RMDLT PORTEL-PARA REDD PROJECT

Document Prepared By Ecosystem Services LLC

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Table of Contents

Acronyms

AFOLU: Agriculture, Forestry and Other Land Uses

BaU: Business as Usual

CCBS: Climate, Community and Biodiversity Standard

EMBRAPA: Brazilian Enterprise for Farming Research

ESLLC: Ecosystem Services LLC

GHG: Greenhouse Gas

Gleba: individual area plot within Project's Boundaries

Ha: Hectare

IBGE: Brazilian Institute of Geography and Statistics

IMAZON: Institute for the Man and Environment in the Amazon

INCRA: National Institute of Colonization and Agrarian Reform

INPE: National Institute of Spatial Research

IPCC: Intergovernmental Panel on Climate Change

ITERPA: Institute for Lands of Pará

IUCN: International Union for Conservation of Nature

LK: Project's Leakage Management Belt

LMA: Leakage Management Area

NGO: Non-governmental organization

PA: Project Area

PB: Project Boundary

PDD: Project Design Document

PRA: Participatory Rural Appraisal

REDD: Reduced Emissions from Deforestation and Degradation

RRD: Reference Region for Deforestation

SA: Social Assessment

tCO_2e: One tonne of Carbon Dioxide equivalent

UNFCCC: United Nations Framework Convention for Climate Change

VCS: Verified Carbon Standard

1 PROJECT DETAILS

1.1 Summary Description of the Project

A. Historical Deforestation Context and Dynamics

The Project is located in a fast-changing region characterized by forests rich in valuable timber species, illegal logging, unclear land tenure laws, widespread land speculation, overall weak law enforcement and severe poverty. With these variables combined the result cannot be other but the depredation of natural resources in the benefit of few.

Pioneer agents open the path for deforestation agents who cut clear the forest as a measure of proving land ownership and implementing low-cost and practically self-sustained productive activities.

The predominant final land-use in the area is deforestation by cattle ranchers to implement pastures , which occurs simultaneously in two deforestation fronts.

The first front is known as “consolidated frontier”, which is the area close to primary roads (federal and state highways) and already occupied mainly by cattle ranching. This frontier continues to expand due to the creation and expansion of secondary and tertiary roads that allow deforestation agents to deforest by using slash and burn.

The second front, known as a “pioneer frontier”, refers to forested areas with low deforestation but with high degradation located far from primary roads, but easily accessible through navigable rivers. These areas are considered to be of “free access” whenever the presence of the legal landowner is not made evident (i.e. through ongoing forest uses or/and monitoring and enforcement). In this front, landless people known as “riberinhos” slash and burn the forest to implement cassava plantations and pioneer agents such as loggers open penetration roads that allow squatters and ranchers to invade otherwise hard-to-access forest areas. Such penetration roads or “pioneer roads” not only allow access to natural resources but also connect the area to the network that leads to primary roads. This connection allows for a faster transportation of products and opens the area to pioneer agents that generate land speculation.

Brief Description of the Project Area

The Project Area comprises 177,899.5 Ha in 17 privately owned parcels or “Glebas” adding up to a total of 194,402.8 Ha in the Portel municipality, located in the Portel micro region.

The Marajo mesoregion constitutes 3 geographic micro regions (MRG): Araí, Furos de Breves and Portel. The first two regions comprise municipalities that are entirely included in the Marajó archipelago. The Portel MRG covers municipalities located in the continent, on the right margin of the Pará River. Even though Portel is geographically not a part of the Marajó archipelago, due to its location on continental lands, it belongs to the mesoregion Marajó. It can be assured, therefore, that from a geopolitical standpoint, Portel municipality belongs to Marajó (IBAMA, 2004). It is located in the whole region, south / southwest from the archipelago, 278 Km^2 from Belem, the state capital. The major access is by the Acuti-pereira River on the extreme east, Camarapi and Pacajá rivers on the central region and Anapu River on the north/northwest region.

The main transportation mean to arrive in Portel is by fluvial public transportation (20 hours from Belem) and then using a private boat to get into the Project Area. In the region of the Project transportation happens mostly by river although pioneer roads are already connected to the road network of the Transamazonica highway in the consolidated frontier thus providing increasing fast access to Project Area by road.

Forests in the area consist of large and productive trees connected to each other by lianas and parasites. The most important species according to size and value are: i) *Hevea brasiliensis* (seringueira); ii) *Castilla ulei* (caucho); iii) *Mauritia flexuosa* (Miritis); iv) *Euterpe oleracea* (Açaizeiros); v) *Ceiba pentandra* (Samaumeira); vi) *Cecropia sp*. (Embaubeiras) and vii) hardwoods.

Local population is comprised mainly of settlers known as *"Ribeirinhos",* who live along the rivers and along the *igarapés* (small streams). There are not indigenous communities located either in the Project Area, the Project's Leakage Management Area, Leakage Belt, the Project Zone or the Reference Region for Deforestation. Economic activities in the area are subsistence timber extraction and sale, fishing and subsistence agriculture.

B. RMDLT Portel - Pará REDD Project

The Project's main objective is to avoid and prevent unplanned deforestation in native forests thus avoiding the net emission of 22,130,927 tCO2e through a period of 40 years of Project's crediting period. Such objective will be achieved by managing the land in the form of a "private conservation reserve" by developing and implementing a management plan. Such plan will include a rigorous monitoring and enforcement plan built up on the existing experience of ongoing surveillance activities in the area since 2008. Such scaled-up monitoring activities will actively count with the participation of local villagers that will be trained in forest management and monitoring techniques. The medium term goal is to allow forest regeneration thus increasing the amount of carbon sequestered in the forest.

Since it started in 2008, the Project has been successful in identifying and removing illegal activities such as logging, squattering and attempts to implement pastures (as made evident by the patrolling reports made available to the validation team). A staff of guardians that continuously travel around the Project Boundary has performed monitoring and enforcement from 2008 to 2012, having just a few of them living in specific points of the Project Area. Although it was possible to cover and manage such a large area by using the aforementioned guardians, it will become more effective and resource-efficient to have monitoring staff actually living within the Project's Boundary. For this reason, from 2012 onwards the Project will scale-up its monitoring activities by employing and properly training local villagers as monitoring staff.

To improve the appropriate area coverage and an effective identification of illegal activities and invasion attempts, the Project will conduct a thorough census in the Project's Boundary and Leakage Belt to identify all affected villagers, to georeference active and resting agricultural plots and to continue with the identification and registration of illegal activities as it has been done since 2005. This census will take place within the first six months after validation and gathered information will be used to develop a detailed social monitoring plan as thoroughly explained in section G1.5 of this Project's CCB PDD. Ranchers identified during this initial census will be invited to participate in the project activities such as capacity building for pasture management, agroforestry practices and others.

The agents who will approach the project area are doing so within 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 it is not currently being used, so a squatter can acquire 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). So, any land-grabber that claims land and only deforests 20% of his land (following the parameters of Law number 4771, September 15th 1965 (D.0.U of September 16th 1965) that state each property must retain 80% of its forested area) will not be breaking the law. Under this reasoning, the Project cannot prevent this otherwise it would be preventing application of the law.

However, because of widespread weak law enforcement (Larson 2008), landowners do not keep the required legal reserve and clear all the forest in their properties (May, Millikan et al. 2011). Addressing deforestation by illegal activities, such as deforestation via cattle ranching, is a responsibility of local and regional governments, who haven't been able to resolve this. For this reason, a single project with which funding is based on a voluntary market cannot be asked to solve such a large and complex problem, which requires a large amount of resources to be solved.

Nevertheless, based on literature data (Margulis 2004) and projected future deforestation, it would be possible for the Project to address squatters and incorporate them into the activities of the Project.

Based on the baseline deforestation projected into the Project Area and literature values for area extent used by a single rancher, the maximum number of deforestation agents that will encroach the Project Area per year will be twelve (12) as presented in Table 1:

Table 1: maximum number of squatters/ranchers that need to be addressed by the Project on an annual basis

Project year t	Stratum i of the reference region in the project area	Average area claimed by person per year and number of persons that would need to be addressed per year					
	$ABSLPA_{i,t}$	BBC's Estimate		Margulis 2004 Estimate			
	ha	Ha per person	Persons per year	Ha per person	Persons per year	Ha per person	Persons per year
1	1,062	161	7	350	3	750	1
2	1,408	161	9	350	4	750	2
3	1,610	161	10	350	5	750	2
4	1,539	161	10	350	4	750	2
5	1,413	161	9	350	4	750	2
6	1,198	161	7	350	3	750	2
7	1,220	161	8	350	3	750	2
8	1,076	161	7	350	3	750	1
9	988	161	6	350	3	750	1
10	906	161	6	350	3	750	1
11	845	161	5	350	2	750	1
12	830	161	5	350	2	750	1
13	789	161	5	350	2	750	1
14	710	161	4	350	2	750	1
15	766	161	5	350	2	750	1
16	779	161	5	350	2	750	1
17	761	161	5	350	2	750	1
18	761	161	5	350	2	750	1
19	757	161	5	350	2	750	1
20	770	161	5	350	2	750	1
21	816	161	5	350	2	750	1
22	799	161	5	350	2	750	1
23	975	161	6	350	3	750	1
24	1,037	161	6	350	3	750	1
25	1,022	161	6	350	3	750	1
26	1,102	161	7	350	3	750	1
27	1,111	161	7	350	3	750	1
28	1,181	161	7	350	3	750	2
29	1,420	161	9	350	4	750	2
30	1,601	161	10	350	5	750	2
31	1,623	161	10	350	5	750	2
32	1,914	161	12	350	5	750	3
33	1,861	161	12	350	5	750	2
34	1,544	161	10	350	4	750	2
35	1,663	161	10	350	5	750	2
36	1,682	161	10	350	5	750	2
37	1,673	161	10	350	5	750	2
38	1,701	161	11	350	5	750	2
39	1,726	161	11	350	5	750	2
40	1,695	161	11	350	5	750	2

Net income from cattle rancher was also obtained from literature and a range is presented in Table 2 where the maximum income per hectare is 102.98 Reais (about US$ 51.49 at current exchange rate) and the minimum is 65.83 Reais (about US$ 32.91 at current exchange rate). Using the values of baseline deforestation projected into the Project Area, the maximum total amount that the Project would need to pay to squatters/ranchers for not clearing the forest and implementing pastures would be US$ 98,553. Such costs are manageable as the costs are lower than the expected returns of the Project (refer to the financial evidence for the Project.

