of data	Activity data for calculating GHG emissions. Calculated according to requirements of VM0015 v1.1.
Calculation method	*Calculation of project emissions*
Comments	*N.A*

Data / Parameter	ΔCPSPAt
Data unit	t CO2-e
Description	*Annual project carbon stock change within the project area at year t*
Source of data	*Satellite images and carbon stocks defined in 4.1*
Description of measurement methods and procedures to be applied	*ARC will be in charged for the climate monitoring according to the methodology VM0015 v1.1. Table 27 and Table 36, Annex VM0015.*
Frequency of monitoring/recording	*At each verification period*
Value applied	*See Table 27 and Table 36, Annex VM0015.*
Monitoring equipment	*N.A*
QA/QC procedures to be applied	*Quality control/quality assurance (QA/QC) procedures will be performed by ARC*
Purpose of data	Calculation of project emissions
Calculation method	*Activity data for calculating GHG emissions reductions.*
Comments	*N.A*

Data / Parameter	ΔREDD
Data unit	t CO2-e
Description	*Cumulative net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity*
Source of data	*Methodology VM0015 v1.1. Table 36, Annex VM0015*

Description of measurement methods and procedures to be applied	*According to the methodology VM0015 v1.1. Table 36, Annex VM0015.*
Frequency of monitoring/recording	*At each verification period*
Value applied	*See VM0015 v1.1. Table 36, Annex VM0015*
Monitoring equipment	*N.A*
QA/QC procedures to be applied	*ARC will assign a QA/QC coordinator*
Purpose of data	Calculation of project emissions
Calculation method	*Final GHG calculations*
Comments	*N.A*

Data / Parameter	ΔREDDt
Data unit	t CO2-e
Description	*Net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t*
Source of data	*Methodology VM0015 v1.1. Table 36, Annex VM0015*
Description of measurement methods and procedures to be applied	*According to the methodology VM0015 v1.1. Table 36, Annex VM0015*
Frequency of monitoring/recording	*At each verification period*
Value applied	*VM0015 v1.1. Table 36, Annex VM0015*
Monitoring equipment	*N.A*

QA/QC procedures to be applied	*ARC will assign a QA/QC coordinator*
Purpose of data	Calculation of project emissions
Calculation method	*Final GHG calculations*
Comments	*N.A*

Data / Parameter	RFt
Data unit	%
Description	*Risk factor used to calculate VCS buffer credits*
Source of data	*VCS Non Permanence Risk analysis*
Description of measurement methods and procedures to be applied	*AFOLU Non permanence Risk Tool v.3.2*
Frequency of monitoring/recording	*At each verification period*
Value applied	*11.75*
Monitoring equipment	*N.A*
QA/QC procedures to be applied	*N.A*
Purpose of data	Calculation of project emissions
Calculation method	*N.A*
Comments	*Buffer calculation*

Data / Parameter	VBCt
Data unit	t CO2-e
Description	*Number of Buffer Credits deposited in the VCS Buffer at time t;*
Source of data	*Methodology VM0015 v1.1. Table 36, Annex VM0015*
Description of measurement methods and procedures to be applied	*According to the methodology VM0015 v1.1. Table 36, Annex VM0015*
Frequency of monitoring/recording	*At each verification period*
Value applied	*See Table 36, Annex VM0015*
Monitoring equipment	*N.A*
QA/QC procedures to be applied	*N.A*
Purpose of data	Calculation of project emissions
Calculation method	*N.A*
Comments	*Buffer calculation*

Data / Parameter	VCUt
Data unit	t CO2-e
Description	*Number of Verified Carbon Units (VCUs) to be made available for trade at time t*
Source of data	*Methodology VM0015 v1.1. Table 36, Annex VM0015*
Description of measurement methods	*According to the methodology VM0015 v1.1. Table 36, Annex VM0015*

and procedures to be applied	
Frequency of monitoring/recording	*At each verification period*
Value applied	*See VM0015 v1.1. Table 36, Annex VM0015*
Monitoring equipment	*N.A*
QA/QC procedures to be applied	*N.A*
Purpose of data	Calculation of project emissions
Calculation method	*N.A*
Comments	*Buffer calculation*

3.3.3 Monitoring Plan

The monitoring plan of the REDD+ Project is a combination of three components: climate, community and biodiversity. ARC group is one of the proponents and implementing partners of this Project, being responsible for coordinating the monitoring processes during its life cycle. The climate aspects will be monitored directly by the ARC group and the social and biodiversity aspects will be monitored by the land owners and partners hired with skills in the subject.

Monitoring Plan for Climate Impacts:

The Climate Impact Monitoring Plan will encompass key issues for the demonstration of emission reduction by deforestation and degradation due to avoided unplanned deforestation, in accordance with the applied methodology VM0015, and changes in carbon stock throughout the project life cycle due to changes in land use within the Project area and in the leakage belt.

TASK 1. Monitoring changes in carbon stocks and GHG emissions for periodic verification.

1.1 Monitoring actual changes in carbon stocks and GHG emissions in the project area;

1.2 Monitoring leakage;

1.3 Ex-post calculation of GHG emission reductions;

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

1.1 Monitoring actual changes in carbon stocks and GHG emissions in the project area.

1.1.1 Monitor the implementation of the project

This task will be the responsibility of TFA. To assure the most effective monitoring of the activities of the Project, areas will be divided in brigades to better manage the extent of the Project Area and LMA. Brigade leaders will oversee the activities and compile and analyze the results from monitoring patrols (Figure 44). Brigade leaders will report to TFA's office in Paragominas, which in turn will report to the office in Ulianopolis. These two offices will be responsible of informing local authorities about illegal activities happening in the Project Area and to follow up the enforcement of the required measures to remove invaders (Figure 45).

Figure 44: Activities management in the Project

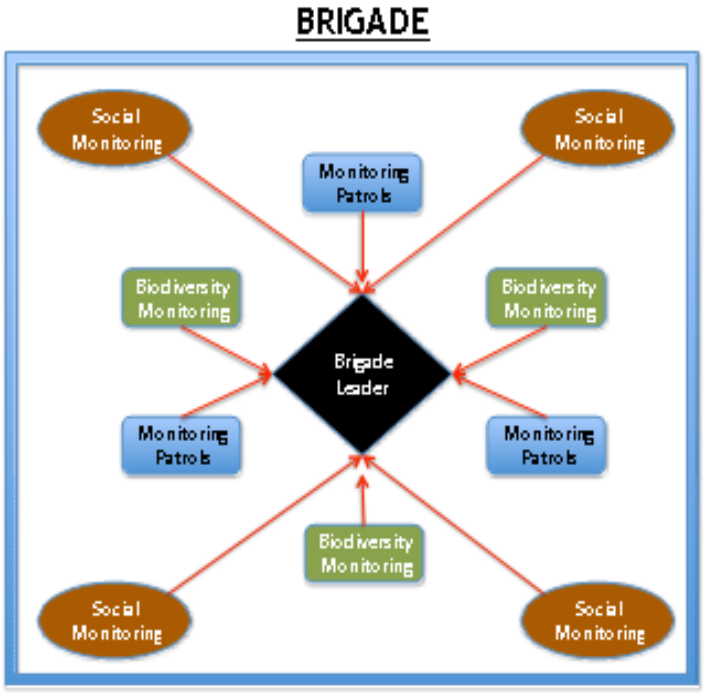
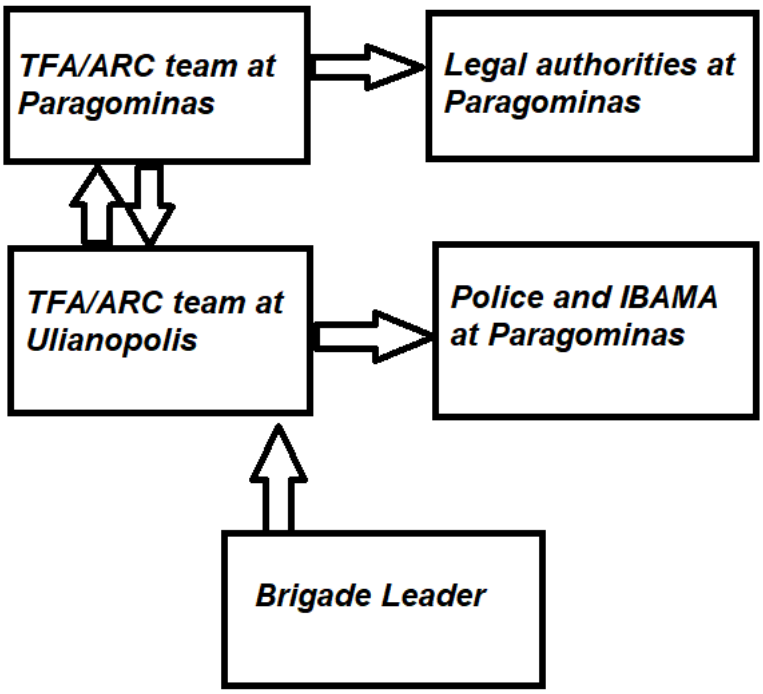


Figure 45: Activities to inform local authorities about illegal activities in the Project Area



The activities of the Project and their monitoring can be group as follows:

1. Forest monitoring: will be conducted by forest monitoring patrols. There will be a responsibility for each monitoring patrol who will generate weekly activities reports unless illegal activities are spotted, in which case a report should be submitted immediately as described in the next section.

Bridage leaders will compile in adequate digital format all the information from the reports to keep track of the areas that are being patrolled each week and what are the findings of each patrol. This ground information will be complemented with monthly or bimonthly Landsat 8 imagery that will also serve as a mean of verifying the effectiveness of the monitoring patrols.

On a monthly basis, brigade leaders will perform random site visits to verify that monitoring patrols are covering the assigned area and that each patrol is wearing the adequate field equipment. Brigade leaders should fill up a report that will be submitted to the TFA/ARC's office in Paragominas. A monitoring patrol that does not wear adequate field equipment or does not cover the designed monitoring route, will receive a warning. If a patrol is a reoffender, the patrol leader will be immediately replaced.

Maps, reports and records will be available to validators at each verification event.

2. Biodiversity monitoring: will be undertaken by biodiversity monitoring squads. These patrols should follow approved monitoring protocols (by ARC) and make reports every two weeks. Reports

should provide georeferenced information about biodiversity spotting and data as determined by the protocols. All data from the reports should be input into electronic format prior to the analysis.

Based on the compiled data, monitoring areas will change to provide better information about biodiversity in the area.

Maps, reports and records will be available to validators at each verification event.

3. Social Monitoring: will be undertaken by social monitoring squads. There will be a responsible for each monitoring squad who will generate monthly activities reports. Each squad will be in charge of specific villages and will use approved questionnaires to gather socio-economic data about the impacts of the activities of the Project. Questionnaires will also include a section for comments to include information that is not contained in the template.

Monthly reports will be submitted to the brigade leader who will input the information into electronic format to analyze it. The results from this analysis will be used to assess the impact of each activity and to identify villages that require particular attention.

The Project management teams in Protel and Belem will held bimonthly meetings to assess the effectiveness of the activities in local villages. Based on the information supplied by the brigade leaders, the management teams will improve the proposed activities.

Maps, reports and records will be available to validators at each verification event.

1.1.2 Monitoring change and land use within the project area.

This task will be the responsibility of ARC. According to the categories presented in Table 35 of the VM0015 methodology (Table 66), the Project will implement MRV to identify and assess LULC-changes within the Project Area due.

Table 46: Categories that require MRV (refer to Table 35- VM0015 methodology)

ID	Type	Conditions under which monitoring is mandatory	Explanations	Applicability to the Project
I	Area of forest land converted to non-forest land.	Mandatory in all AUD project activities		Applicable
II	Area of forest land undergoing carbon stock decrease.	Mandatory only for AUD project activities having planned logging, fuel-wood collection and charcoal production activities above the baseline.	Change in carbon stock must be significant according to *ex ante* assessment, otherwise monitoring is not required.	Does not apply because none of the the Project's activities involve planned logging, fuel-wood collecion and charcoal production.
III	Area of forest land undergoing carbon stock increase.	Mandatory only for AUD project activities wishing to claim carbon credits for carbon stock increase.	Increase must be significant according to *ex ante* assessment and can only be accounted on areas that	Does not apply because the Project will not claim carbon credits from carbon stock increase.

			will be deforested in the baseline case.	