Table 2: total amount that would need to be disbursed by the Project to avoid displacement of cattle activities

Project year *t*	Stratum *i* of the reference region in the project area	Net Income per hectare from cattle (pre year)			
	$ABSLPA_{i,t}$	Max		Min	
	ha	102.98 Reais/ha	US$ Equivalent	65.83 Reais/ha	US$ Equivalent
1	1,062	109,355	54,678	69,906	34,953
2	1,408	144,973	72,487	92,674	46,337
3	1,610	165,827	82,913	106,005	53,002
4	1,539	158,486	79,243	101,312	50,656
5	1,413	145,474	72,737	92,994	46,497
6	1,198	123,369	61,685	78,864	39,432
7	1,220	125,621	62,811	80,303	40,152
8	1,076	110,857	55,428	70,865	35,433
9	988	101,765	50,882	65,053	32,527
10	906	93,340	46,670	59,668	29,834
11	845	87,001	43,500	55,615	27,808
12	830	85,499	42,750	54,655	27,328
13	789	81,245	40,623	51,936	25,968
14	710	73,154	36,577	46,764	23,382
15	766	78,909	39,455	50,443	25,221
16	779	80,244	40,122	51,296	25,648
17	761	78,326	39,163	50,070	25,035
18	761	78,326	39,163	50,070	25,035
19	757	77,992	38,996	49,856	24,928
20	770	79,243	39,622	50,656	25,328
21	816	84,081	42,041	53,749	26,874
22	799	82,246	41,123	52,576	26,288
23	975	100,430	50,215	64,200	32,100
24	1,037	106,770	53,385	68,253	34,126
25	1,022	105,268	52,634	67,293	33,646
26	1,102	113,526	56,763	72,572	36,286
27	1,111	114,360	57,180	73,105	36,552
28	1,181	121,617	60,809	77,744	38,872
29	1,420	146,224	73,112	93,474	46,737
30	1,601	164,826	82,413	105,365	52,682
31	1,623	167,161	83,581	106,858	53,429
32	1,914	197,107	98,553	126,001	63,000
33	1,861	191,601	95,801	122,481	61,241
34	1,544	158,987	79,493	101,632	50,816
35	1,663	171,249	85,624	109,471	54,735
36	1,682	173,250	86,625	110,750	55,375
37	1,673	172,333	86,166	110,164	55,082
38	1,701	175,169	87,584	111,977	55,988
39	1,726	177,755	88,877	113,630	56,815
40	1,695	174,502	87,251	111,550	55,775

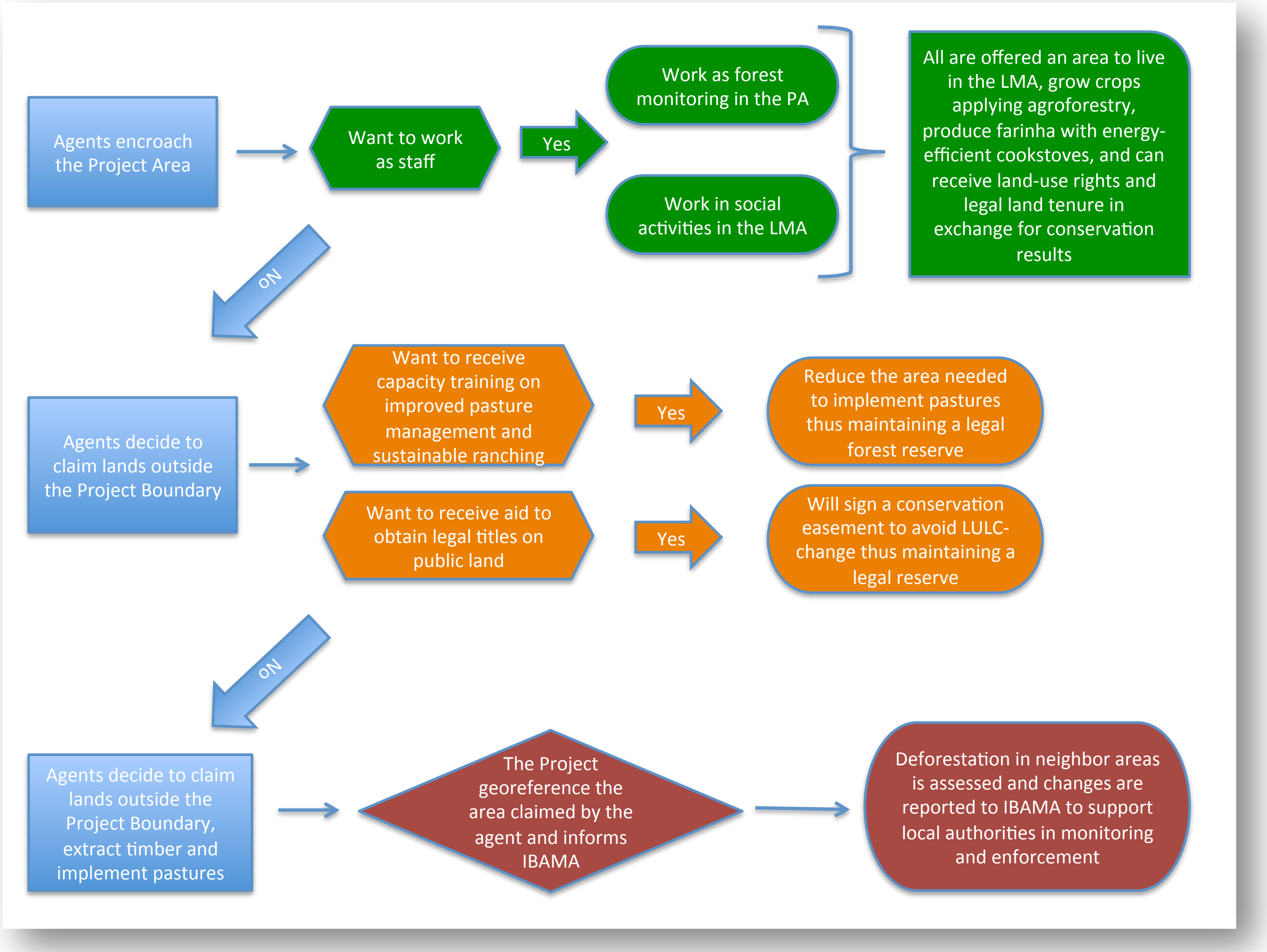
However, it would not be sustainable to compensate each and every squatter that approaches the Project Area just to avoid them deforesting somewhere else because, as mentioned before, this is a problem that needs to be addressed by local authorities and not at a project level. For this reason, the Project will identify and approach squatters/ranchers and invite them to participate in the activities of the Project (a procedure thoroughly described in the answer provided for the second round of this observation).

Instead of offsetting the revenues from avoided cattle ranching it would be better to address squatters/ranchers and invite them to participate in the activities of the Project to provide opportunities to help to replace their baseline income, product generation and livelihoods:

According to the baseline scenario, the expected 11 squatters who will approach the PA each year will be intercepted by the existing patrols. We have already explained that the patrols have been successful thus far to intercept all potential agents on the project boundary to turn them away and keep them from settling and extracting forest resources. With the onset of the funded REDD+ project, the intercepted would-be squatter agents will not only be asked to take part in project activities see, but they also will be asked to become part of the PA patrol system (see Flowchart 1 next page). Starting with the blue box in the upper left, the agents will encroach the Project Area and have the project activity explained to them and be asked if they wish to work as forest monitors in the PA, or work in the social activities taking place in the LMA. Both the forest monitors and social activity workers in the LMA will be offered an area in which to live in the LMA, applying agroforestry techniques, producing farinha with energy efficient cookstoves, and receive land-user rights in exchange for their conservation results. All participants (including those who choose not to become Project workers) will have the opportunity to gain from capacity building training about improved pasture management). Those who wish to pursue conservation will assistance to obtain legal land titles. Those choose not to participate may decide to claim land outside the boundary and their locations and whereabouts will be reported to IBAMA.

Since all of the projected squatters will be offered participation in work opportunities to offset and replace their income and program activities to live and pursue conservation, the Leakage Displacement Factor will be 0%.

Figure 1: process by which the Project will be able to provide opportunities to replace baseline income, product generation and livelihood of all of the agents



Based on the census results the Project boundary will be divided in brigades[1] 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; Ecosystem Services LLC will hire technicians from Portel or Breves.

After the census and on a yearly basis, the social monitoring staff of each brigade will be in charge of updating the census in their area. 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. 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 ranchers to let them know –in good terms- that this is private land, they cannot undertake such activities in the area and that they are welcome to participate in the project's activities to receive capacity building to improve their activities thus reducing deforestation.

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 Portel and to IBAMA in Portel and in Belem. The efforts of on-site monitoring and reporting will be complemented by monthly flights over the Project Area and by the use of free satellite imagery as it becomes available. Additionally, once a year the Project will use adequate satellite or radar imagery to conduct an assessment of the forest cover in the Project Area and Leakage Belt.

The Project will not develop or implement extractive activities or activities that cause significant reduction in carbon stocks. Also, the Project will not implement reforestation activities or introduce invasive species to the area.

The Project, in agreement with the landowner, will provide land tenure rights versus conservation results to villagers living within the Project's Boundaries but outside the Project Area[2]. To those living outside the Project Boundary in neighbor villages, the Project will provide knowledge to legally claim and secure land titles on unused public land. Geo-referenced information will be gathered and provided for villagers to know which areas can be claimed without incurring in private land encroaching.

Additionally, the Project will provide support to enhance community's organizational capabilities for a better management of local resources.

Finally, the Project will provide capacity building on agroforestry systems with native species[3] and on implementation of energy efficient cook stoves for cassava production to villagers within and nearby[4] the

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[1] We define as brigades the subdivisions of the Project Area.

[2] According to VCS's definitions these areas are known as Leakage Management Areas and are non-forest areas thus are not included in the Project Area.

3 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 a particular specie.

[4] To those willing to participate in such activities.

Project Boundary. At the same time, capacity building activities will be held with the main agents of deforestation to show them the benefits of pasture managements and intensified cattle ranching.

As for biodiversity, the Project will enhance ecosystem functionality by allowing regeneration of degraded forest thus eliminating ecosystem fragmentation.

Through its activities, the Project is expected to generate positive leakage[5] by addressing key underlying drivers of deforestation outside the Project Boundary. Negative leakage will be low as a result of the high levels of deforestation in the Project's Leakage Belt in the baseline scenario. The Project will not claim benefits from positive leakage (to be conservative).

1.2 Sectoral Scope and Project Type

Project Scope 14: Agriculture, Forest and other Land Use (AFOLU)

Project Category: Reduction Emission from Deforestation and Degradation (REDD)

Type of Activity: Avoided Unplanned Deforestation (AUD)

1.3 Project Proponent

Organizations	RMDLT Property Group Ltd ALLCOT Group AG
Responsibles	Ron Dewhurst (RMDLT) Alexis L. Leroy (ALLCOT Group AG)
Title of main contact point	Ron Dewhurst : RMDLT President
Address	RMDLT: 1194 Sunnyside Road, Kelowna, BC V1Z 2N8 ALLCOT Group AG: Dammstrasse 19 CH-6301, Zug Switzerland
E-mail	ron@kabwayinc.com

[5] Positive Leakage is understood as an unintentional positive outcome on carbon stocks from conservation projects, for example when the activities of a project are adopted voluntarily outside project boundaries and more carbon sequestration and/or avoided GHG emissions are achieved Schwarze, R. N., J. and Olander, J. (2002). "Understanding and Managing Leakage in Forest-Based Greenhouse Gas Mitigation Projects." Nature conservancy.

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	all@allcot.com
Short Descriptions	RMDLT: RMDLT Property Group Ltd. is an international business corporation formed on August 5, 2010 in the country of Belize, Central America. It is a privately held corporation registered under ”The International Business Companies Act”, Chapter 270 of the Laws of Belize. The purpose of RMDLT Property Group is to form a funding and operations company to engage in the development of international lands, either privately or governmental held for the monetization of carbon credits under REDD using various industry accepted standards. Additionally, besides the monetization and sales under the carbon credits business unit, RMDLT will use the revenue derived for this activity to create sustainable and regenerative socially responsible business development in the REDD project areas. This activity will be oriented towards ensuring the preservation of ecological systems health for the bio-diversity and the forestry in the area. ALLCOT Group AG: The ALLCOT Group is a vertically integrated carbon asset management company that develops, manages and trades in all sectors related with climate mitigation. The ALLCOT core strength lies in the compliance and VER markets where they are an active player, acting as a route to market for project developers, as well as, providing efficient sourcing and project development services.

1.4 Other Entities Involved in the Project

Project Developer, implementing and managing entity

Organization	Ecosystem Services LLC
General Manager	Gonzalo Castro de la Mata
E-mail	gcastro@ecosystemservicesllc.com
Technical Director	Giancarlo Raschio
E-mail	graschio@ecosystemservicesllc.com
GIS / Modeling Expert	Christian Contreras
E-mail	Christian Contreras <ccontreras@ecosystemservicesllc.com>
Address	1250 24th Street, NW Suite 300, Washington, DC, 20037, USA

Short Description	Ecosystem Services LLC is a forestry, renewable energy, and Natural Resources Company specialized in the generation of internationally marketable environmental services. ES LLC was founded by leaders in the environmental field that share the belief that long-term conservation of the environment and unprecedented profits for investors are possible through sustainable ecosystem management, renewable energy development, and carbon markets.

1.5 Project9:

The Project started on January 1st 2008, when on-the-ground activities to avoid and remove invasions were already taking place. The landowner conceptualized protecting his lands under a carbon project scheme since 2005.

It is in 2005 when the landowner hires the services of a lawyer to clarify any doubts on land titling and to execute corrective actions through legal means to remove invaders (squatters and illegal loggers). Although forest protection initiatives and activities were developed back in 2005, setting a 2008 Project start date was a conservative approach to make sure the Project had enough monitoring and enforcement experience to start producing conservation results.

1.6 Project Crediting Period

The crediting period for the Project is 40 years starting on January 1st, 2009.

1.7 Project Scale and Estimated GHG Reductions or Removals

1.7.1 Project Scale

According to VCS definitions for REDD Projects (VCS Standard V3.3) and based on our 40-year average ex ante GHG emission reduction estimations (553,273 tCO2e/yr), the Project can be categorized as:

Project	
Large project	X

1.7.2 Estimated GHG emissions reductions generated by the Project

Ex ante estimations of GHG emission removals by the Project are presented in Table 2:

Table 2: Estimated ex ante GHG emission reductions by the RMDLT REDD Project

Project year t	*Ex ante* VCUs tradable annual VCU_t tCO_2-e	cumulative VCU tCO_2-e
0	-	-
1	**369,828**	**369,828**
2	**508,205**	**878,033**
3	**587,878**	**1,465,910**
4	**572,931**	**2,038,841**
5	**538,552**	**2,577,393**
6	**469,351**	**3,046,744**
7	**484,563**	**3,531,307**
8	**439,778**	**3,971,085**
9	**417,913**	**4,388,997**
10	**392,984**	**4,781,981**
11	**370,637**	**5,152,618**
12	**366,268**	**5,518,887**
13	**346,647**	**5,865,534**
14	**313,586**	**6,179,120**
15	**329,874**	**6,508,994**
16	**330,550**	**6,839,544**
17	**322,778**	**7,162,322**
18	**320,435**	**7,482,756**
19	**318,566**	**7,801,323**
20	**322,125**	**8,123,448**
21	**337,476**	**8,460,923**
22	**332,664**	**8,793,588**
23	**396,195**	**9,189,783**
24	**417,799**	**9,607,582**
25	**416,320**	**10,023,902**
26	**451,695**	**10,475,597**
27	**454,769**	**10,930,366**
28	**471,828**	**11,402,194**
29	**558,804**	**11,960,998**
30	**630,761**	**12,591,759**
31	**646,248**	**13,238,006**
32	**756,492**	**13,994,498**
33	**724,760**	**14,719,257**
34	**607,987**	**15,327,244**
35	**640,147**	**15,967,391**
36	**640,626**	**16,608,017**
37	**644,357**	**17,252,374**
38	**646,226**	**17,898,600**
39	**652,887**	**18,551,487**
40	**643,045**	**19,194,532**

1.8 Description of the Project's Activities

The Project's main objective is to avoid and prevent unplanned deforestation in native forests thus avoiding the emission of 22,130,927 tCO_2e within a period of 40 years of Project crediting period. Such objective will be achieved by managing the land in the form of a "private conservation reserve" by developing and implementing a management plan. Such plan will include a rigorous monitoring and enforcement plan built up on the existing experience of ongoing surveillance activities in the area since 2008. Such scaled-up monitoring activities will actively count with the participation of local villagers that will be trained in forest management and monitoring techniques. The medium term goal is to allow forest regeneration thus increasing the amount of carbon sequestered in the forest.

Since it started in 2008, the Project has been successful in identifying and removing illegal activities such as logging, squattering and attempts to implement pastures (as made evident by the patrolling reports made available to the validation team). A staff of guardians that continuously travel around the Project Boundary has performed monitoring and enforcement from 2008 to 2012, having just a few of them living in specific points of the Project Area. Although it was possible to cover and manage such a large area by using the aforementioned guardians, it will become more effective and resource-efficient to have monitoring staff actually living within the Project's Boundary. For this reason, from 2012 onwards the Project will scale-up its monitoring activities by employing and properly training local villagers as monitoring staff.

To improve the appropriate area coverage and an effective identification of illegal activities and invasion attempts, the Project will conduct a thorough census in the Project's Boundary and Leakage Belt to identify all affected villagers, to georeference active and resting agricultural plots and to continue with the identification and registration of illegal activities as it has been done since 2005. This census will take place within the first six months after validation and gathered information will be used to develop a detailed social monitoring plan as thoroughly explained in section G1.5 of this Project's CCB PDD. Ranchers identified during this initial census will be invited to participate in the project activities such as capacity building for pasture management, agroforestry practices and others.

Based on the census results the Project boundary will be divided in brigades[6] 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; Ecosystem Services LLC will hire technicians from Portel or Breves.

After the census and on a yearly basis, the social monitoring staff of each brigade will be in charge of updating the census in their area. 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. 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 ranchers to let them know –in good terms- that this is private land, they cannot undertake such activities in the area and that they are welcome to participate in the project's activities to receive capacity building to improve their activities thus reducing deforestation.

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[6] We define as brigades the subdivisions of the Project Area.

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 Portel and to IBAMA in Portel and in Belem. The efforts of on-site monitoring and reporting will be complemented by monthly flights over the Project Area and by the use of free satellite imagery as it becomes available. Additionally, once a year the Project will use adequate satellite or radar imagery to conduct an assessment of the forest cover in the Project Area and Leakage Belt.

The Project will not develop or implement extractive activities or activities that cause significant reduction in carbon stocks.

The Project, in agreement with the landowner, will provide land tenure rights versus conservation results to villagers living within the Project's Boundaries but outside the Project Area[7]. To those living outside the Project Boundary in neighbor villages, the Project will provide knowledge to legally claim and secure land titles on unused public land. Geo-referenced information will be gathered and provided for villagers to know which areas can be claimed without incurring in private land encroaching.

Additionally, the Project will provide support to enhance community's organizational capabilities for a better management of local resources. Finally, the Project will provide capacity building on agroforestry systems and on implementation of energy efficient cook stoves for cassava production to villagers within and nearby the Project Boundary. At the same time, capacity building activities will be held with the main agents of deforestation to show them the benefits of pasture managements and intensified cattle ranching.

As for biodiversity, the Project will enhance ecosystem functionality by allowing regeneration of degraded forest thus eliminating ecosystem fragmentation.

Through its activities, the Project is expected to generate positive leakage[8] (Schwarze 2002) by addressing key underlying drivers of deforestation outside the Project Boundary. Negative leakage will be low as a result of the high levels of deforestation in the Project's Leakage Belt in the baseline scenario. The Project will not claim benefits from positive leakage (to be conservative) but will account reductions from negative leakage.

1.8.1 Climate, Community and Biodiversity Objectives of the Project

Climate Objectives

The Climate objective of the Project is to avoid and prevent unplanned deforestation in native forests thus avoiding the emission of 22,130,927 tCO2e through a period of 40 years of Project crediting period.

Community Objectives

The Project will provide, as agreed with the landowner, land tenure security to villagers living within the Project Boundaries but outside the Project Area[9]. For those living outside the Project Boundary, capacity

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[7] According to VCS's definitions these areas are known as Leakage Management Areas and are already deforested areas.

[8] Positive Leakage is understood as an unintentional positive outcome on carbon stocks from conservation projects, for example when the activities of a project are adopted voluntarily outside project boundaries and more carbon sequestration and/or avoided GHG emissions are achieved

[9] According to VCS's definitions these areas are known as Leakage Management Areas and are already deforested areas.

building workshops on land titling will be held to provide clear information about which steps villagers need to take in order to legally claim use rights and if possible ownership over free lands.

Geo-referenced information will be gathered and provided for villagers to know which areas can be claimed without incurring in private land encroaching.

Additionally, the Project will provide support to enhance community's organizational capabilities for a better management of local resources.

Finally, the Project will provide capacity building on agroforestry systems and on implementation of energy efficient cook stoves for cassava production to villagers within and nearby the Project Boundary.

Biodiversity Objectives

The Project will protect local ecosystems through avoided unplanned deforestation and will enhance ecosystem functionality by allowing patched of deforestation to regenerate thus eliminating ecosystem fragmentation.

Local villagers that wish to participate in the monitoring program will receive training on biodiversity monitoring and identification, so they will be a fundamental component of the project activities.