To assess LULC-change from forest land to non-forest land, the Project will use LANDSAT 8 imagery and/or radar imagery to generate annual deforestation data throughout the Reference Region using the standard protocol. This analysis will generate classes of forest and non-forest, updated every year, and will be compared with previous years. Deforestation estimates obtained from this analysis will be compared with the deforestation model designed using IDRISI Selva that was used to establish the baseline scenario in the region of interest, and differences between projected and observed values will be presented for every year.

Of particular importance is the implementation of the surveillance system that will allow continuous monitoring of the Project Area to prevent the entry of squatters and illegal loggers. The Project Area will be divided in brigades to facilitate monitoring such a large area. Initially, brigades will be constituted by a technician specialized in forestry topics that will function as a manager (it is expected that technicians will not belong to the villages) and a group of villagers as a patrol. With time and as experience is gained, it is expected that brigades managers will be chosen from local villages.

The actual size of a brigade and the numbers of villagers to be hired depends on the results from the census that will be conducted after validation. The area of a brigade will need to be a reasonable one to allow for an effective surveillance given available staff. If not enough local villagers are willing to work as monitoring staff; ARC will hire technicians from Paragominas or Ulianopolis.

Brigades will identify and report any illegal activities (invasions and timber extraction) to the brigade leader. If illegal activities are spotted, brigades should geo-reference the finding and make a short description of what was found. Brigades should approach squatters or loggers to let them know – in good terms- that this is private land, they cannot undertake such activities there and they should leave immediately.

With the information supplied by each patrol, brigade leaders will fill –up a monitoring report that will include at least the coordinates where the illegal activities are taking place, the date and a brief report of what was identified. Finally, each brigade leader will submit this information to the local police in Paragominas and to IBAMA in Paragominas and in Belem.

Monitoring reports should be numbered and filed appropriately. Once a month monitoring reports should be scanned to have digital copies in an archive as backup.

Maps, reports and records will be available to validators at each verification event.

1.1.3 Monitoring of carbon stock changes and non-CO2 emissions from forest fires

None of the cases presented in Section 1.1.3 of the VM0015 methodology apply to the Project (Table 47). So, the Project is not required to set sampling plots to measure carbon stocks in either the Project Area or Leakage Belt.

Table 47: Applicability criteria for monitoring non-CO2 gasses

	ID	Type	Applicability to the Project
	Within the Project Area		
Mandatory monitoring of carbon stocks	I	Areas subject to significant carbon stock decrease in the project scenario according to the *ex ante* assessment.	Does not apply.
	II	Areas subject to unplanned and significant carbon stock decrease e.g. due to uncontrolled forest fires and other catastrophic events.	Does not apply.
	III	Area of forest land undergoing carbon stock increase.	Does not apply.
	Within leakage management areas		
	IV	Areas subject to planned and significant carbon stock decrease in the project scenario according to the ex ante assessment.	Does not apply.
Optional monitoring of carbon stocks	**Within the Project Area**		
	V	Areas subject to carbon stock increase after planned harvest activities.	Does not apply.
	VI	Areas recovering after disturbances.	Does not apply.
	Within leakage management areas		
	VII	Aras subject to carbon stock increase due to leakage prevention measures.	Does not apply.
	Within the leakage belt		

	VIII	Aras undergoing significant changes in carbon stock.	Does not apply.

1.1.4 Monitoring of the impacts of natural disturbances and other catastrophic events

Catastrophic events are not expected in the Project Area or Leakage Belt. Nevertheless, if by any chance a catastrophic event presents during the Project's lifetime, such events will be evaluated and reported if significant. Monitoring will follow VM0015 Tables 20.f, 20.g, 21.f and 21.g to report reductions by catastrophic events.

1.1.5 Total ex post estimated actual net carbon stock changes and GHG emissions in the project area

All ex post estimations in the Project Area will be summarized using the format of Table 24 of the VM0015 methodology.

1. 2 Monitoring of leakage

The Project is not expected to generate any type of leakage. Even so, as mentioned in item 1.1.2 of this Monitoring Plan, LULC-change analysis will be developed for the leakage belt using Landsat 8 imagery (and Alos Palsar when required) on a yearly basis during the first fixed baseline period.

Carbon stocks in pre and post-deforestation classes are assumed to remain constant, as there are not significant decreases or increases of carbon stocks in the leakage belt.

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

The activities of the project won't generate GHG emissions.

1.2.2 Monitoring of carbon stock decreases and increases in GHG emissions due to activity shifting leakage

It is not expected for the Project to generate any kind of leakage. Even so, LULC-change will be monitored annually throughout the Reference Region, including the leakage belt as part of the monitoring activities described in Section 1.1.2 of this monitoring plan.

For the case of the leakage belt, LULC-change analysis will be focused on assessing deforestation above baseline levels. If such deforestation is identified results will be reported in Tables 29.a, 29.b and 29.c.

If some deforestation occurs in the leakage belt during the project period, the loss of carbon stocks will be accounted for using the current values of carbon stock per hectare of the forest class in question, and will be deducted from the non- permanence buffer.

Monitoring of increases in GHG emissions

The parameter values used to estimate emissions will be the same used for estimating forest fires in the baseline (table 18 of VM0015 methodology), except for the initial carbon stocks (Cab, Cdw) which shall be those of the initial forest classes burned in the leakage belt area.

The results will be reported using the same table formats (Table 18 and 19 of the VM0015 methodology) used in the ex-ante assessment of baseline GHG emissions from forest fires in the project area.

TASK 2 - Revisiting the projected baseline at fixed periods

2.1 Update information on agents, drivers and underlying causes of deforestation

ARC will be responsible for carrying out this part of the monitoring.

The variables used to project future deforestation from the reference region will be reviewed at 10-year fixed periods. Information regarding the biophysical variables, agents, vectors, and the underlying causes of deforestation will be updated (Step 3).

2.2 Adjust the component of use and land-use change of the baseline

ARC will be responsible for carrying out this part of the monitoring.

Step 4 of Part 2 of the methodology VM0015 will be repeated to consider the following 10-year period in the Reference Region (2025-2035).

Updating the baseline scenario will take place both in the modeling component of the system dynamics (which defines the amount of change) and the spatial component that defines the distribution of deforestation. Key variables that will be used to recalculate the baseline in the second 10-year period of the project are:

• Socio-economic information retrieved from the Project's monitoring activities

• Distance to new roads

• Average distance to selective logging activities from pioneer roads

• Distance to non-forest

• Planned infrastructure in the region

To collect this information, field visits will be made and Landsat 8 imagery will be used (and when necessary also Alos Palsar imagery). Also workshops will be held to receive feedback from local villagers (within and nearby the Project's Boundary) to elucidate new land use dynamics.

2.3 Adjusting the carbon component of the baseline

2.4 According to Section 1.1.3 of this monitoring plan, it will not be necessary to adjust the carbon component of the baseline.

3.3.4 Dissemination of Monitoring Plan and Results (CL4.2)

It will be through the website of TFA/ARC group that the monitoring plan, as well as its results obtained will be available to the public. Statements of relevant and summary information addressed to communities and stakeholders will be transmitted through the REDD Technical Chamber and visits by Foundation technicians to rural communities.

3.4 Optional Criterion: Climate Change Adaptation Benefits

Does not apply

3.4.1 Regional Climate Change Scenarios (GL1.1)

Does not apply

3.4.2 Climate Change Impacts (GL1.2)

Does not apply

3.4.3 Measures Needed and Designed for Adaptation (GL1.3)

Does not apply

4 COMMUNITY

4.1 Without-Project Community Scenario

4.1.1 Descriptions of Communities at Project Start (CM1.1)

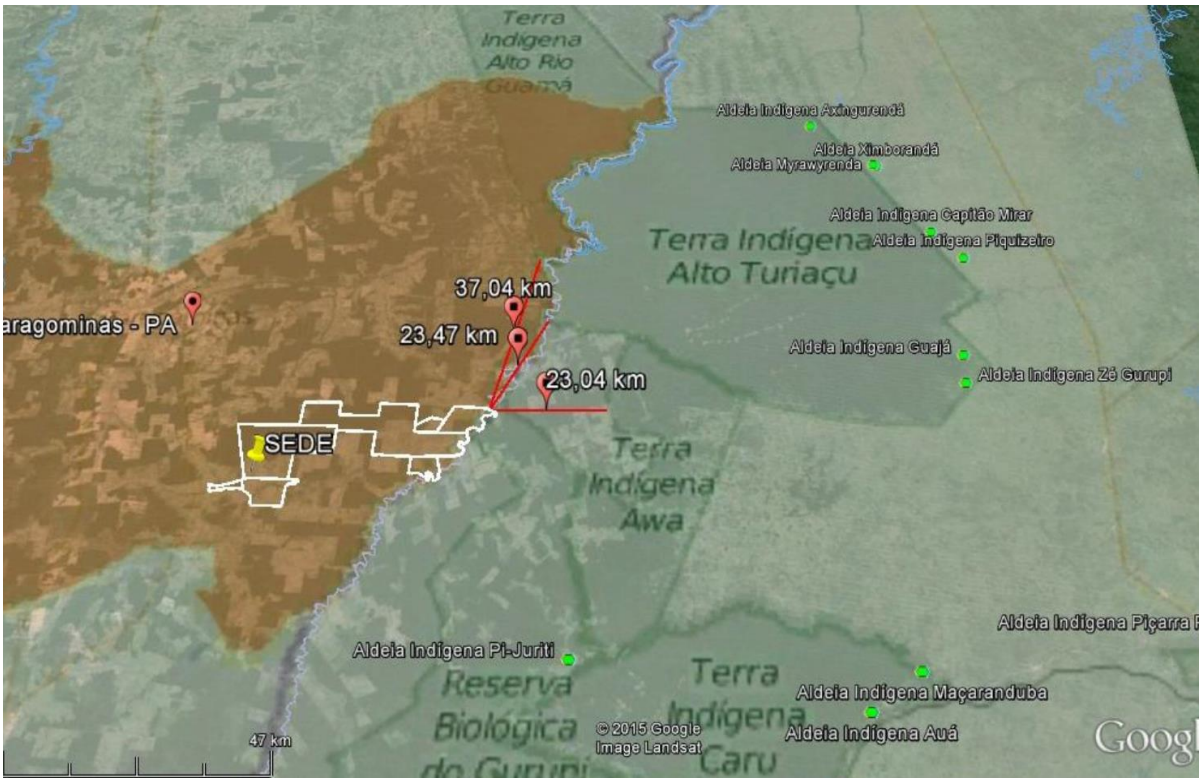
For the social and economic study of the project area, the reference area of the municipalities was taken as a sample, no other municipalities were reviewed as these are very large municipalities and the next most approximate municipality was not directly near the project area, or had no secondary roads that allowed access, thus separated from the relevance of the project. This choice was made because there is a social and economic relationship between the Property and the municipality of Paragominas and Ulianopolis, 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 Paragominas and Ulianopolis region.

In addition to the aforementioned relationships, it is also noteworthy that: a) access to the area is via Paragominas, Ulianopolis and Nova Esperanca do Piria; b) the area is non-contiguous in this region; c) the settlements for agrarian reform (considered vectors of deforestation) are located in the municipalities of Paragominas and Ulianopolis not too far from the property; d) all other areas are deforested, privately held, and used for agriculture purposes;

In the Project Zone, corresponding to the private property (private farm), there were no Community, Community Groups or Indigenous Groups prior to the Project or after the project. The only people who lived in the farm were the property keeper and his family. This was the only farm worker and he was responsible for tending to the cows in the pasture.

Figure 46, shows the block of land closest to indigenous areas that are at the closest 23.04 km away from the property. The darker green where it states Terra Indigena is federal indigenous reserves. The orange is the municipality of Paragominas.