1.8.2 Project Activities

1. **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. Brigades will be formed by a leader –who will be a trained technician or park ranger- and a group of local villagers from within or around the Project Boundary. 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 Portel. The staff at the Portel 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 2 shows how brigades will be organized and Figure 3 shows the process to report illegal activities in the Project Area:

Figure 2: Local organization of monitoring tasks

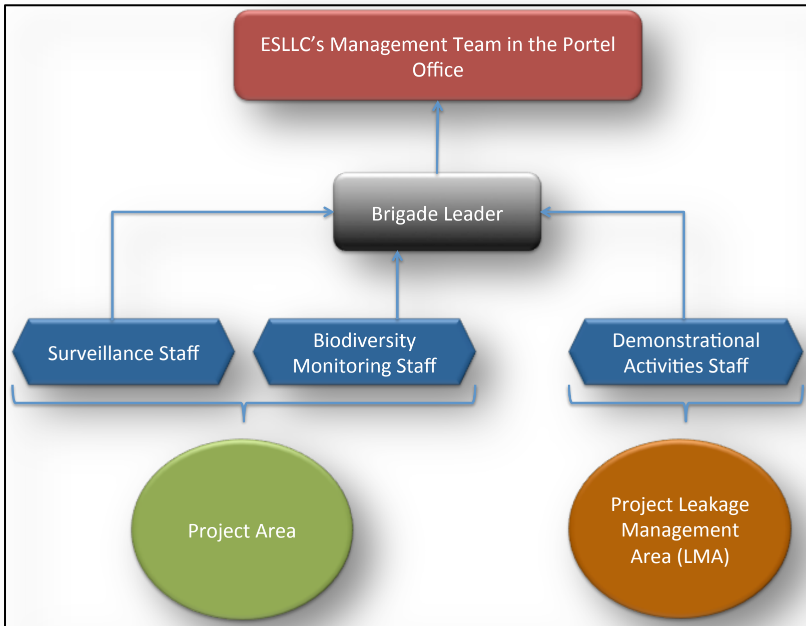
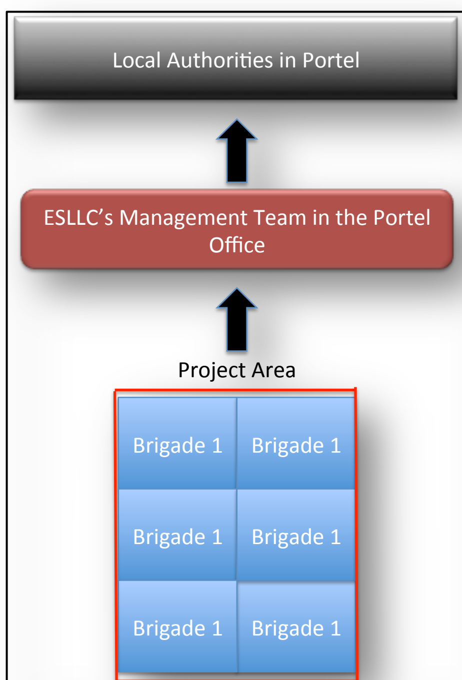


Figure 3: Reporting sequence for illegal activities in the Project Area



2. 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.

3. 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 (Fearnside 2001; Larson 2011).

The Project's Management Team, along with the landowner, have put forward a proposal to regularize land tenure status of those villagers living in the Leakage Management Area (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 Participatory Rural Appraisal (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.

4. 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 does not 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.

5. 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.

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 a particular specie.

6. Providing capacity building on improved efficiency cook stoves and implement cook stove pilots

In order to reduce the amount of firewood needed to produce farinha, 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.

7. 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 Non-governmental organization (NGOs)[10]- capacity building to local families to develop and submit business plans (individually or in groups) to apply for

[10] To be determined once the Project activities start.

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.

8. **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 the find some benefit in changing their business as usual behavior.

   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.

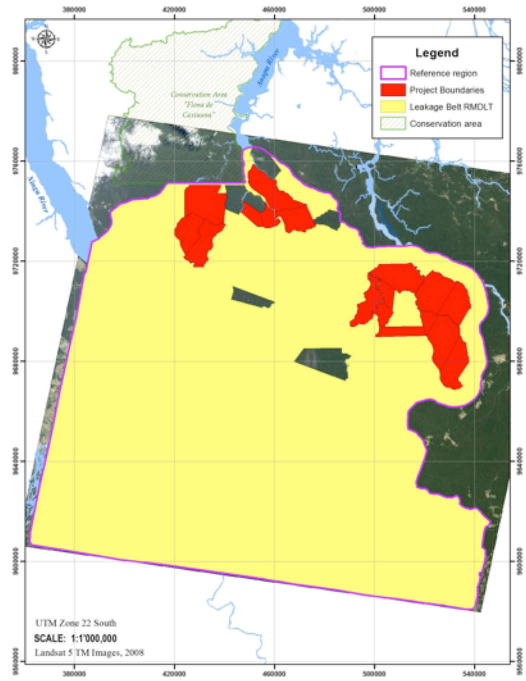
1.9 Project Location

The Project is located in northwest of Brazil, in the State of Para, micro region of Portel, municipality of Portel (Map 1). The regular main transport to arrive in Portel is by boat, the trip takes approximately, 20 hours from Belém. Some parts of the area are also accessible by car as the network of roads of the Transamazonica highway (BR-230) has already connected to logging (pioneer) roads that keep developing in the Project Area.

The Project Boundary (PB) has 194,402.8 ha[11] and the Project Area (PA) has 177,899.5 ha. In total the Project is constituted by 17individual Glebas or plots that contain forest and non-forest land.

[11] The "Project Area" will be smaller than the Project Boundary as it has to contain only areas that have been forest for the past 10 years from the Project start date.

Map 1: Project Location



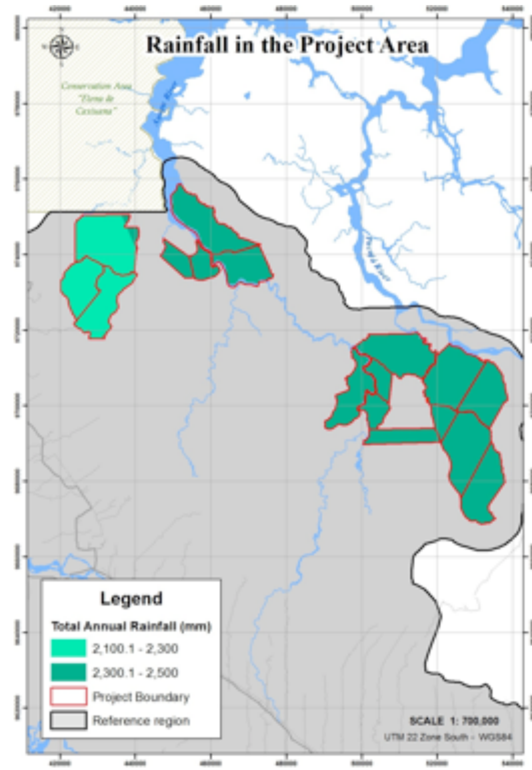
1.9.1 General Characteristics of the Project Area

Climate

Climate in the Marajó region, as it is in the great Amazon region, is tropical rainy (SEMA 2010). The average annual temperature is never above 27 degrees Celsius and rainfall ranges between 2,800 and 3,400 mm with relative humidity 85%. Rain is concentrated during six months between January and June. The summer is dry with sparse rain from August to December.

It is a humid tropical climate with 350mm of precipitation in April and 60mm in October. The rainiest season is between February and April while the driest months are August, September and October (annual precipitation 2.200mm). Average annual temperature is 21^{o} Celsius. Average insolation is 2,200 hours per year.

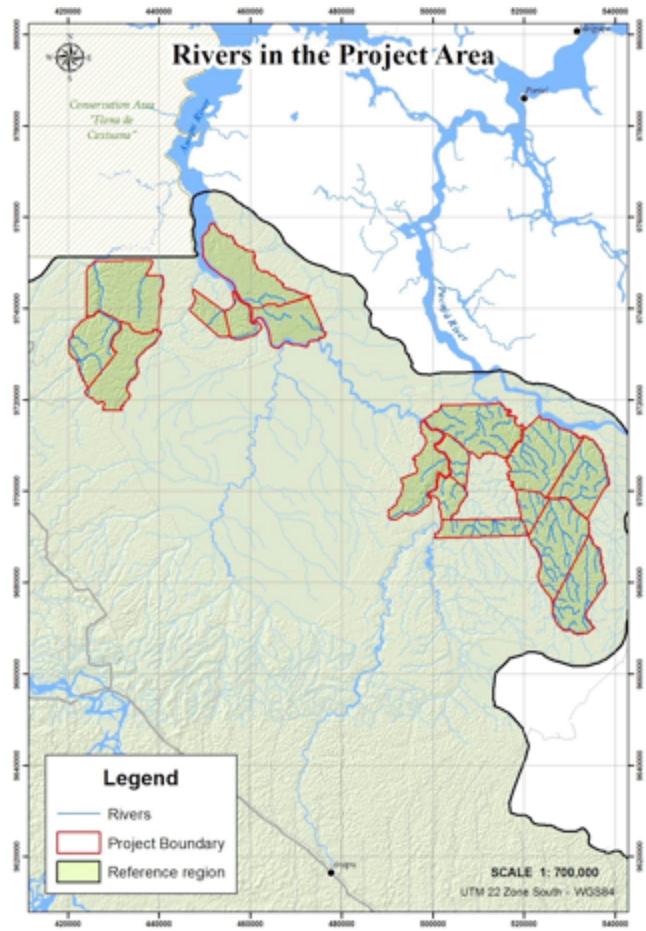
Map 2: Annual Precipitation



Hydrography

This municipality has 3 big rivers that drain the entire region: Anapu River, Pacaja River, and Camairapiri River. They flow from south to north. The Anapu river flows to the Pracui bay and Caxiuana bay and the major tributaries are: from the right – Marinau river, Tueré river and the igarapés: – Itatira, Merapiranga, Janal, Umarizal, Marapua, Atua and Majua. From the left – Pracuruzinho river, Curio river and Pracupi river, and the igarapés: Carunbé, Itatinguinho, Tatingao, Cocoajá e Tapacú.

Map 3: Hydrography

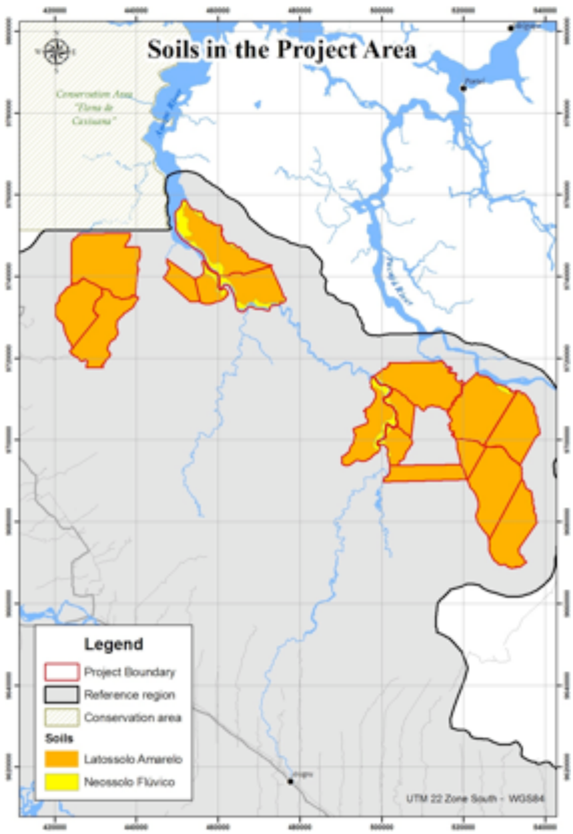


Soils

Soils in the Project Area appear to be mostly Latosol Amarelo, with some Agrisol Amarelo and some minor areas of Neossol Fluvico, according to the Brazilian System of Soil Classification (SEMA 2010). Soils in the Project Area and its surroundings are showed in the map below.

Latossolo Amarelos contain clay B horizon with a range from 15% to over 60%. It is possible to define a sort of intermediate texture of the soil (15% to 35% of clay), clay (35% to 60% of clay) and other clay (more than 60% of clay). Soils in the Project Area are showed below in Map 4.

Map 4: Soil types in the project area



Geology

Geologic formations in the Project Area belong almost entirely to one single class Formacao Alter do Chao with some areas with Tucunare formations and a little of Fluvial alluvion.

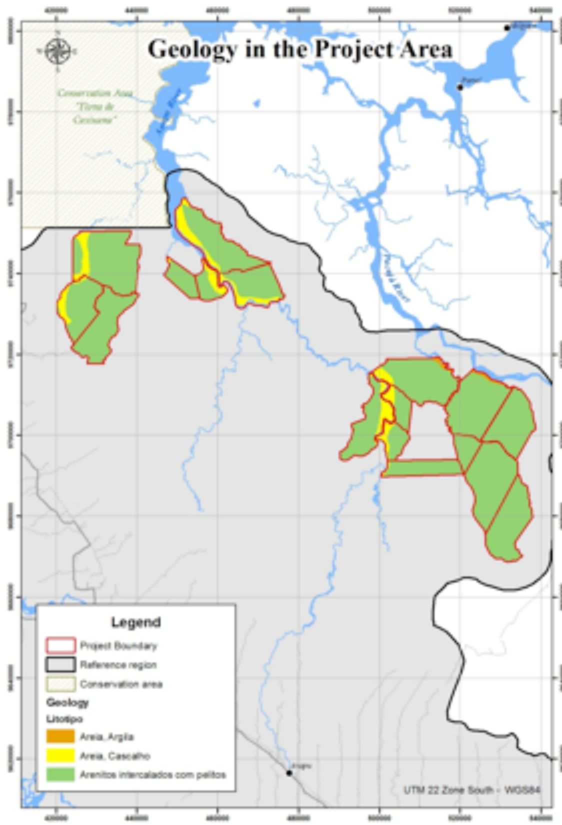
Fluvial deposits, fluvial-lacustrine and estuarine: these Quaternary deposits are associated with the basin of the Tocantins River, whose deposition formed large alluvial subject to tidal action. These unconsolidated deposits consist of fine sand, silt, clay and gravel, which develop sandy-argillic soils.

On top of these deposits can be observed plains associated with Argissolos Amarelos and Plintossolos Háplicos; Fluvial plains with low terraces and floodplains, on areas, which develop Neossolos Quartzarênicos, Neossolos Flúvicos and Gleissolos.

Alluvial deposit: This unit is composed of clay, silt, sand, fine gravel and unconsolidated organic matter and its deposition is associated with the flood plains of the rivers Tocantins, Crenicichla Pacajá and their major tributaries. This fine sediment gives origin to soils such as Gleissolo Flúvico Neossolo and Háplico.

Geologic formations in the Project Area are showed below in Map 5:

Map 5: Geology in the project area



Land Use

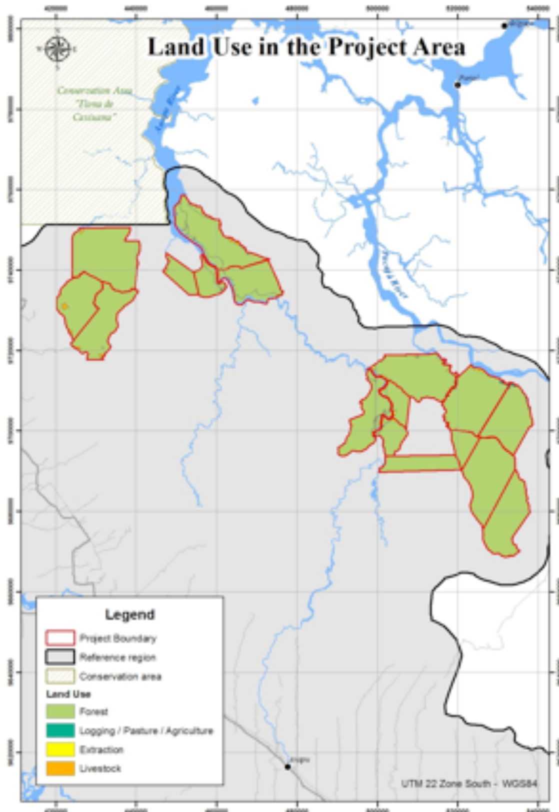
According to Imazon (SEMA 2010) land uses in most of the Project Boundary is constituted by primary and secondary ombrophilous forest with very small patches of human activity. These small patches constitute small-scale cassava agriculture (conducted by riberinhos[12] using slash and burn technique). From our social assessment (ESLLC 2012) conducted in the months of December 2011 and January-February 2012, it is known that there were nearby areas under timber extraction within the past ten years. Settlers claim they are not involved with illegal logging companies in the area, although settlers state they extract one or two trees per year to support their households' income and pay for school and health services (ESLLC 2012)

Nevertheless, the Proposer has been implementing on-the-ground efforts to deal with invaders and illegal logging activities in the Project Area since 2005, having a success rate proportional to the finance availability for the Project. Selective logging activities -as identified and defined by SEMA (SEMA 2010)-

[12] Riberinhos are settlers that live along river shores and whose livelihoods depend entirely on temporal crops such as cassava (ESLLC 2012).

have been spotted in the Project Area and its vicinity since 2004 through our historical baseline analysis using Landsat TM imagery. Land-uses in the Project Area (SEMA 2010) are presented in Map 6:

Map 6: Land Use in the Project Area



The main type of forest in the Project Boundary is Ombrophilous Forest (SEMA 2010). Primary and secondary forests that regenerate from former logged areas constitute vegetation in the area.

Vegetation

The Amazon forest is recognized as a heterogeneous biome, composed by a mosaic of different habitats and approximately only 5% of its taxonomy and richness is known (Viana, 2003). Nevertheless, its physiognomy follows a pattern, usually composed by 4 main ecosystems:

- Ombrophilous Forest
- Occasionally and Permanently Flooded Areas (Várzea and Igapó)
- Savannas (Campinarama and Capoeira)

Approximately 90% of the vegetation cover in Pará is original (IBGE 2007) and considering the size of the state it is unlikely that the Project zone hosts any invasive/non-native species.

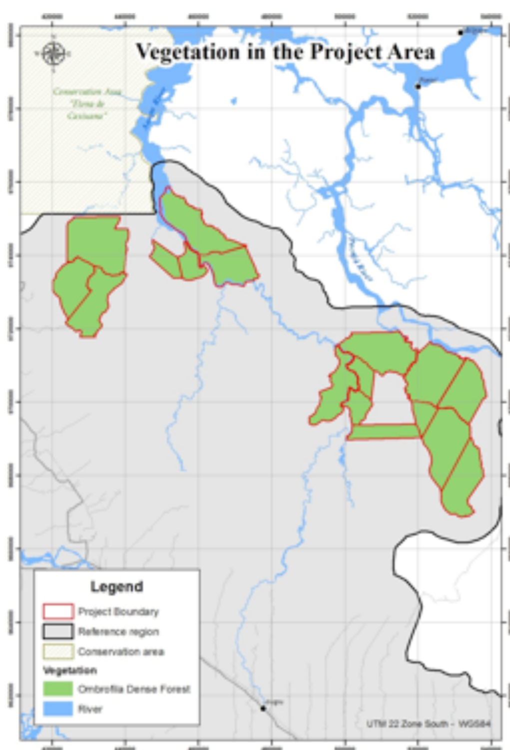
In the Project Area approximately 90% of the vegetation is composed by Ombrophilous Forest. Other forest ecosystems in the area are the Flooded Forest followed by Natural Savannas (SEMA 2010).

The region and surrounding areas are mainly composed by Ombrophilous Forest. Trees, lianas and palms, mainly compose the floristic composition in the area with great abundance of species per hectare (Almeida *et al*. 2003).

Through November 2011 to February 2012, and under contract and supervision from Ecosystem Services, SETA Ambiental conducted a forest carbon inventory in an area of 1,019,346.27 ha that encompass the Project Area, a potential buffer area of 15Km from the Project Area and a similar area southwards of the Project in order to better understand the carbon dynamics in the region (for further details refer the attached CCB PDD Section G.1.5 Community Information).

The main type of forest identified in the Project Area is Ombrophilous Forest[13]. Although forest in the Project Area is mainly dense forest, there are some areas with evidence of past selective logging, which are currently regenerating. Along river shores, Riberinhos apply slash and burn on 3 to 5 years old regenerated forests in preparation for agriculture.

Map 7: Vegetation in the Project Area



[13] Accordingly to secondary information from SEMA 2010.

Social aspects

From 2008 through 2012 the Project only activity has been monitoring and enforcement to remove squatters and illegal loggers. Although some interaction with local villagers took place, it was with the sole purpose of spreading the word on the Project Boundary being privately owned. According to information provided by Big Lands Brasil (who was in charge of surveillance activities from 2008) the approximate number of villagers contacted is less than 10% of the total population in the area.

Given the fact activities from 2008 until 2012 didn't include or affect villagers, the Project didn't conduct a Free Prior Informed Consent (FPIC) process. It is only in 2012 that the Project contemplates the opportunity to train and work with local villagers to improve local livelihoods and to scale-up forest surveillance. Thus it is in 2012 when the Project starts to impact villagers in a positive way without affecting their traditional way of live[14] when a FPIC process will take place as part of the activities of a planned census.