Figure 46: Showing indigenous reserves around the project area

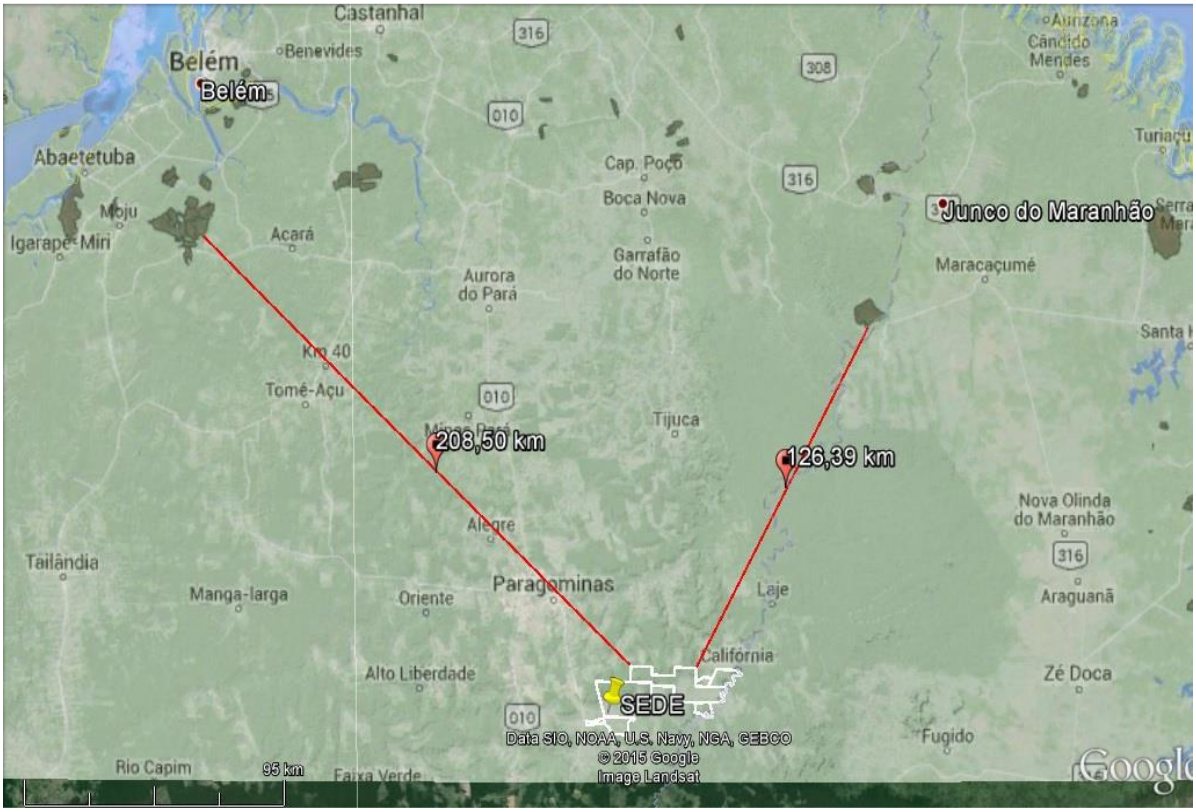


Special interest is taken from ARC to verify the lack of traditional communities within the properties where the management activities are developed. The right to the definitive title of the lands occupied by the remaining communities of quilombos is guaranteed by the Federal Constitution of 1988, in the Transitional Constitutional Provisions Act. This means that no title of real estate registration will be valid in the face of this historical ownership developed by the communities.

Quilombola are people who are descendants of African slaves, who formed communities after slavery was made illegal in 1888.

Even if the quilombola community has not yet obtained title to the area they are occupying, the right to it is a constitutional guarantee, which is why it must be respected and cannot, unless agreed with the community, occupy or use these areas with any activity. The same occurs in the eventual existence of indigenous communities. As the Constitution guarantees to traditional communities the maintenance of their ways of living (article 216, part II of the CF) there is even possibility of expanding the lands destined to these communities if the necessity for the maintenance of their traditions.

Figure 47: Location of traditional Quilombo communities



The choice of methodology for the social and economic analysis of the 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 and secondary data.

The actors interviewed by the social study were identified as small ranchers, farmers and squatters in rural areas, employees of the property, and in urban areas, representatives of the population and local public agencies such as the education agencies in the three municipalities. 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.

In this way, questionnaires were used, applied to three groups of the study population, rural area, urban area and farm workers, which served as a basis for further analysis. The questionnaires were applied in field work conducted October 08–17, 2016. 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 the municipalities and the workers at property. 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.

Socio Economic Situation of the adjacent Area

The main factors that occur in the region and contribute negatively to the development of local communities are:

• Progressive decline in productivity and profitability of traditional agriculture and livestock.

• Lack of work and income generation options in the region.

• Level of poverty and lack of communities.

• Inefficiency by the public power to promote sustainable productive activities, order the occupation of the territory and meet the main demands of the communities for health, housing, education and leisure.

Figure 48:The state ranking of Ulianopolis for IDH

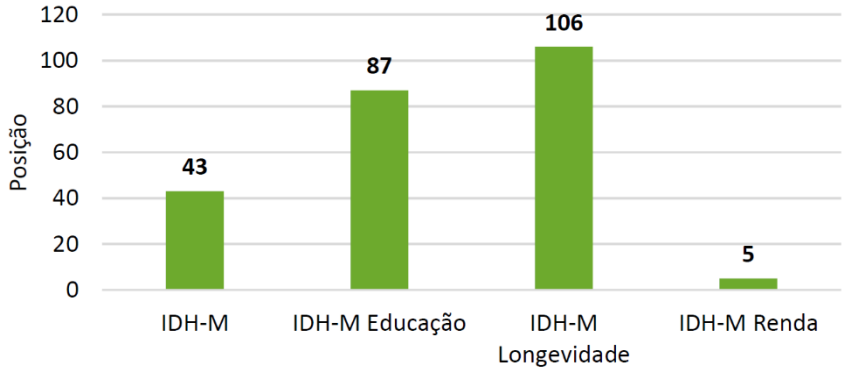


Figure 49: National ranking of Ulianopolis for IDH, out of 5600 municipalities

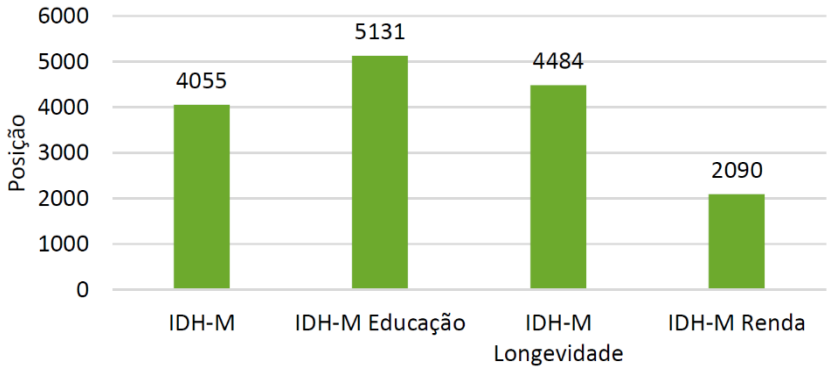


Figure 50: brings the HDI (Human Development Index) of the municipality of Paragominas for the year 2010. Figure 50 is the ranking in the state ranking and Figure 43 in the national ranking (UNDP, 2013). Blue is the average, with yellow being above average and red being below average.

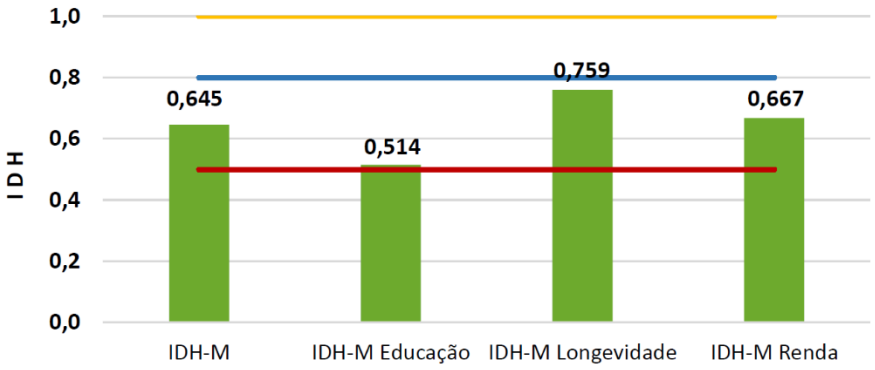


Figure 51: The state ranking of Paragominas for IDH

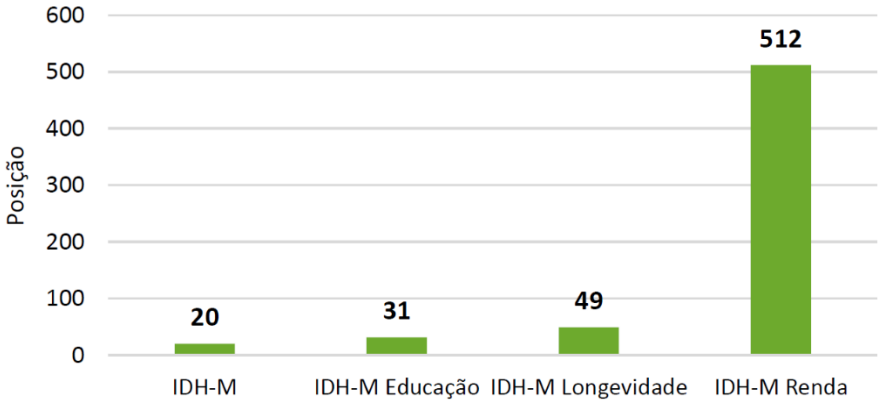


Figure 52: National ranking of Paragominas for IDH, out of 5600 municipalities

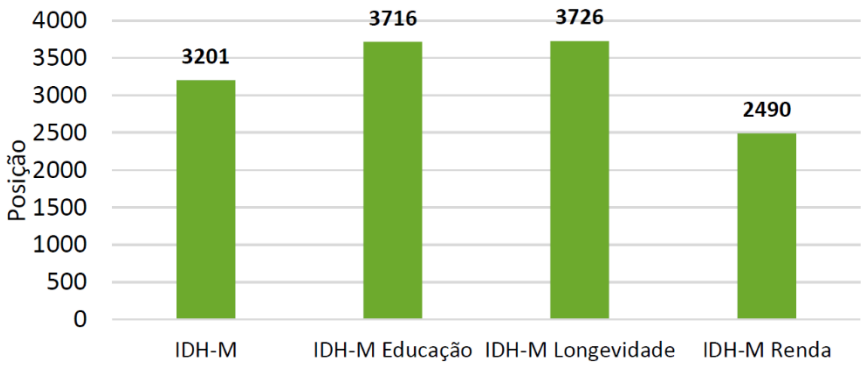


Figure 53 shows the Human Development Index (HDI) of the municipality of Nova Esperança do Piria for the year 2010.