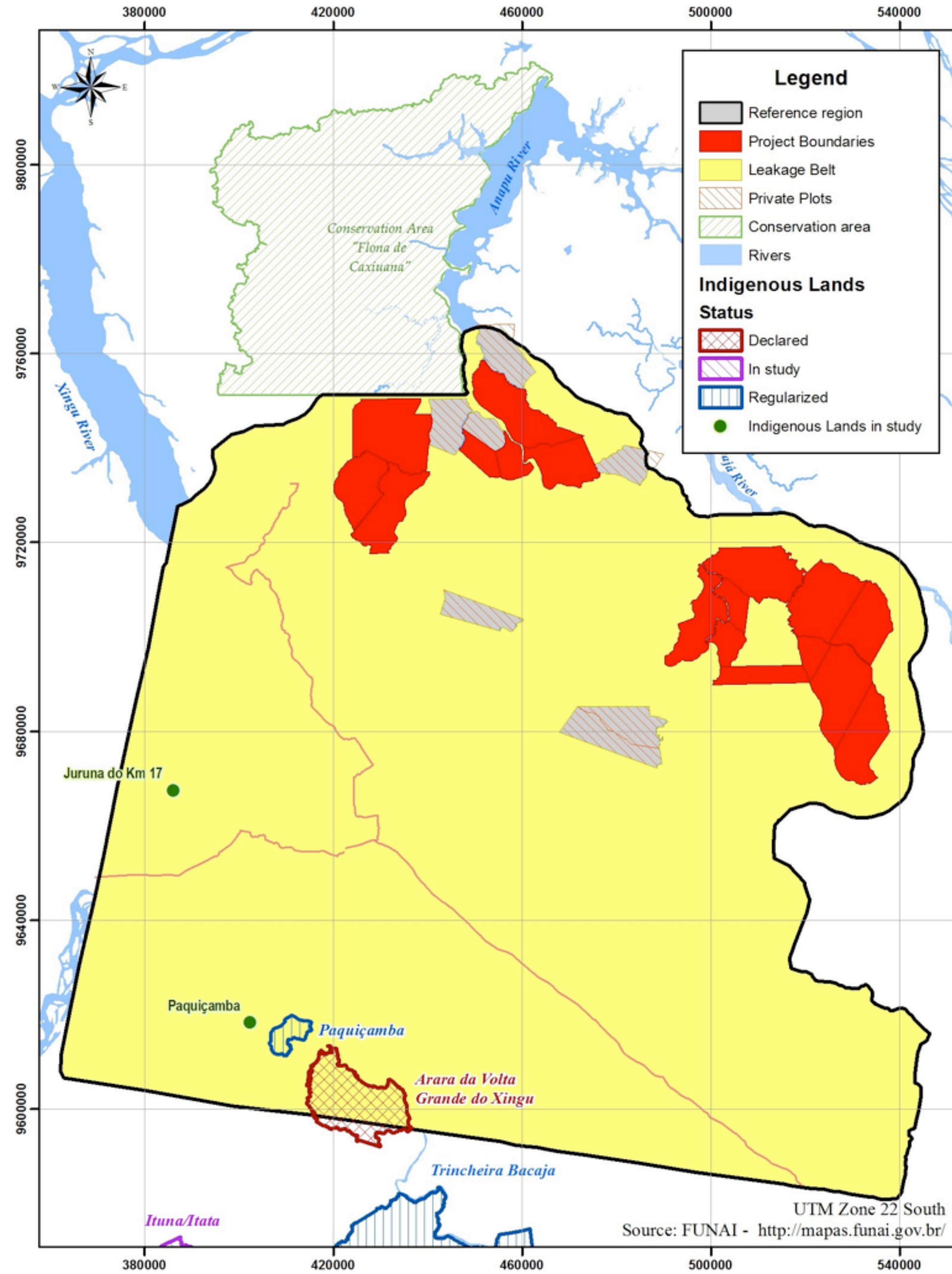
During the months of December 2011 and January-February 2012, Participatory Rural Appraisals (PRAs) were conducted in the area constituted by the Project's Boundary and a 15km buffer to gather socio-economic information. All the information presented in this section is derived from such study. It should be remarked that the Project couldn't find available official demographic and socio-economic information at villages' level for the sampled area so it was necessary to conduct an exploratory fieldwork to gather as much information as possible from primary sources. It is worth to mention that the Project's limited economic resources and time availability neither allowed to identify nor to perform a census of all the villages within the sampled area. As a result, surveyed villages do not represent an exhaustive list of those participating in the activities of the Project.

Upon validation, the Project will have access to available funds to cover most of the costs until it reaches breakeven point. This will allow the Project to conduct a thorough census in the Project's Boundary and Leakage Belt to identify all affected villagers and to georeference active and resting agricultural plots. This census will take place within the first six months after validation and gathered information will be used to develop a detailed social monitoring plan.

As for indigenous groups, according to official information form IMAZON (see Map 8); indigenous lands recognized by FUNAI are not present in the Project's Boundary or Leakage Belt. Therefore, the project will not affect indigenous people.

[14] The Project won't negatively affect villagers' way of live because villagers conduct their activities in a buffer of 3Km from river shores inwards the forest. These areas don not belong to the Project Area but to the Project's LMA, where agricultural activities are not only envisions but also enhanced.

Map 8: Indigenous Lands in the Project's Area and RRD according to official FUNAI database



Source: ESLLC, based on official information from FUNAI available at http://mapas.funai.gov.br/

The smallest administrative unit at which population size information can be found is at sectors scale, which are smaller than municipalities but still broad divisions of the territory. Sectors are smaller administrative units known by ID codes designated by IBGE.

Population in the project zone is completely rural (the only urban center is in Portel city, capital of the micro region of Portel). Population in the micro region of Portel is classified as belonging to sectors. Sectors have been defined as registry units by the 2010 census (IBGE 2011).

Impacted population is distributed along Anapu and part of Pacaja rivers and its tributaries, thus receiving the definition of *riberinhos* (people who live along river shores).

Stakeholders involved by the Project are those living in the LMA, which is located around the Project Area, in a buffer of 3Km form river shores. Total population in this area is approximately 860 villagers having a demographic density of 1.5 person/Km^2 according to the latest demographic census at sectors level (IBGE 2011)

Biodiversity

The project zone is inserted in an area of extreme importance for biodiversity conservation, according to the Brazilian Ministry of Environment, this area holds a great diversity and abundance of species, not only important for the maintenance of ecological relationships, but also of socio-economic importance such as Brazil nut trees and other noble tree species. All the species inventoried were gathered in current literature about Caxiuanã National Forest and Eastern Amazon fauna and flora.

Flora

The Phanerogams in the area are responsible for approximately 62% of the region's representativeness. The families presenting the biggest number of individuals are: Sapotaceae, Leguminosae, Chrysobalanaceae, Lecythidaceae, Burseraceae e Lauraceae. The most abundant and widely distributed species are: *Vouacapoua americana* Aubl. (Acapu), *Dinizia excelsa* Ducke (Angelim vermelho), *Eschweilera coriacea* (A.P. DC.) Mart. ex Berg (matá-matá preto), *Lecythis idatimon* Aubl. (jatereu), *Eschweilera grandiflora* (Aubl.) Sandw. (matá-matá), *Protium tenuifolium* Engl. (breu vermelho), *Licania octandra* (Hoff. Ex R. & P. Ktze.) *Licania egleri* Prance, *Pouteria cladantha* Sandw., *Pouteria jariensis* Pires & Pennington, *Pouteria decorticans* Penn. (abiu arrepiado), *Virola micheli* Heckel, *Virola calophylla* Warb., *Rinorea guianensis* Aubl., *Bertholetia excelsa* H.B.K. (castanha-do-pará), *Euxylophora paraensis* Ducke (pau amarelo), *Manilkara huberi* (Ducke) Standley (maçaranduba), *Manilkara bidentata subsp surinamensis* Pennington. In the understory are described *Faramea cf. anisocalyx*., *Phoebe cf. cinnamomifolia* (H.B.K.) Nees, *Pithecellobium unifoliolatum* Benth., and *Martiodendron excelsum* (Benth.) Gleason; species which can be considered rare for the Amazon (Silva *et al*. 2003). Of all the species mentioned above, the only one which status is vulnerable is *Bertholletia excelsa* (IUCN 2012).

The second most predominant forest is the permanently flooded forest (igapó). The most abundant species are: *Virola surinamensis* Warb (ucuuba), *Euterpe oleracea* Mart. (açaí), *Alantoma lineata* (Mart.ex Berg) Miers (ceru), *Xylopia emarginata* R. E. Fries (ioi do igapó), *Symphonia globulifera* L. f. (anani) (this one also occurs in terra-firme), *Eperua bijuga* Mart., *Macrolobium bifolium* (Aubl.) Pers. and *Macrolobium pendulum* Vog. are widely distributed throughout this ecosystem (Silva et al. 2003). All the species mentioned above also occur in the occasionally flooded forest (várzea). Only 3 species belong to this habitat exclusively: *Pentaclethra macroloba* (Willd.) Kuntze (pracaxi), *Mauritia flexuosa* L.f. (buriti), and *Campsiandra laurifolia* Benth. (acapucarana). The most abundant species are açaí, ucuuba and *Pachira aquatic* Aubl. (mamorana). In the understory it can be found abundantly *Bactris* sp. (marajá) (Silva et al. 2003).

Patches of secondary vegetation (capoeira) can be found on the area. These areas were used by the communities for subsistence agriculture. Its floristic composition varies depending on how long these areas were abandoned. The most representative species are: *Tapirira guianensis var guianensis* Aubl., *Trema micrantha* (L.) Blume, and many species of Cecropia sp. There is also the aquatic vegetation, which can be found by the *igarapés* margins. The families including the highest number of species are Cyperaceae and Araceae (Silva *et al*. 2003).

Regarding the Pteridophytes, 19 families can be found in the area: Lycopodiaceae, Selaginellaceae, Salviniaceae, Marattiaceae, Marattiaceae, Schizaeaceae, Hymenophyllaceae, Cyatheaceae, Metaxyaceae, Thelypteridaceae, Aspleniaceae, Blechnaceae, Polypodiaceae, Dryopteridaceae, Pteridaceae, Oleandraceae, Lindsaeaceae, and Tectariaceae (Silva & Rosário 2008).

Fauna

Pará REDD project zone also holds innumerous species of animals, including mammals, birds, reptiles, amphibians and fish.

Mammals

The most threatened fauna is found within the mammalian group. In the Primates group, *Cebus kaapori* (Ka'apor Capuchin) and *Chiropotes satanas* (Black Bearded Saki) are critically endangered both by IUCN and IBAMA, and the latter considered the least sighted primate (Ferrari *et al*. 2007) in the region. In the Carnivores, *Leopardus tigrinus* (oncilla) is considered vulnerable (IUCN, IBAMA) and *Pteronura brasiliensis* (giant otter) endangered (IUCN). Other threatened mammals are: *Mymecophaga tridactyla* (giant anteater) and *Priodontes maximus* (giant armadillo), both considered vulnerable by (IUCN 2012) and endangered by (IBAMA 2008)

Chiroptera is the most dominant mammalian taxon throughout Amazon. Due to their sensitiveness to changes in the ecosystem, they respond easily and quickly to those changes, which makes them good bio-indicators. The region of lower Xingu, including the project zone area, is very heterogeneous in terms of vegetation, which allows a wider range of bat species (Marques-Aguiar *et al*. 2003).

Birds

Regarding the birds group, all the species were found in literature about Eastern Amazon in general and other inventories in Eastern Amazon national forests (Silva *et al*. 1990, Henriques *et al*. 2003), due to the lack of literature on birds' species in Caxiuanã and Xingu-Tocantins interfluvium. According to MMA (2002), Caxiuanã region is a region that lacks bird data, and for that reason it is included in the criterium of extreme important site for birds' inventory. There are some studies performed within the boundaries of Caxiuanã national forest investigating frugivore by Pscittacidae.

Amphibians

Amphibians are not widely known by specialists, considering the Eastern Amazon context. What is known is that 82% of the amphibian species in the entire Legal Amazon are endemic. There is not any record of vulnerability, threat nor endanger of any amphibians documented in Pará (IBAMA 2008).

Fish

The project zone contains three main rivers: the Anapu River, located on the north; to the west Alto Anapu River – including Caxiuanã Bay; and Pacajá River on the east. The physiognomy of this basin combined with the innumerous igarapés present on the region, makes the project zone a very diverse site in terms of fish fauna (Montag *et al*. 2008). Based on a study carried out inside Caxiuanã national forest and surroundings, an inventory of the fish fauna sampled between November 1999 and November 2004 (Montag *et al*. 2008). The inventory comprises species sampled in Caxiuanã Bay, Caxiuanã, Pracupi and lower Anapu River. The entire region is classified as being part of a macro zone located between Xingu and Tocantins Rivers, composed by interlinked water bodies of similar physical-chemical composition –

black water rivers (Montag *et al*. 2008). It allows us to infer that the species found inside Caxiuanã can also be found in the further surrounding rivers, i.e. Pacajá and Pacupi River.