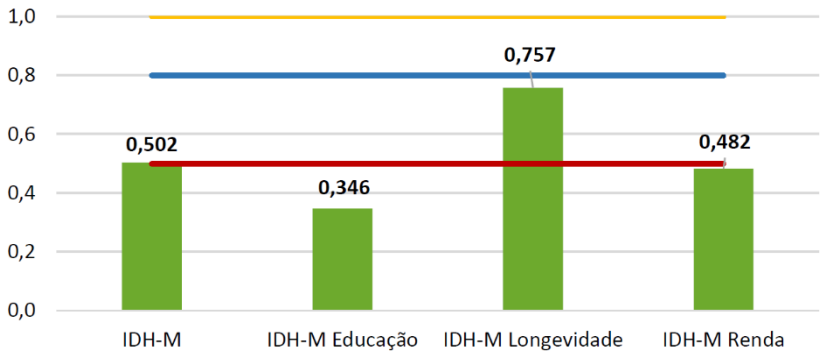


Figure 54:The state ranking of Nova Esperança do Piriá for IDH

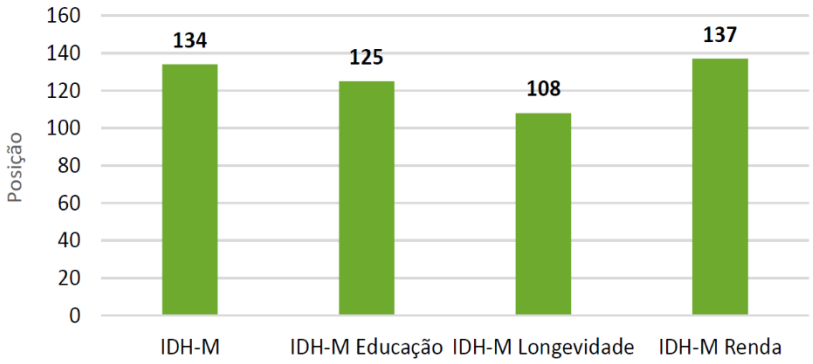
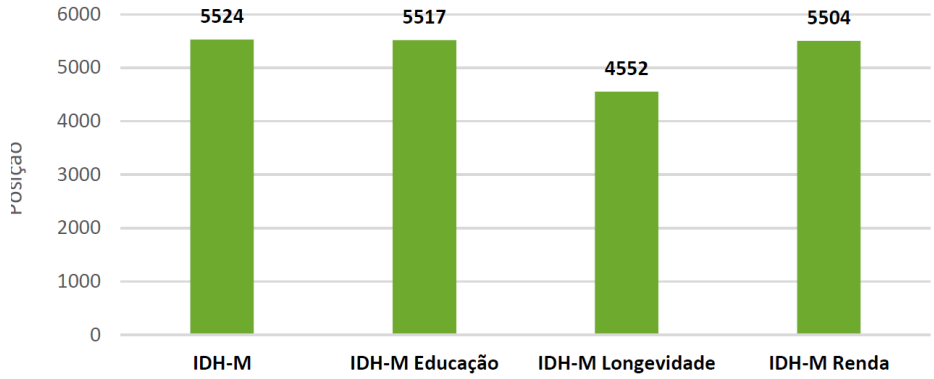


Figure 55: National ranking of Nova Esperança do Piriá for IDH, out of 5600 municipalities



Educational Aspects

In the rural area in 2013 school census, there were 838 enrolments all in Municipal school. Only students attending rural schools have access to transportation. There is no school transportation contemplating students who need to go to the urban nucleus to study.

Among the families interviewed in field work carried out in this municipality, we verified the levels of education described in Figure xx. It can be seen that, as in the urban area, a large number of people (52%) frequenting primary school or just part of it. It is also noticed that 9% did not complete high school, suggesting the occurrence of school drop-out, possibly due to the need for secondary education rural schools or in the urban area, necessitating the use of school transportation.

The illiteracy rate is around 9%, which is equal to the Brazilian rate and slightly lower than the northern region, which is 10.6% (IBGE, 2010). Attention is drawn to the rate of people with a complete or incomplete higher education level, which did not appear in interviews in the urban area, this information should be analysed with caution as it may not represent the reality of higher education professionals, since interviews were sampled within the error limits.

Health aspects

Regarding the sanitation of the residences, only Paragominas has a sewage treatment network and in the rural area, the use of rudimentary cesspit prevailed and in the urban area the use of septic tank. In both cases this issue is of concern in terms of health, since the second CAERD servant interviewed, contamination of rivers and wells due to the use of pits can occur if they are not more than 600 meters from the pit. According to this survey, in the urban area the contamination of wells occurs in all the residences that use them.

Regarding access to health services, there was dissatisfaction among the population. Part of this is due to the existence of only one UBS (Basic Health Unit), insufficient to meet the entire resident population in the rural and urban areas of the Municipality.

These graphs point to similar perceptions regarding the needs of the Basic Health Unit of the Municipality. It was a UBS because both the population living in urban and rural areas of the Municipality are served by UBS located in the urban area of the Municipality. This especially hampers access to care for families in rural areas, who are often in difficulty to transport to the city.

With regard to diagnosis of diseases, was obtained information from the SINAN - Information System on Aggravation and Notification, that the incidence of Leishmaniosis is a concern in the Municipality; however none of the interviewees in an urban or rural area stated that they knew of any cases in the family. This servant also reported a high incidence of Hepatitis, Leprosy and Syphilis, diseases that were also not mentioned and/or appeared in few interviews. The diseases most declared by the interviewees were malaria and dengue. Another cause for entry into the service of the UBS narrated as very frequently are the cases of work accidents related to the activities in the sawmills. These cases were also not mentioned by people interviewed in rural and urban areas.

Another issue of relevance raised by the employees of the health department is that the greatest cause of mortality among the inhabitants is homicide. It is a question related to public safety and the offer of other social devices, but this data ends up being filed by the health department, in view of the entrance to the emergency room. Another problem was the presence of a high number of abuses against minors, practiced mainly by those responsible for the child, a fact also pointed out by the guardianship council during an interview.

Characteristics associated with gender

Women currently constitute a work force working in services that were previously classified as exclusively male. In the urban area, the field research revealed the presence of female heads of household and contributing to the monthly income of the residence, however in more than 50% of the interviews it was verified that the income was less than R $ 1,000.00/month or less than minimum wage, thus slave wages – which has been determined by the government as a major issues in the Amazon region of Brazil.

In the case of the performance of women in the Rural area of the Municipalities, respondents, the majority declared the women not participating in the family income. It may be thought that in this context, although women often perform various activities in the agricultural production phases, their labour is not accounted for and remunerated. However, it is not possible to deepen the discussions because these would require a longer time in the field so that the researchers perceive some nuances of social life that do not arise immediately with the interpretation of the questionnaires.

Economic characteristics

In the rural income, it was difficult to quantify annually, due to the lack of control of the production by the producers and the irregular prices of some of the products produced such as Mandioca (Cassava).

During the interviews it showed the income of the people, and it should be noted that rural income was obtained taking into account only the annual production data of the property. In the case of the homemade interviewees, there were cases where they could not report the annual income of the property or did not want to respond.

Looking for information on possible land use changes, the continuity of the activities already developed in the case the dairy farming was the most cited, however the cultivation of corn, banana, cassava and fish farming appear as alternatives of use from soil.

The presence of large farms, occupied with livestock and soybeans and also small farms producing milk, cocoa, and subsistence agriculture, was verified in the field work around the property. The above fact can be exemplified in two very clear moments found in the field, one that refers to the incorporation of rural plots by farms and another by the maintenance of family agriculture.

In the second case, in the other two secondary roads that finish in the limit of the property, the majority of the properties are split between government settlement area which comprise typically of 100 or 200 hectare plots and large landowners typically of 2000 hectares or more. However, most of the interviewees pointed to the inefficiency of public policies, focused on health, education in the field and technical assistance as the main causes of abandonment and sale of rural properties, together with deficiencies in the soil and lack of resources for investments in land reclamation and acquisition of agricultural inputs.

4.1.2 Interactions between Communities and Community Groups (CM1.1)

The project will be developed within three community nuclei, comprising a total of seven communities, which within the nucleus observe a good interaction between communities and community groups. This interaction occurs due to the geographic proximity between them, so the relationship of the outer distant communities of the nuclei is considered incipient and/or superficial due to the geographic distance and the absence of common activities to be carried out jointly by the communities. The REDD+ Project may provide for the proximity and interaction between communities and community groups.

Community Group	Interactions with the community
Women	The women hold a clear role in the community and the society (cooking, cleaning, raising children etc.). It is unusual for a woman to step outside of this role. Women participate in village decision making through attendance at village assembly meetings, where older women are afforded greater respect. The women are not represented in village or forestry governance structures. They feel that men are unaware of all that they do; and desire more respect for their voices and their rights. Each village has a woman's group, composed of elected members from each sub-village. They meet and receive training regarding governance, civic rights, land rights and leadership etc. Generally women are married in their late teens or early 20's to an older man.

Children	There is a gender and an age based power structure. Therefore the children must respect their elders, as respect comes with age. This is a period of learning, either in school or from their elders. Responsibility is handed down quite young to assist with life in the communities.
Young Men	The young men must respect their elders. Within tradition they have little opportunity to voice their opinions or participate in decision making processes. However, it is possible for youth to hold political positions of power. The young men's strongly value the local tradition and desire its maintenance whilst simultaneously progressing forward with the knowledge gained through their school education. They are generally unmarried and spend a lot of time amongst themselves, both inside the community and traveling outside.
Male Elders	This group leads the community, making higher-level decisions and holding responsibility. Greater age equals greater respect. They resolve conflicts within the community. They compose the village and local governance.
Pastoralists	91% of community members are practicing catholic as a livelihood. It is the most respected occupation within the community and undermines the entire organization of the community. More cows afford you more respect.
Agriculturists	If you run a farm as a business and do not simultaneously own livestock, the community perceives this to be an inadequate occupation and hence pure agriculturalists are disrespected. However most of the agriculturalists are farming alongside owning livestock, which is well regarded. There is not much of a market for the produce within the villages, so a lot of it is transported out and sold in other villages.
Other Stakeholders	Elected Village Government forms the centre of legal decision making, the village chairman is also involved in the forestry conservation. An elected village government is not represented in district government structure. The village is represented through though a ward councillor elected by all village members.
District Government	Have a legal role to play in jurisdictional governance of the district. Located in Belem, the district capital. Resources are limited therefore interactions with the communities are also limited.

4.1.3 High Conservation Values (CM1.2)

The High Conservation Values (HCV) concept was developed by the Forest Stewardship Council (FSC, 1996) for the certification of timber products from responsible forest management, according

to standard Principles and Criteria that reconcile environmental and ecological safeguards with social benefits and economic viability (FSC, 2014).

According to Jennings et al. (2003), an area with HCVA represents a natural or managed area with exceptional values or critical importance, meeting the objectives of conservation of biodiversity, rare ecosystems and areas with relevant social and cultural functions.

Within the context of the socio-economic context of the REDD Project, some cultural, historical and relevant aspects are discussed for local traditional communities, which may characterize High Conservation Values Area, which must be identified and managed in order to guarantee their maintenance and improvement (BROWN et al., 2013). From the six listed criteria, two of them are directly related to traditional populations.

High Conservation Value	Amazon forests
Qualifying Attribute	Protecting tropical amazon forests is a fundamental pillar of many national and international strategies for conserving biodiversity. Although improved regulatory and incentive measures have reduced deforestation rates in some tropical nations, the conservation value of the world's remaining primary forests may be undermined by the additional impacts of disturbance, which falls into two broad categories. First, landscape disturbance results from deforestation itself, with area, isolation and edge effects degrading the condition of the remaining forests. Second, within-forest disturbance, such as wildfires and selective logging, induces marked changes in forest structure and species composition.
Focal Area	The Amazon is home to as many as 80,000 plant species from which more than 40,000 species play a critical role in regulating the global climate and sustaining the local water cycle. But the richness of species is one thing, and abundance another. While there may be many species in tropical rainforests, these often exist in low numbers over large areas.

High Conservation Value	Medicinal Plants
Qualifying Attribute	In Western modern medicine, around 25% of all drugs are derived from rainforest plants. That's an impressive statistic, especially considering that less than 5% of Amazon plant species have been studied for their potential medicinal benefits.

Focal Area	Cat's claw (Uncaria tomentosa) is an Amazonian vine used for centuries in traditional jungle medicine. Both its bark and roots are used by indigenous tribes to treat arthritis, stomach ulcers, inflammation, dysentery and fevers.
	The cinchona tree grows to the east of the Andes in the high jungles of the Amazon Basin. One of history's most famous medicinal plants, it is well-known globally as the source of quinine, a medication used to treat malaria and babesiosis. Extracts from quinine tree bark have been used to treat malaria since the 1600s, and quinine was first isolated from the bark in 1820. The genus Cinchona officinalis is the national tree of Peru and appears on the Peruvian coat of arms. There are several medicinal value plants in the amazon patch.

4.1.4 Without-Project Scenario: Community (CM1.3)

The current scenario of the territory presents socioeconomic indicators, which characterize a region with low socioeconomic well-being conditions and few productive economic alternatives, these circumstances contribute to leave the families in a situation of vulnerability in the search for better living conditions. Therefore, these factors can be considered as potential causes that lead to deforestation in the REDD Project communities.