Arthropods

Of all the groups listed on this baseline, the arthropods are probably the group that holds the highest number of publications in the project zone. As part of a multi-inventory taxonomic project, the museum Emilio Goeldi made available a list of the species found within the boundaries of the national forest. Apart from this inventory, there is plenty of academic literature about different families.

Arthropods are abundant in almost every terrestrial ecosystem and are extremely important in the process of litter nutrient cycle, interacting with other organisms and interfering in soil composition (Praxedes *et al*. 2003). Praxedes *et al*. (2003) report that during their sampling period (June and November 2001; April and July 2002), it was collected individuals belonging to the following Classes: Insecta, Arachnida, Diplopoda, Chilopoda e Malacostraca, with Insect being the most representative one, encompassing the following Orders: Collembola (38%), Hymenoptera (27%), Coleoptera (20%) and Diptera 5%. The least representative within Insect were Isoptera, Orthoptera, Thysanura, Thricoptera and Hemiptera, representing 10 % of the total of Insecta.

To conclude, the list presented is a result of all the data gathered about arthropods, which the most representative group is Hymenoptera, followed by Diptera. All the Arthropods are not included in any list of vulnerability or least concern (IUCN 2012)

1.10 Conditions Prior to Project Initiation

As also described in the additionality assessment section, currently, cattle ranchers are the main deforestation agent in the area. 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 be of mutualism[15] or at least of commensalism[16]. 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).

Be as it may, 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 (Kirby, Laurance et al. 2006), 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) and from known corruption and weak

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[15] A relationship where the two agents benefit from each other's actions.

[16] A relationship where at least one of the agents benefits from the other agent's actions but the last one is not affected.

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).

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[17]. 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 (Larson 2008) and regardless increasing distances to selling points (Pfaff 2009). 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), 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 Transamazonica 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.

On one side, we have a consolidated frontier that moves northwards to the Project Area. This frontier is characterized by the presence of the Transamazonica highway[18] and the Senador Jose Porfirio highway[19]

[17] A land with forest cover is assumed to be unused thus susceptible to be claimed or expropriated. For this reason, deforestation is the main way to prove that a land has an owner and that is currently under productive use (Araujo, Bonjean et al. 2009)

[18] It is a federal highway known as BR-230.

where the colonization process had been already started at the beginning of our historical reference period (1996). Colonization in this southern part of the RRD started by governmental incentives to logging and cattle ranching activities and aided by the fact that there was a high volume of cheap workforce that moved into the area looking to make a living (Walker, Moran et al. 2000; Margulis 2004). Over time, deforestation started to consolidate in this area, giving birth to large-scale cattle ranching and expanding secondary roads and the associated deforestation towards north.

On the other side, we have the Project Boundaries and its immediate vicinity. In this northern part of the RRD, landless people or riberinhos colonize river shores and develop small villages; squatters (invaders) clear-cut patches of forest through slash and burn to prove land ownership and attempt a future land re-sale; illegal loggers establish operations on the shores of secondary rivers (they avoid main rivers to prevent calling attention on their operations) and open paths deep into the forest to selectively extract valuable timber species.

1.11 Compliance with Relevant Laws, Statutes and Other Regulatory Frameworks

1.11.1 Regulations regarding conservation and REDD projects

Currently there aren't any laws or regulations related to REDD projects in Para or Brazil (Santos and Brito 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 compromises of the Brazilian government to 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 form 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.

Specific regulations affecting the Project are described in Table 3:

[19] It is a state highway know as PA-167

Table 3: Relevant Laws and Regulations Applicable to the Project

Name of the Law	Description	Project Compliance
Law number 4771, September 15th 1965 (D.0.U of September 16th 1965)	The Brazilian forest code of 1965 – Brazilian Forest Code – provides for example: II – area of permanent preservation: protected area in the terms of article 2^0 and 3^0 of this law, covered or not by native vegetation, with the role of protecting the water resources, landscape, geological stability, biodiversity, flux of genes of plants and animals, protect de soil and secure a good environment for the human population; III – Legal Reserve Areas: Area located in the property or "*posse rural*" excluding the areas of permanent preservation, for the sustainable use of the natural resources, conservation and restoration of the ecological process, biodiversity conservation and refugee and protection of native animals and plants; Art. 150 – It is prohibited under empirical form the exploration of primitive forest of the Amazon watershed, but only can be explored in accordance of technical management plans approved by act of Public authorities, to be issued in one-year term.	All properties have legal reserve areas and APPs defined. In accordance with the CARs (Environment Rural Registry) at SEMA (Environment State Institute)
Normative Instruction number 003 of May 23th 2007 – Executive office of environment, science and technology - SECTAM	Regulatory of the Environmental Rural Registry - CAR in the state of Pará and providence of other requirements. Art 1 – establish criteria and procedures for implementation of the CAR – PA as a instrument for identification of the rural properties in the state of Pará that must be issued by SECTAM-PA in accordance with this Normative Instruction. Art 2 – It is necessary for all rural properties in the state of Pará to be registered in the CAR-PA, even the properties that have no production activity. Art 3 – The issuance of the CAR-PA, as toll for identification of the property will be done only once for each property. It will be a registry number with a sequential number. This number will be in all licenses, authorizations, and other documents issued for the environmental regularization of the rural property. This registry number will be linked to the land, independent if the land is sold, transferred or taken possession by other person. Single paragraph – There will be no concession of any license for the land that has no registry at CAR-PA. Art 4 – In the CAR-PA it will be mentioned all the basic data of the rural property, Total area- AT, Area of permanent preservation – APP, legal reserve areas – ARL, and area of alternative use of the soil – AUAS , in addition the	Development of CAR in all lands in the Project Area

	name and profession of the land owner, geographic coordinates and other information required by complementary laws	
Federal Decree number 5.975/2006	Art. 10 – Forest exploration and succession formations that require shallow harvest of the forest only will be permitted under specific authorization for alternative land uses issued by SISNAMA. # 1o By alternative land use is understood any conversion of the forest to other land cover, such as settlements, agriculture, pasture, industry, energy generation, mining and transportation.	All properties have legal reserve areas and APPs defined. In accordance with the CARs (Environment Rural Registry) at SEMA (Environment State Institute)

1.11.2 Regulations regarding labor rights

Workers' rights in Brazil follow the rules defined in the Law Decree n° 5.452 approved on May 1st 1943 which approves the Consolidation of Workers Laws. This is the most important regulation regarding workers' rights and established the norms that regulate individual and group work activities.

The following is a list of Brazil's all relevant laws and regulations covering worker's rights:

- The Brazilian Constitution, Chapter II-Social Rights, Articles 7- 11 which addressed: o Minimum w age o Normal working hours o Guidance on vacation and weekly leave o Guidance on maternity and paternity leave o Recognition of collective bargaining o Prohibition of discrimination.

In addition to the Constitution, there are two additional decrees related to Brazilian labor laws.

- Consolidação das Leis do Trabalho (CLT): DECRETO-LEI N.o 5.452, DE 1o DE MAIO DE 1943 (Consolidate of Working Laws)[20]. This decree gives more clarification on: o Hourly, daily, weekly and monthly work hours o Employment of minors and women o Establishes a minimum wage o Worker safety and safe working environments o Defines penalties for non-compliance by employers o Establishes a judicial work-related process for addressing all worker related issues
- Estatui normas reguladoras do trabalho rural: LEI No 5.889, DE 8 DE JUNHO DE 1973 (Establishes Regular Norms for Rural Workers)[21]. This is a complimentary law to the aforementioned 1943 decree because prior to 1973, rural workers did not have the same rights as urban workers. In 1973, this law was established to specify the equality between urban and rural workers, along with compensation for overtime.

The Project will abide by Brazilian national laws and especially the Brazilian Constitution. This includes Chapter 6 of the Brazilian Constitution, which specifically discusses environmental issues in Article 225:

Article 225. All have the right to an ecologically balanced environment that is an asset of common use and essential to a healthy quality of life, and both the Government and the community shall have the duty

[20] Presidency of the Republic, "DECRETO-LEI N.o 5.452, DE 1o DE MAIO DE 1943, Available: http://www.planalto.gov.br/ccivil_03/decreto-lei/Del5452.htm

[21] Presidency of the Republic. "LEI No 5.889, DE 8 DE JUNHO DE 1973," Available: http://www.planalto.gov.br/ccivil_03/leis/L5889.htm

to defend and preserve it for present and future generations.

Paragraph 1 - In order to ensure the effectiveness of this right, it is incumbent upon the Government to:

1. Preserve and restore the essential ecological processes and provide for the ecological treatment of species and ecosystems;

2. Preserve the diversity and integrity of the genetic patrimony of the country and to control entities engaged in research and manipulation of genetic material;

5. Control the production, sale and use of techniques, methods or substances that represent a risk to life, the quality of life and the environment;

6. Promote environment education in all school levels and public awareness of the need to preserve the environment;

7. Protect the fauna and the flora, with prohibition, in the manner prescribed by law, of all practices that represent a risk to their ecological function, cause the extinction of species or subject animals to cruelty.

The already approved new Brazilian Forest Code is of particular importance to the Project. This includes:

- The original Brazil Forest Code entitled, Law No. 4771, September 15, 1965.
- Revision of Brazil Forest Code under Law No. 7803, July 18, 1989.
- Provisional Measure entitled 2166-67, August 24, 2001.

In addition to the Forest Code, Law Number 6.938 of August 31, 1981 is Brazil's National Environmental Policy and thus, also relevant to the Project[22]. Another important national Brazilian law that is relevant to the Purus Project is the National Climate Change Policy (NCCP):

On December 29, 2009, the Brazilian Parliament adopted Law 12.187. The law establishes the National Climate Change Policy (NCCP) of Brazil and sets a voluntary national greenhouse gas reduction target between 36.1 and 38.9 percent of projected emissions by 2020. In October 26th, 2010, the government published an executive summary of the sectorial mitigation plans to implement its voluntary commitment.

Among other instruments, the NCCP law considers in article 9 the creation of a Brazilian Emission Reductions Market (BERM) to achieve the voluntary emission reduction target.

1.12 Ownership and Other Programs

1.12.1 Proof of Title

All the Project Boundary is privately owned land under complete control of the Project Proponent.

[22] Presidency of the Republic, "Law No. 6.938, August 31, 1981," Available: http://www.planalto.gov.br/ccivil_03/leis/L6938.htm

The Cadeia Dominial is a certificate provided by the registry office where the land's deed and title are registered. This certificate is used to show the history of the property and the owners. This document will show any updates on the property.

Also, a law firm was hired by the landowner to perform a due diligence process to verify that there weren't claims on his lands.

Finally, the landowner provided copies of the original land titles for each one of the Glebas that constitute the Project Boundary.

Proofs of ownership and land titles are considered sensitive information and will only be showed to the validation team upon request.

1.12.2 Emissions Trading Programs and Other Binding Limits

Brazil is a non-Annex I country under Kyoto Protocol and does not have any GHG reduction commitments under the Convention. Moreover, the Project Proponent does not have any project related to carbon credit generation under the CDM or other regulatory scheme within the project area.