Within the communities, we highlight the following vectors:

- Low income parameters: the factors that lead to low income in families are due to the limitation of the productive activities developed, presenting low productivity, lack of better production techniques, low diversification, difficulties in the outflow of production, as well as access to the consumer market;

- Low level of education: the communities involved in the project have a relatively low level of education, 57% of the producers have not completed elementary school;

- Developed activities: the agricultural and livestock activities carried out by the producers are developed with the lack of technologies and good productive practices, a fact that contributes to deforestation. In agriculture, the production system used is the cutting and burning system, in which producers every two or three years, due to the infertility of the soil, have the need to open new areas and carry out the burning, to start a new cycle Livestock, despite the low scale, is still done in a conventional way with the opening of large areas for grazing. Despite the low incidence of interviewed producers practicing this activity, it was verified from the interviews that some of the producers are interested in the opening of areas for pasture, a factor that is a great motivation for deforestation;

- Low social organization: the need for access to public policies and the guarantee of exceptional rights in communities is a fundamental factor in the search for socioeconomic well-being for

families, and this is based on a good political and institutional articulation. However, the communities involved have a low level of social organization, which weakens the local conditions of search for these fundamental rights, such as access to education, communication, energy and health. Of the producers interviewed, 50% participate in some community organization, the other 50% do not participate or do not have an organization that represents them. It is worth mentioning that of the existing organizations, only one showed a certain level of social organization, the others showed latent weaknesses in both management and recognition by producers.

Another important measure for the success of these actions is community empowerment, based on strengthening and consolidating social organizations, aiming at the integral and effective participation of community members in decision-making, implementation and management of local socioeconomic development projects, contributing to the management of risks associated with rural activities and the improvement of socioeconomic aspects by the community members themselves.

Table 48. Relationship between vectors, agents, underlying causes of deforestation and scenarios with and without the REDD Project.

Potential vectors of deforestation	Situation found	Deforestation agents	Underlying Causes of Deforestation	Scenario 1 (without REDD+)	Scenario 2 (with REDD+)
Economy and Income	Low income levels, most of the producers are unemployed and dependent on government programs	Population with insufficient income to meet basic needs	Lack of policy principles for socioeconomic development, as well as development programs for communities	Demand for domestic resources pressures the forest natural resources due to increased unplanned agro-extractivist activities	Activities aimed at the generation of income and jobs and incentives for sustainable practices in the management of forest resources such as the pressures on the forest
Education	Low level of schooling and difficulties in access to secondary education	Uninformed population with low levels of schooling	Lack of Public Policies for Education	Increase in illegal logging activities due to low formal education and consequent difficulty in getting jobs	Activities aimed at education, technical and professionals courses and incentives for sustainable practices in the management of forest resources reduce illegal activities
Agriculture	Low productivity. Increase in areas for agriculture	Small-scale, expanding farmers	Population increase and urbanization increase demand for food	Demand for food in the urban environment and low agricultural productivity motivates the conversion of forest areas into agriculture	Increased agricultural productivity, agro- ecological production techniques and strengthening of production marketing channels prevent the conversion of forest areas into agriculture.

Livestock	Low-scale livestock production and remained constant during the period	Extensive stock farming cattlemen	Population increase and urban eating habits demand higher meat production	Increased demand for meat and low pasture productivity lead to the conversion of forest areas into pasture	Implementing good livestock practices increases productivity and prevents new areas from being converted to pasture
Extractives	Basis of subsistence for rural communities. Scarcity of official data on the management	Small scale extractives	Domestic and international market demand	Predatory extractives negatively impacts the forest (timber and non-timber resources)	Improvements in traditional management practices, studies on ecology, production and management of forest species and control of the productive chain avoid environmental degradation and allow socioeconomic gains with sustainable extractives
Social Organization	Absence or fragility of community social organizations	Producers with difficulties in accessing public policies and with levels of access to essential basic rights below expected	Lack of public policies focused on socioeconomic development and education	Demand for better conditions of housing, communication and energy increases the need for producers to leave the community encouraging the rural exodus	Activities that promote social organizational strengthening, facilitate access to existing public policies, avoid rural exodus, and keep families in their territories

The guarantee of access to a positive scenario and the good progress of the Project demands a rural development agent, with expertise and capacity to attend to the needs of the families. Currently, this role is assumed by the ARC group, actions for its strengthening are planned, with a view to maintaining and expanding its operations, visualizing a more positive scenario for the Project.

4.2 Net Positive Community Impacts

4.2.1 Expected Community Impacts (CM2.1)

Impacts to the communities described below include benefits, costs, and risks, including those related to social, cultural, environmental, and economic aspects; the following items present issues related to impacts for communities.

No negative impacts on other identified stakeholders are expected. Conversely, it is expected that the positive impacts of the project impact on areas outside the project area and therefore actors who are not involved directly in the project. Although the protection and restoration processes are performed in a localized way, the benefits derived from these activities cover a larger area because of the natural ecosystem connectivity. Reducing deforestation rates results in reducing soil erosion and protecting watersheds present in the project area, so, by improving highlands of a basin, it is benefiting all the downstream community and even from other departments.

Reference: Based on ARC REDD Theory of Change.

Community Group	1. *Number of trained people in biodiversity and forest Monitoring* 2. *Number of people participating in the monitoring activities each month*
Impact(s)	*Increased transparency of community income and expenditure*
Type of Benefit/Cost/Risk	Predicted, indirect benefit 1. *Capacity building related to the monitoring and management of the forest and biodiversity.* 2. *Job Opportunities*
Change in Well-being	*Improved confidence in leadership and the dissemination of community funds; empowerment of community members over community finances; increased efficiency in community development projects and improved service provision leading to improved quality of life and wellbeing, greater community cohesion, resilience and stability*

Community Group	*Number of community leaders trained to improve their level of organization, management and democratic governability*
Impact(s)	*Strengthened governance, resource management plan and land rights*
Type of Benefit/Cost/Risk	*Predicted, indirect benefit* 1. *overall satisfaction of community*
Change in Well-being	*Overall better management of society and resource/land use leading to improved service provision; greater trust and confidence in the government; security in land rights; successful implementation of the land use plan leading to improved livelihoods*

Community Group	1. *Number of people trained in the use of efficient improved cooking stoves* 2. *Number of improved cooking stoves pilots implemented in local families*
Impact(s)	1. *Capacity building related to efficient and improved cooking stoves* 2. *improvement in health*
Type of Benefit/Cost/Risk	*Predicted, indirect benefit* 1. *overall satisfaction and health of community*

Change in Well-being	*Improved quality and quantity of produce from livestock, ensuring greater food security and income for themselves and their families;*

Community Group	1. *Number of people trained in agroforestry techniques* 2. *Number of implemented agroforestry pilot projects*
Impact(s)	1. *Capacity building* 2. *Improved agricultural practices*
Type of Benefit/Cost/Risk	*Predicted, indirect benefit* 1. *overall satisfaction and food security of community*
Change in Well-being	*Improved quality and quantity of produce from livestock, ensuring greater food security and income for themselves and their families; easier access to pasture and reduced tension/conflict when herding livestock; greater potential to own more cows*

4.2.2 Negative Community Impact Mitigation (CM2.2)

Based on ARC REDD theory of change there are no negative community impacts observed and hence there is no need for mitigation.

4.2.3 Net Positive Community Well-Being (CM2.3, GL1.4)

Net Positive community impacts are expected to be:

• Secured land tenure

• Diversification of food through agroforestry practices which helps in an improvement of local nutrition

• More efficient technologies to produce local crops therefore less time in consuming to do this activity.

• Generation of income from monitoring activities.

• Better understanding of the importance of protecting the forest and how forest conservation will benefit their livelihoods.

• Opportunity to develop local businesses through an external fund.

Table 49: Comparison of the benefits with and without project scenario

Category	Without project scenario	Project scenario
Incomes	1. Low sustainable income-generating activities and work opportunities 2. Low market access and knowledge about cash crops prices 3. Low living-comfort	1. Technical support on market advices on alternatives means of subsistence and income generating activities (cash crop and agro-ecological technique) 2. Market value chain improvement 3. The increase of revenues mainly to agricultural activities will allow to decrease poverty and increase material properties, especially for house well-being
Social cohesion and participation	1. Association exits in certain villages concern by the project and contribute to awareness about environmental issue 2. Difficulties to access to forest lands for agriculture for a part of the population	1. Associations will be supported by the project improving their land and forest resources management and the provision of several services to communities 2. Common construction of land use plans 3. Enhancement of local participation, for better management of natural resources
Health and livelihood improvement	1. Rate of diseases is relatively high and access to care is difficult because of the remoteness of the area	1. TFA/ARC will provide a service of medicine storage

	1. Forest resources depreciation and higher risks of hunger during the food shortage	1. Diet and subsistence activities' diversification 2. Reduction of food vulnerability during dry season 3. Increase of households income lead to cash crop and sustainable agricultural techniques
Education	Low rate of school enrolment	1. TFA/ARC provide services of literacy for adults 2. Increase of revenues could limit the necessity for child work and increase school enrolment
Skills improvement	Persistence of unsustainable local means of subsistence	Capacity building, technical strengthening and know-how transfers

4.2.4 High Conservation Values Protected (CM2.4)

The main goal of this project is to assist the community in the implementation of the resource management plan which formalises their traditional land management techniques and customs. Therefore, it is not anticipated that the project will have a negative impact on any of the project area's High Conservation Values. The project is designed to protect and conserve these areas from misuse, enhance community understanding of their value and to improve overall community well-being.

The HCVs related to community well-being will not be negatively affected by the project; on the contrary, only positive impacts are expected.

4.3 Other Stakeholder Impacts

4.3.1 Impacts on Other Stakeholders (CM3.1)

The Project is designed to generate only positive impacts to the stakeholders living in the LMA and it won't generate negative impacts to those living outside the 3Km buffer identified during the PRA.

No other stakeholders have been identified to use or depend from the resources in the Project's Area or LMA.

Potential and actual positive impacts that the project activities are likely to cause on the well-being of other stakeholders (District Government) include:

- increased capacity of local government in relation to conflict resolution, participatory forest and wildlife conservation, village land use planning, conservation agriculture and environmental education

- increased awareness on issues ranging from forest conservation, agriculture, land tenure and improving village governance as a result of awareness raising activities

- percentage revenue from carbon sales and an understanding of Payments for Environmental Services or specifically REDD projects

4.3.2 Mitigation of Negative Impacts on Other Stakeholders (CM3.2)

As mentioned in the previous item, there area not expected negative offsite impacts thus no mitigation strategies are required.

4.3.3 Net Impacts on Other Stakeholders (CM3.3)

As shown in 4.3.1 and 4.3.2, the project is anticipated to generate positive impacts on the other stakeholders and no negative impacts, hence leaving a net positive impact overall.

4.4 Community Impact Monitoring

4.4.1 Community Monitoring Plan (CM4.1, CM4.2, GL1.4, GL2.2, GL2.3, GL2.5)

The theory of change was the basis for selecting indicators to use for long term community monitoring. We then decided on the best methods to use to collect this data, keeping in mind the desire for accuracy, precision, cost effectiveness and simplicity. From this, a monitoring plan was designed to collect information on the identified indicators. Meetings minutes, finance sheets, attendance records, employment registries and resource management plans were some of the tools chosen to support assessing the indicators. We believe that measuring natural resource availability and access impacted by the conservation-focused activities will provide insight into the effects on the major community-related HCV areas of pasture and traditional medicine sources as identified in the RMP. Improved governance, rights and access to resources such as pasture, traditional medicine, and wild honey along with the employment of games scouts, and increased availability of management and development funds should support resilience and adaptation ability in the communities going forward and thus is crucial for monitoring. A full community monitoring plan and guideline is available as well, as a supporting document. The project's social impact assessment will be conducted using the following framework, which also highlights which indicators relate to monitoring of HCVs;

The project proponents have designed a Social Impacts Monitoring Plan in accordance to the results obtained in the rural participatory diagnosis developed in the project area and initially

considering the indicators for the products of the proposed activities based on the identification of the necessities indicated by the population and the strategies foreseen to accomplish the project goals.

The following Table (Table 50) shows a non-comprehensive list of activities and indicators that will be considered during monitoring. A full and detailed list will be presented in the monitoring plan that will be developed and submitted within the first six months after validation.

Table 50: Some activities and indicators of the Social monitoring

Activity	Product Indicator
1. Capacity building related to the monitoring and management of the forest and biodiversity. Opportunities to work as control/supervision staff.	• Number of trained people in biodiversity and forest monitoring. • Number of people participating in the monitoring activities each month. • Number of people returning to the monitoring work positions after one rotation
2. Improving organizational capacities of each community.	• Number of community leaders trained to improve their level of organization, management and democratic governability • Number of local leaders participating in the development of an organization system • Number of local associations/organizations strengthened by the project activities
3.Providing land ownership legal rights versus conservation results	• Number of people living inside LMA and its proximities • Number of people registered in the program to become legal land owners • Number of people that meet the forest conservation agreement.
4. Providing assistance to obtain land use rights over the forest owned by the government.	Number of people registered in the program to obtain the use rights over the government land.

5. Providing assistance and training in agroforestry techniques and implementing pilot cases.	• Number of people trained in agroforestry techniques • Number of implemented agroforestry pilot projects
6. Capacity building related to efficient and improved cooking stoves and implementation of pilot demonstrative cases	• Number of people trained in the use of efficient improved cooking stoves • Number of improved cooking stoves pilots implemented in local families
7. Providing assistance and training on sustainable small-scale timber extraction in the LMA.	Number of people trained in the sustainable small scale timber extraction
8. Capacity building on the development of small communitarian enterprises.	• Number of people trained in the development and management of a small scale enterprise • Number of small scale enterprises developed in the project area

A Participatory Census will be carried out previously to the design of the definite Monitoring Plan in the Project area. This intends to collect information about the unsatisfied basic needs, health, education, family economy, communal organization, etc., which will become the project baseline and also represent the social indicators to be monitored throughout the project´s execution.

Likewise, in order to develop the social-environmental indicators for the results, several communitarian workshops will take place as a fundamental part of the Social Communitarian Monitoring System that will facilitate the follow-up and evaluation of the benefits of the project to improve the quality of life of the communities.

This system will have trained communitarian monitors that will continuously carry out the follow up activities evaluating the commitments, project activities and communities every 3 to 6 months. Also, the Communitarian Impacts Monitoring Plan will carry out an exhaustive annual assessment of the indicators.

The Social Impacts Monitoring Plan aims at creating an association and mutual responsibility sense between the project and local communities in the management of social environmental impacts, as well as improving the perception of the social responsibility adopted by the project.

4.4.2 Monitoring Plan Dissemination (CM4.3)

All results will be publicly available on the internet and summaries are communicated to the Communities and Other Stakeholders through appropriate media. Additionally, all documents and

information about the results of the monitoring and verification of this project will be published in the platforms of the VCS and CCB standards as usual.

ARC group has extensive experience working with communities. The most effective medium agreed with communities is workshops and newsletter reporting the progress of the project. The monitoring plan and monitoring result will be disclosed through the President of the community action boards.

Till to date, neither monitoring nor verifications reports have been conducted.

4.5 Optional Criterion: Exceptional Community Benefits

The project does not seek to be validated to the Gold Level for exceptional community benefits .

4.5.1 Exceptional Community Criteria (GL2.1)

Not Applicable

4.5.2 Short-term and Long-term Community Benefits (GL2.2)

Not Applicable

4.5.3 Community Participation Risks (GL2.3)

Not Applicable

4.5.4 Marginalized and/or Vulnerable Community Groups (GL2.4)

Not Applicable

4.5.5 Net Impacts on Women (GL2.5)

Not Applicable

4.5.6 Benefit Sharing Mechanisms (GL2.6)

Not Applicable

4.5.7 Benefits, Costs, and Risks Communication (GL2.7)

Not Applicable

4.5.8 Governance and Implementation Structures (GL2.8)

Not Applicable

4.5.9 Smallholders/Community Members Capacity Development (GL2.9)

Not Applicable

5 BIODIVERSITY

5.1 Without-Project Biodiversity Scenario

5.1.1 Existing Conditions (B1.1)

The description of the biodiversity presented in this section corresponds to the flora and fauna that has been reported for the region of reference. More detailed descriptions (municipal scale) are presented only for those municipalities where project areas are located with availability of studies (Source for all details is from the survey done from FAO to TFA (land owner) in 2014/15).

Vegetation and Flora

The area of the Project is composed of ten different plant of *phytophysiognomies*, including forest and non-forest formations, with predominance of Lowland Dense Ombrophilous Forests and Submontane Dense Ombrophilous Forests.

For the phytosociological characterization carried out in the REDD area, a survey was carried out with the installation of 75 sample plots with dimensions of 25 x 25 meters (1 hectare), subdivided into four subplots. At the end of the forest inventory, 8,664 individuals were distributed in 340 tree species, highlighting the richness of the flora existing in this Amazon region (NELSON and OLIVEIRA, 2001). The richest and most abundant families in the Project area are: family Sapotaceae, Mimosaceae, Caesalpiniaceae, Burseraceae and Fabaceae.

Table 51: Inventory of Flora documented in the project area - 61 Species, and 28 families

Family	Scientific Name	Common Name
FABACEAE	*Tachigali sp*	tachi
	Macrolobium sp	
	Dahlstedtia sp.	
	Inga alba (Sw.) Willd.	ingaí
	Hymenaea sp.	jatobá
	Abarema mataybifolia (Sandwith) Barneby & J.W.Grimes	
	Inga marginata Willd.	ingá
	Inga laurina (Sw.) Willd.	ingá-de-macaco
RUTACEAE	*Rauia resinosa Nees & Mart.*	cafezinho
APOCYNACEAE	*Lacmellea aculeata (Ducke) Monach*	sorvinha
ARECACEAE	*Astrocaryum gynacanthum Mart.*	tucum
BURSERACEAE	*Protium altsonii Sandwith*	breu-branco
	Protium sp.2	breu
VIOLACEAE	*Rinorea macrocarpa (Mart. ex Eichler) Kuntze*	
SAPOTACEAE	*Pradosia sp.1*	
MYRISTICACEAE	*Virola sp.1*	
	Campnoseura sp.	
	Iryanthera sp.1	

RUTACEAE	*Sohnreyia excelsa K.Krause*	surucucumirá
	Rauia resinosa Nees & Mart.	
URTICACEAE	*Pourouma villosa Trécul*	imbaúba-branca
	Pourouma sp.	
	Cecropia palmata Willd.	imbaúba
SAPOTACEAE	*Pouteria sp.1*	
	Pouteria sp.3	
	Pouteria sp.4	
	Pouteria sp.2	goiabinha
	Micropholis sp.	
	Chrysophyllum sp.1	
	Pouteria sp.6	
LECYTHIDACEAE	*Eschweilera sp.1*	
	Eschweilera sp.2	
	Cariniana sp.	
OLACACEAE	*Minquartia guianensis Aubl.*	acariquara
EUPHORBIACEAE	*Aparisthmium cordatum (A.Juss.) Baill.*	ariquena-queimosa
	Micrandra sp.2	
	Croton matourensis Aubl.	maravuvuia
	Micrandra sp.1	
	Mabea speciosa Müll.Arg.	
HYPERICACEAE	*Vismia baccifera Triana & Planch.*	lacre
SALICACEAE	*Laetia procera (Poepp.) Eichler*	apijó
	Casearia sp.1	
COMBRETACEAE	*Buchenavia sp.1*	
SAPINDACEAE	*Cupania cf. scrobiculata Radlk.*	
	Matayba sp.	
MELASTOMATACEAE	*Bellucia grossularioides (L.) Triana*	goiaba-de-anta
CHRYSOBALANACEAE	*Licania sp.3*	
	Licania sp.1	
VOCHYSIACEAE	*Vochysia sp.*	
MALVACEAE	*Apeiba echinata Gaertn.*	pente-de-macaco
SIMAROUBACEAE	*Simaba sp.*	
BIGNONIACEAE	*Jacaranda copaia (Aubl.) D.Don*	pará-pará
NYCTAGINACEAE	*Guapira sp.*	
BORAGINACEAE	*Cordia exaltata Lam.*	freijozinho
ANNONACEAE	*Xylopia sp.*	
	Annona sp.	
ANACARDIACEAE	*Astronium lecointei Ducke*	muiracatiara
VIOLACEAE	*Rinorea macrocarpa (Mart. ex Eichler) Kuntze*	
SIPARUNACEAE	*Siparuna guianensis Aubl.*	caá-pitiú

LAURACEAE	*Nectandra sp.*	

The inventory of Flora within the project area, has resulted in a priority to conserve the flora on Table 52, which are targeted by illegal loggers.

Table 52 –Target Species for Conservation

Family	Species
Sterculiaceae	*Sterculia excels Mart.*
Leguminosae-Mimosoideae	*Anadenathera colubrine (Vell.) Brenan*
Vochysiaceae	*Callisthene major Mart.*
Caryocareaceae	*Caryocar microcarpum Ducke*
Sapotaceae	*Chrysophyllum lucentifolium*
Lecythidaceae	*Couratari oblongifolia Ducke et R.Knuth*
Leguminosae-Papilionideae (Fabaceae)	*Diplotropis purpurea*
Lauraceae	*Endlicheria paniculata (Spreng) J.F.Macbr*
Leguminosae-Mimosoideae	*Enterolobium schomburgkii (Benth.) Benth*
Sapotaceae	*Pouteria oblanceolata Pires*
Burseraceae	*Protium puncticulatun Macbr.*
Sterculianceae	*Sterculia excelsa Mart.*
Leguminosae-Mimosoideae	*Zygia selloi*
Sapotaceae	*Manikara huberi (Ducke) Cheval.*
Burseraceae	*Protium heptaphyllum (Aubl.) March*

Regarding to species threatened with extinction, eleven of them are listed in threatened species provided by bodies such as IBAMA and IUCN, being: six species present in the IBAMA list and eight species in the IUCN list. Table 53 lists the endangered flora species according to the IUCN Red List of Threatened Species

Table 53. Flora species threatened according to the IUCN Red List of Threatened Species

IUCN Threat Category	Scientific Name
Critically Endangered (CR)	*Vouacapoua americana* Aubl.
Endangered (EN)	*Manilkara elata* (F. Allemão ex Miq.) Monach
	Pouteria amapaenses Pires & T.D.Penn.
	Virola surinamensis (Rol.) Warb.
Vulnerable (VU)	*Bertholletia excelsa* H. & B.
	Joannesia princeps Vell.
	Pouteria krukovii (A.C.Sm.) Baehni
	Pouteria oppositifolia (Ducke) Baehni

Fauna:

The region of the Project Area is very rich and presents a very diverse fauna, presenting 1,245 species already registered. In relation to the avifauna, one can affirm that the region is in an area of high concentration of birds' species. In all, 578 species of native birds were distributed, distributed in 63 families and 24 orders. The most numerous families were composed by the birds, standing out Thraupidae, Tyrannidae and Thamnophilidae, with 52, 50 and 47 species, respectively. Then the families of eagles and hawks (Accipitridae) and hummingbirds (Trochilidae), with 29 species each.

At the state of the project, between 2015 and 2016 a monitoring program for Fauna, both Avifauna and Mastofauna was in acted. In Tables 54 to 55, we are able to determine the results of the study and the endangered species identified.

Table 54: Avifauna sited

	Number of Species Seen (AviFauna) 2013
Group II	149
Group III	177
Threatened Species	66
	Number of Species Seen (MastoFauna) 2013
Group II	19
Group III	20
Threatened Species	14
	Number of Species Seen (AviFauna) 2014
Group II	177
Group III	199
Threatened Species	70
	Number of Species Seen (MastoFauna) 2014
Group II	22
Group III	19
Threatened Species	15

Table 55: Endangered : Species of avifauna for monitoring and Conservation

Species	**Popular Name**
Penelope pileata	*jacupiranga*
Psophia viridis obscura	*jacamim-de-costas-verdes*
Guaruba guarouba	*ararajuba*
Pyrrhura lepida	*tiriba-pérola*
Pteroglossus bitorquatus bitorquatus	*araçari-de-pescoço-vermelho*
Synallaxis rutilans omissa	*João-teneném-castanho*
Phlegopsis nigromaculata paraensis	*mãe-de-taoca*

Table 56: Endangered, At Risk or state priorities for conservation - Species of Mastofauna for monitoring and Conservation

Taxom	**Popular Name**
Dasypodidae	
Priodontes maximus	tatu-canastra
Cebidae	
Saguinus niger	sagui-una
Cebus paella	macaco-precgo
Saimiri sciureus	macaco-de-cheiro
Aotidae	
Aotus azarae	macaco-da-noite
Atelidae	
Alouatta beizebul	guariba-pteto
Felidae	
Leopardus pardalis	jaguatirica
Leopardus tigrinus	gato-do-mato-pequeno
Puma concolor	onca-parda
Panthera onca	onca-pintada
Canidae	
Cerdocyon thous	graxaim
Familia Tapiridae	
Tapirus terrestris	anta
Tayassuidae	
Tayassu pecari	queixada
Cervidae	
Mazama Americana	veado-mateiro

Below mentioned are the list of target species (avifauna & mastofauna) for monitoring and conservation:

• *Penelope pileata* (jacupiranga).

• *Guaruba guarouba* (ararajuba).

• *Pteroglossus bitorquatus* (araçari-de-pescoço-vermelho).

Target species (mastofauna) for monitoring and conservation:

• *Saimiri sciureus* (mico-de-cheiro)

According to the analysis of avifauna survey carried out in 2016, in view of the panorama of the original forest cover of the area, which historically can be defined as composed of Amazonian terra firm forest, it is possible to highlight the predominance of forest birds registered in the remaining

samples, which occupy the dark understorey of the forests as well as large frugivorous growers of the upper canopy areas (60% of species). The predominance of these species was expected, taking into account the high wealth that the forest areas present, as well as the predominance of these environments in the sampled regions.

Only a small fraction of these fragments remain with visible signs of anthropogenic disturbance. Considering the alteration of the original forest cover, the avifauna was also replaced by colonizing elements characterized by generalist species that commonly inhabit regions of capoeiras or even drastically recharacterized places (WILLIS & ONIKI 1988). In this sense, it is important to highlight the transitional areas, constituted by capoeiras as the second most representative environment in terms of use by birds (30% of species).

As a result of avifauna monitoring in 2016, in view of the panorama of the original forest cover of the area, which historically can be defined as composed of Amazon forest can be highlighted the predominance of forest birds registered in the remaining sampled birds that occupy the dark forest understory as well as large frugivorous growers from the upper canopy forest (60% of species). The predominance of these species was expected, taking into account the high species richness of the forest areas as well as the predominance of these environments in the sampled regions.

In the considerations presented on the mastofauna in 2016, the study presents several species that indicate the quality of the environment. Although no sampled fragment has original characteristics of its landscape, it can be affirmed that these still represent areas of great importance for the maintenance of the local fauna.

Two species of large felines were recorded with probable occurrence in the region by the literature. These are species that occupy the top of the food chain and require large territories for their survival, which characterizes them as an umbrella species. The maintenance of environmental requirements for the healthy existence of these feline populations can help to maintain several other species in the environment.

For the monitoring of the mastofauna in 2016, as observed in situ in the studied localities few fragments have characteristics that were originally observed there. However, these fragments still play a fundamental role in the maintenance of the target species and as a direct consequence the maintenance of the entire local biota.

Despite the strong recharacterization of the environment, the number of endangered species recorded was significant, according to the International Union for the Conservation of Nature (IUCN 2014) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 2014), Ministry of Environment Machado et al., 2008. Rev. Bras. Zootec., 37 (6): 1121-1128) and List of endangered species of flora and fauna in the State of Pará. The vast majority of registered species are included in the Vulnerable Category (VU) or CITES Appendix I or II.

Table 57: Mammals that are registered under threat and are in the project area.

Family	**Species**
Dasypodidae	*Dasypus novemcinctus*
	Euphractus sexcinctus
Atelidae	*Alouatta belzebul*

Cuniculidae	*Cuniculus paca*
Caviidae	*Hydrochoerus hydrochaeris*
Dasyproctidae	*Dasyprocta prymnolopha*
Felidae	*Puma concolor*
Canidae	*Cerdocyon thous*
Procyonidae	*Nasua nasua*
Tapiridae	*Tapirus terrestris*
Tayassuidae	*Pecari tajacu*
Cervidae	*Tayassu pecari*
	Mazama americana

In the IUCN list, there are a total of nineteen species in the three categories preached by the organization, being a species of mammal in category EN (endangered), seventeen species of animals (seven species of birds, six species of mammals, two species of amphibians and two reptile species) in the VU category (vulnerable) and one mammal species in category CR (critically endangered) (Table 58). No species of endangered or CITES-listed fish were recorded.

Table 58. Species of wildlife endangered according to the IUCN Red List of Threatened Species

BIRDS		
IUCN Threat Categories	Popular Name	Scientific name
Vulnerable (VU)	Pomba-botafogo	*Patagioenas subvinacea*
	Mutum-poranga	*Crax alector*
	Formigueiro-liso	*Myrmoborus lugubris*
	Choquinha-estriada	*Myrmotherula surinamensis*
	Tucano-grande-de-papobranco	*Ramphastos tucanus*
	Tucano-de-bico-preto	*Ramphastos vitellinus*
	Azulona	*Tinamus tao*
MAMMALS		
IUCN Threat Categories	Popular Name	Scientific name
Vulnerable (VU)	Queixada	*Tayassu pecari*
	Gato-do-mato-pequeno	*Leopardus tigrinus*
	Anta	*Tapirus terrestris*
	Macaco-aranha-preto	*Ateles paniscus*
	Tamanduá-bandeira	*Myrmecophaga tridactyla*
	Tatu-canastra	*Priodontes maximus*
Endangered (EN)	Ariranha	*Pteronura brasiliensis*
Critically Endangered (CR)	Macaco-preto	*Chiropotes satanas*
AMPHIBIANS		

IUCN Threat Categories	Popular Name	Scientific name
Vulnerable (VU)	Sapinho	*Anomaloglossus beebei*
	Sapo	*Atelopus spumarius*
REPTILES		
IUCN Threat Categories	Popular Name	Scientific name
Vulnerable (VU)	Tracajá	*Podocnemis unifilis*
	Jabuti, jabutitinga	*Chelonoidis denticulatus*

5.1.2 High Conservation Values (B1.2)

As defined by the HCV Resource Network, the high value attributes for conservation 1, 2 and 3 were considered for the present work, since they are criteria related to biodiversity. Within this context, to guide the following items in this document, the guidelines for identification, management and monitoring of high values were considered, as stated in the "General Guide for the Identification of High Conservation Values" (BROWN et al., 2013), "Common Guidance for the Management & Monitoring of High Conservation Values" (BROWN, SENIOR, 2014), "FSC Principles and Criteria for Forest Stewardship" (FSC, 2012) and "The Climate, Community and Biodiversity Alliance" (CCBA, 2013).

These areas correspond to Amazon forest ecosystems, wilderness and landscape. According to the FAO, amazon ecosystems are globally important areas such as factories of water, biodiversity rich habitats, places for recreation and tourism and areas of important cultural value. The forests directly provide food for 20% of humanity, they also provide between 50-60% of the water in wetlands and more than 70-95% in semiarid and arid environments.

The project zone includes several High Conservation Values (HCVs) related to biodiversity. Currently, there is no definition of HCVs at the national level in Brazil. Identification and description of these HCVs were carried out mainly using the common guidance for identification of High conservation values from the High Conservation Value Resource Network, information on threatened species from the IUCN Red list of Threatened Species, and information from field surveys (IUCN, 2017). HCVs are detailed in the table below.

High Conservation Value	*Concentration of biological diversity, including endemic species and rare, threatened or endangered species that are significant at global, regional or national levels.*
Qualifying Attribute	*The Amazon rainforest is the world's largest intact forest. It is home to more than 24 million people in Brazil alone, including hundreds of thousands of Indigenous Peoples belonging to 180 different groups.* *The region is home to 10 percent of all plant and animal species known on Earth. There are approximately 40,000 species of*

	plants and more than 400 mammals, with almost 1,300 different varieties of birds and an insect population in the millions. *In addition to its unparalleled diversity of life, the Amazon plays an essential role in helping to control the planet's atmospheric carbon levels. The Amazon Basin stores approximately 100*
	billion metric tons of carbon — that's more than ten times the annual global emissions from fossil fuels.
Focal Area	*Entire project area*

High Conservation Value	*Rare, threatened or endangered ecosystems, habitats or refugee.*
Qualifying Attribute	*The Eastern amazon forest Eco-region, in which the project zone is located, hosts significant biodiversity value but is endangered due to deforestation and forest degradation.* *The Amazon rainforest has long been recognized as a repository of ecological services not only for local tribes and communities, but also for the rest of the world. It is also the only rainforest that we have left in terms of size and diversity.* *But as forests burn and global warming worsens, the impact of Amazon deforestation continues to gradually undo the fragile ecological processes that have been refined over millions of years.* *Ironically, as rainforest continues to disappear, scientific work from the last two decades has shed light on the critical ties that link the health of rainforests to the rest of the world.* *(Vourlitis, G.L. et al, 2002. Seasonal variations in the evapotranspiration of a transitional tropical forest of Mato Grosso, Brazil. Water Resources Research, Vol. 38)*
Focal Area	*Entire amazon biome*

High Conservation Value	*Intact forest landscapes and large landscape-level ecosystems and ecosystems mosaics that are significant at global, regional or national levels and that contain viable populations of the great majority of the naturally occurring species in natural patterns of distribution and abundance.*
Qualifying Attribute	*Due to deforestation, Brazil amazon forest is now reduced to a narrow strip of forest, composed of protected area connected by relatively intact unprotected forest blocks. This native forest blocks have a great value for biodiversity and its conservation, as they include most of the country's remaining amazon rain forests and are the refuge of many population of threatened species or endemic species. Biodiversity of these native forest*

	blocks has received little attention but these corridors contain many conservation priority species, and in case of low human pressure, can contain species diversity similar to protected areas. *Tropical forests and woodlands (e.g. amazon, savannas) exchange vast amounts of water and energy with the atmosphere and are thought to be important in controlling local and regional climates.*
	Scientists believe that less than half of 1% of flowering plant species have been studied in detail for their medicinal potential. As the Amazon rainforest biome slowly shrinks in size, so does the richness of wildlife found in its forests, along with the potential use of plants and animals that remain undiscovered. (Laurance, W.F. 1999. Gaia's lungs: Are rainforests inhaling Earth's excess carbon dioxide? Natural History (April), p. 96.)
Focal Area	*Entire amazon biome*

Given that within the Project Area is an area of high conservation value (HCV) of attribute number 3, related to forest areas that contain or are contained in rare, threatened or endangered ecosystems, the activities and mitigating measures to improve and maintain it are already listed and are included in the Project.

The protection of HCVs is the core objective of the project. To maintain or enhance all the HCVs related to biodiversity, identified above, the area that needs to be managed is the entire forest of project area.

5.1.3 Without-project Scenario: Biodiversity (B1.3)

According to UNEP, the impacts of agriculture on ecosystem functions can be grouped into five areas: 1) soil structure; 2) nutrients and microorganisms; 3) water cycle; 4) complexity of the landscape; 5) atmospheric properties. Agriculture affects soil structure and biota primarily through the reduction of organic material incorporated above the soil and roots, by ploughing the soil due to tillage and compaction livestock. In particular, in the high mountain areas, intensive soil management carried out in the clean crops have caused, among other adverse effects, lower carbon content and soil nitrogen.

The scenario in the absence of the ARC REDD+ Project would be for the occupation of land squatters and small farmers, who would be impacting the forest areas through the opening of the forest by the cutting and burning system. These areas are cultivated for a short period of time, one or two years, and then abandoned due to the fact that the soil becomes unproductive, with the opening of new areas to raise subsistence agriculture. The increase in deforestation was 31,252 hectares of land in the Project Area during the thirty years of the project.

In short, given the current conditions of the territory, it requires a type of sustainable productive activities with the environment and viable for producers. In the absence of the project, the continuation of inefficient exploitation of the soil and other natural resources within the three

municipalities selected for the project may affect biodiversity conditions, around the following effects:

Table 59. Impact on biodiversity in the scenario without the project.

Scenario without project	Environmental impact	Impact on Biodiversity
Expansion of the agricultural frontier and livestock areas	Deforestation, forest fragmentation and reduction of biological corridors	Loss of habitats for birds and mammals, endemic and migratory species threatened. Timber threat of low frequency and high commercial value
	Simplification of the vertical structure of vegetation	Destruction of climatic shelters and predators for wildlife and sites for feeding and reproduction
Lack of technical assistance and education, which leads to continued poor agricultural practices	Degradation and soil compaction and even in areas of grazing stubbles	Extinction of native species intolerant to intensive livestock
		Loss of habitat quality and capacity of natural forest regeneration
	Low productivity and increased use of fertilizers	Threat to soil organisms that play important roles as predators, decomposers and parasitoids. Reduction microfauna
	Pollution of water sources and wildlife due to the use of agrochemicals	Threat to aquatic wildlife and incidence

The permanence of natural environments in the Project Area is of extreme conservationist importance, since, in addition to promoting the conservation of biodiversity, it guarantees the maintenance of ecosystem services, such as pest and disease control, pollination, water quality, climate regulation and obtaining of resources for traditional communities. According to Silva et al. (2005) (Da Silva, José Maria & Rylands, Anthony & Fonseca, Gustavo. (2005). The Fate of the Amazonian Areas of Endemism. Conservation Biology. 19. 689 - 694), the connectivity between

the fragments constitutes a large and resilient conservation system to mitigate future global changes, make significant improvements in the living standards of local populations, and provide global communities with ecological services. In addition, the REDD+ Project seeks to protect the High Conservation Value Areas (HCVA), stimulate and improve knowledge about local biodiversity through studies, for example, long-term monitoring, since knowledge about the flora and, more specifically, of the fauna of the region can still be considered scarce.

5.2 Net Positive Biodiversity Impacts

5.2.1 Expected Biodiversity Changes (B2.1)

Biodiversity conservation objectives

Through the long-term preservation of the amazon forest cover, the Project is expected to generate positive impacts on biodiversity by preserving habitats and floristic and fauna species that would otherwise be threatened by deforestation. Moreover, the protection of the forest by the status of REDD Area will lead to the elaboration of a management plan which will aim to guarantee the durability of local uses of forest: collection of NTFP, forest exploitation for local construction and hunting. The Project presents specific objectives for biodiversity conservation in the project zone:

- Maintain forest cover and reduce habitat fragmentation;
- Maintain the integrity of the animal corridor
- Conserve habitats and native species of Amazon
- Ensure the conservation of threatened animal and plant species;
- Reduce human activities that do not comply with the conservation of biodiversity;
- Improved the natural resources management by local communities and facilitate their sustainable use;
- Raise awareness of environmental-related issues in local communities;
- Promote scientific research and monitoring of natural resources;
- Prevent and control the spread of invasive exotic species.

Expected positive impacts of project on biodiversity

In the without-project scenario, biodiversity is affected by progressive decrease of forest cover due to slash and burn agriculture, extension of cattle pasture and the maintenance or increase of animal poaching. On the contrary project activities are expected to generate biodiversity benefits by the long-term protection of forest landscape, which contributes to the preservation and enhancement of the faunal and floristic populations. The expected positive impacts of project on biodiversity can be evaluated through defined biodiversity indicators that will be monitored and can be summarized as follows:

Biodiversity Element	*Forest cover and Habitat*
Estimated Change	*Decrease of the loss of forest cover and thus maintain connectivity between communities and native forest cover through the reduction of deforestation and forest degradation in Project Area will contribute to maintain suitable habitat and population connectivity.*
Justification of Change	*In project scenario, deforestation and degradation of amazon forest are mitigated through the decrease of anthropic pressure due mainly to slash and burn agriculture. Implementation of sustainable agricultural techniques in the project zone is expected to reduce deforestation. Likewise, the development of a value chain of cash crop as alternative to slash and burn agriculture is expected to reduce deforestation.*

Biodiversity Element	*Floristic biodiversity*
Estimated Change	*Slowdown of the loss of floristic biodiversity by the reduction of non-controlled selective logging and improved forest re-growth through the reduction of overgrazing and uncontrolled bushfires.*
Justification of Change	*In the project scenario, the implementation of an effective control and watching system based on ground patrols is expected to reduce selective logging and to ensure respect of the regulations.*

Biodiversity Element	*Wildlife biodiversity*
Estimated Change	*Slowdown of the loss of wildlife biodiversity through the reduction of animal poaching and habitat loss.*
Justification of Change	*The abundance of animal species is expected to increase in project area, through the reduction of animal poaching, and the maintenance of habitat connectivity. Animal poaching is expected to decrease with the implementation of an effective surveillance and protection system in the project zone, the creation of the HCV area and the creation of a long-term natural resources management plan for the project zone.*

5.2.2 Mitigation Measures (B2.3)

The HCV attributes are not expected to be negatively affected by the project. By reducing the deforestation rate in the project area, the project will preserve the habitat for endangered and

vulnerable species. The recovery of ecological niches for endemic, vulnerable or threatened species is favoured.

5.2.3 Net Positive Biodiversity Impacts (B2.2, GL1.4)

The activities proposed by the REDD Project seek to generate diverse benefits to the climate, communities and biodiversity. The main benefits to biodiversity are linked to the reduction of deforestation and forest degradation and the conservation of biodiversity and habitats.

The implementation of the Project activities, as described above, have a direct and positive impact on biodiversity, such as the maintenance of vegetation cover and the conservation of biodiversity, acting directly against the loss of habitats and also against the fragmentation of the local vegetation cover. These positive impacts are due to avoided deforestation, improvements in management practices, monitoring of deforestation and biodiversity, technical assistance and rural extension, patrimonial surveillance, and other activities carried out during the life of the Project.

The effectiveness of the Project's activities is intended to generate positive net impacts to the climate, communities and biodiversity, but negative impacts may arise, and mitigation measures are necessary to avoid and minimize these impacts.

The sustainable forest management implemented by the ARC Group is well planned and performed in a correct manner, following strict norms and well established criteria, which guarantee the abundance and biodiversity of the local species. In large part, the negative impacts of this activity are ephemeral and not very severe, and do not endanger the conservation of the species. Negative impacts may be related to disturbances due to increased vehicle and person traffic in the Project region and noise production, local suppression of few species to open tracks and infrastructure, possible trampling of animals, increased hunting, fishing, and extraction of wood and non-timber products, as a consequence of the opening of tracks and bites.

In the scenario with the Project, we can see the generation of several positive impacts on biodiversity, a result of the reduction of deforestation and forest degradation in the Project area, thus promoting biodiversity conservation and mitigating the risks of extinction, guaranteeing genetic diversity, among others effects. The indirect impacts promoted by climate change on biodiversity will also be attenuated.

5.2.4 High Conservation Values Protected (B2.4)

All project activities are aimed at the conservation of forest areas, páramos, and protection of areas and species of fauna and flora.

Specifically, given that the ecotourism activity involves a closer interaction with HCV biodiversity, the implementation of these activities should follow the recommendations outlined in the previous section in order to ensure non-involvement of ecosystem wealth in the project area.

5.2.5 Species Used (B2.5)

An important role in the region's economy is filled by vegetable extraction and forestry, mainly as a source of subsistence for families. The vegetal extraction of the municipalities mainly counts on the management of non-timber forest products (NWFP) of native species of the region, such as brazil nuts and açaí.

In addition, the rural communities living in the Project area are mainly engaged in the production of cassava, flour and manioc, according to the Family Diagnosis of the REDD Project. Crops of corn, banana, orange, cabbage, cupuaçu, eucalyptus and cacao are also employed by some local communities but in smaller scales than the others already mentioned.

Table 60. Species used in the project

Common name	**Scientific name**
Eucalipto rosado	*Eucalyptus grandis*
Maize	*Zea mays*
Beans	*Vigna unguiculata*
Cassava	*Manihot esculenta*
Pineapple	*Ananas comosus*
Yam	*Dioscorea alata*
Peach palm	*Bactris gasipaes*
Soursop	*Annona muricata*
Waterleaf	*Talinum fruticosum*

5.2.6 Invasive Species (B2.5)

None of the Project's activities will introduce invasive species or genetically modified organisms. The project's developer will only approve agroforestry activities that use native species commonly known to occur in the Para region and are not in the Global Invasive Species Database before approving the utilization of particular species.

5.2.7 Impacts of Non-native Species (B2.6)

As specified above (section 5.2.6 –Invasive Species), the ARC REDD Project encourages the use of native species by local communities. In addition, approximately 75% of the main crops and

sources of income of the producers assisted by the Project are based on the development and production of native species (chestnut, açaí, flour, cassava, cupuaçu, among others).

The few non-native species are however used by local communities, i.e., small-scale use and do not have an adverse impact on the environment. Again, quoting the text above, these species have been cultivated for years, being part of the cultural history of the region and serving as a source of subsistence for these communities and not being encouraged their use by the REDD+ Project.

5.2.8 GMO Exclusion (B2.7)

Guaranteed that no GMOs are used to generate GHG emissions reductions or removals.

5.2.9 Inputs Justification (B2.8)

Not Applicable

5.2.10 Waste Products (B2.9)

Not Applicable

5.3 Offsite Biodiversity Impacts

5.3.1 Negative Offsite Biodiversity Impacts (B3.1) and Mitigation Measures (B3.2)

No potential negative offsite biodiversity impacts have been identified and therefore no measures or activities have been developed.

5.3.2 Net Offsite Biodiversity Benefits (B3.3)

No potential negative impacts have been identified due to the environmental-friendly techniques adopted in the proposed project activity.

5.4 Biodiversity Impact Monitoring

5.4.1 Biodiversity Monitoring Plan (B4.1, B4.2, GL1.4, GL3.4)

The framework of pressure, state and response of biodiversity has been adapted to develop a monitoring system that is both effective and efficient. This project will reduce the pressure on the wildlife in the project area by reducing the deforestation rates, thus conserving habitat. Additionally, the ARC REDD+ will develop a program for conservation of habitats linked to endangered species and development of a plan for conservation of biodiversity-linked HCVs identified.

Specifically, the following variables are foreseen to be monitored during the project:

Strategy	Indicator	Unit measure	Method
Biodiversity conservation	Illegal settlements in the project area and leakage belt	Number of hectares usurped by illegal settlements	GIS analysis

	Community biodiversity	Hectares of forest conservation by properties	GIS analysis
	Community biodiversity	Reforestation hectares in community polygons	GIS analysis
	Community biodiversity	Hectares with agroforestry system	GIS analysis
	Community biodiversity	Forest cover increased through restoration of degraded land	GIS analysis
	Community biodiversity	Connectivity between areas (biological corridors)	GIS analysis
	Presence of fauna	Number of times endangered species were observed	Direct observation

Develop and implement a monitoring plan to assess the effectiveness of measures taken to maintain or enhance all identified High Conservation Values related to globally, regionally or nationally significant Biodiversity present in the Project Zone.

The effectiveness of the measures taken to maintain or enhance High Conservation Values will be monitored through the following variables:

• Increased forest cover

• Conservation of amazon ecosystems and increased forest cover in the state of para area in the reference region

• Presence of endemic species, migratory or endangered

The first two variables are monitored for each verification period, while the third will be monitored in the inventories of fauna.

5.4.2 Biodiversity Monitoring Plan Dissemination (B4.3)

The results of monitoring undertaken will be made publicly available on the internet and through the web site of ARC. Additionally, all documents and information about the results of the monitoring and verification of this project will be published in the platforms of the VCS and CCB standards as usual.

5.5 Optional Criterion: Exceptional Biodiversity Benefits

The project does not seek to be validated to the Gold Level for exceptional Biodiversity Benefits.

5.5.1 High Biodiversity Conservation Priority Status (GL3.1)

Not Applicable

5.5.2 Trigger Species Population Trends (GL3.2, GL3.3)

Not Applicable