1.12.3 Participation under Other GHG Programs

The Project is not registered or seeking registration in any other GHG programs

1.12.4 Other Forms of Environmental Credit

The project does not intend to generate any other form of GHG-related environmental credit for GHG emission reductions or removals claimed under this VCS project.

1.12.5 Projects Rejected by Other GHG Programs

The Project is not requesting registration of this project in any other GHG Programs nor have any other GHG programs rejected the project.

1.13 Additional Information Relevant to the Project

1.13.1 Eligibility Criteria

The project is not a grouped project.

1.13.2 Leakage Management

The Project's activities will not generate GHG emissions thus there will not be GHG emissions from leakage prevention activities.

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[23]. The Project's leakage belt extent was calculated using a Mobility Analysis.

The Project's LK delimits the area from the Project Boundary outwards- that has the highest probability of being deforested as a result of activities displacement given the mobility of the deforestation agents. The Project Boundary falls in the pioneer frontier and is surrounded by rivers, so it is logical that agents will start deforesting from the rivers (or from secondary or tertiary roads if such agents arrive as a result of the expansion of the consolidated frontier) towards the Project Boundary. Baseline projections indicate that by the time agents enter the LK, most of the forest outside the LK will be deforested. For that reason deforestation agents that arrive to the vicinity of the Project Boundary and are displaced by the Project's activities will have to choose either to cut down the available forest in the LK or to move outside the LK.

1.13.3 Commercially Sensitive Information

Proofs of ownership and land titles are considered sensitive information and will only be showed to the validation team upon request.

The Project will not disclose to the public the name and contact information of the current landowner of the Glebas as requested by him.

1.13.4 Further Information

Not applicable

2 APPLICATION OF THE METHODOLOGY

2.1 Title and Reference of the Methodology

The Project has been developed using the guidelines in the VCS VM0015 REDD Methodology: Methodology for Unplanned Deforestation V2.0

This Project follows and uses these documents and tools:

- VCS Program Guide 3.3
- VCS Program Standard 3.3
- VCS AFOLU Requirements Version 3.3
- VCS Tool VT0001 Version 3.0 – Tool for Demonstration and Assessment of Additionality in AFOLU Project Activities.
- VCS AFOLU Non-Permanence Risk Tool Version 3.1

The Project does not apply any deviations from the VM0015 methodology.

[23] Taken from the definition of "leakage belt" in the vm0015 methodology page 10.

2.2 Applicability of the Methodology

Table 4 indicates the applicability conditions to the VM0015 methodology and explains how the Project meets each criterion.

Table 4: Demonstration of the Project Applicability to the VM0015 Methodology (Refer to Table 2 - VM0015 methodology)

Applicability Conditions	Project Compliance to the methodology
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	The activities in the baseline are unplanned timber logging and pasture implementation.
Project activities may include one or a combination of the eligible categories defined in the description of the scope of the methodology	The Project falls in category E: Avoided Deforestation of Degrading Forest with Carbon Stock Increase.
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[24].
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.	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.
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	The Project does not include forested wetlands.

[24] According to the UNFCCC, Brazil's definition for forest is 1 hectare with 30% crown cover and 5 meters tree height. http://cdm.unfccc.int/DNA/index.html

be defined as organic soils with at least 65% organic matter and a minimum thickness of 50 cm. If the Project Area includes a forested wetlands growing on peat (e.g. peat swamp forests), this methodology is not applicable.	

2.3 Project Boundary

2.3.1 Spatial Boundaries

2.3.1.1 Reference Region for Deforestation (RRD)

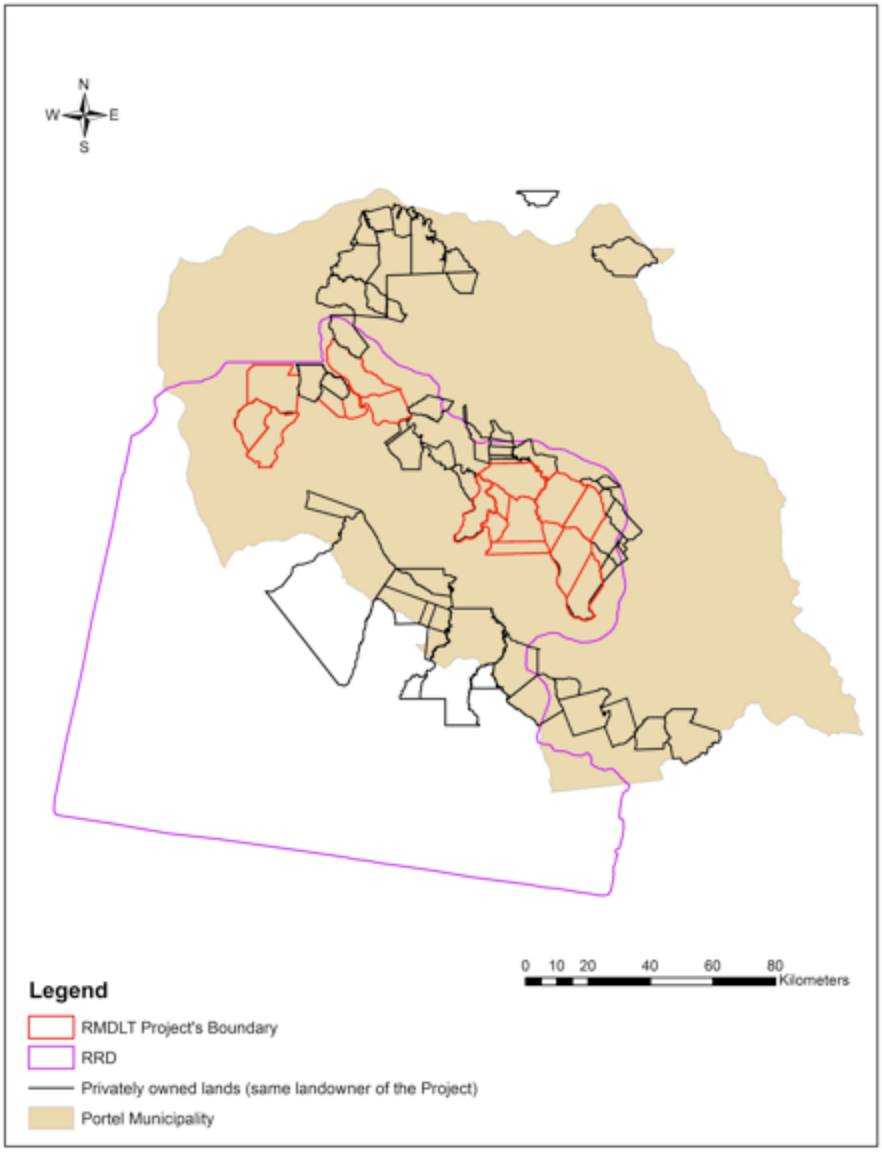
The RRD encompasses the PB, PA, LMA and LK of the Project and it is just one single, continuous area. The RRD area is 13.47 times the PA thus it complies with the "rule of thumb" for size presented in the vm0015 methodology for projects larger than 100,00 ha (that states the RRD should be between 5-7 times larger than the PA).

In terms of landscape configuration and ecological conditions, these are uniform throughout the RRD. Although some areas may present slights 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 riberinhos. 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.

In terms of socio-economic and cultural conditions, the RRD complies with all the requirements indicated in the vm0015 methodology. Firstly, the PB is privately owned land (legal tenure requirement) and will remain under the same legal status during the baseline case (legal status of the land requirement). In the RRD exist more privately owned lands (many of them belonging to the same landowner of the PB), which will also remain as private lands in the baseline case and because the PA belongs to the Portel municipality, which composes 40% of the RRD, municipal, regional and national regulations apply to both the PA and the RRD as well as the degree to which law is enforced. (Map 9). Secondly, the final land-use class expected to occur in in the PA is cattle ranching while small-scale agriculture is already existing in the LMA[25]. In the RRD cattle ranching is the dominant post-deforestation final land-use class but small-scale agriculture can also be found close to rivershores.

[25] Small-scale agriculture is not expected to occur in the PA or at least not as a final land-use in the baseline case because of three reasons: the historical contribution to small-scale agriculture in the land-use change has not been significant (2%); the PA is in most of the cases more than 3Km from river shores (and from the PRA it is known that riberinhos won't implement activities beyond this distance), and; cattle ranching is a more profitable activity that will eventually replace cassava sale thus replacing small-scale agriculture.

Map 9: Other privately owned lands in the RRD



As for agents and drivers of deforestation, the dynamics of deforestation in the RRD have been presented in sections 2.4.1 and 2.4.6.3 of the PD. As a brief summary, at the start of the historical reference period pioneer agents occupied the lands in the immediate vicinity of the BR-230 (Transamazonica highway) and PA-167 (Senador Jose Porfirio highway), where they extracted timber and implemented pastures. Over time, these original pioneer agents became consolidated agents and, together with new pioneer agents, they started to build secondary roads from the BR-230 and expanding into the forest in the north and south. As years went by, this secondary roads gave birth to tertiary roads in which became an intricate network of roads, all of them leading to the BR-230 or/and PA-167. By then end of the historical reference period (1996 to 2008), unofficial roads density in the RRD was 1,766 Km/104Km (an increase of 303% between 1996 to 2008) whereas site-specific literature indicates that average density of unofficial roads in 40% of the State of Para is 591Km/104Km (da Silva Viana, Fonseca et al. 2009).

A higher increase of unofficial roads in the RRD compared with the State of Para can be explained because around 40% of the RRD falls in the municipality of Portel, which has an increasing trend in deforestation rate while the State of Para has a decreasing rate. Also, the municipality of Portel still has vast areas of forest in comparison to the areas close to the BR-230 and PA-167 that are already deforested, so it is not possible for the deforestation rate to go any higher in such areas.

During the historical reference period timber resources in the areas surrounding the BR-230 and PA-167 were already depleted so illegal loggers (given their high mobility) started to explore forested areas far from primary roads (May, Millikan et al. 2011).

Nowadays these pioneer roads are connected to the road network of the BR-230 and the PA-167 thus became tertiary roads, just as it was verified during the on-site visit by the audit team based on the testimony of local riberinhos. The development of pioneer roads and their expansion is also made evident by a Map of digitalized roads based on Landsat TM imagery from 1996 and 2008 (map 16 of the PD). This road map shows how tertiary roads in the Project Area and its vicinity extend for kilometers, merging with secondary roads until reaching the BR-230 and PA-167. This finding is also supported in the literature, which states that timber operations can expand road networks for hundreds of kilometers (Uhl, Barreto et al. 1997). Although the digitalized road network does not appear to be continuous up to the BR-230 and PA-167 (some sections seem to be "cut" by the forest canopy), the literature explains that logging and deforestation agents would leave some trees with large canopy to hide their activities from airborne surveillance until at some point, when all the remaining forest has been cleared and their activities are made evident but are irreversible (Margulis 2004).

This connection of road networks not only allows for products to be transported faster to major market selling points but also allows pioneer deforestation agents such as squatters to gain access to the Project Area, who try to claim large areas of forest looking to implement pastures. Nevertheless, monitoring and enforcement activities supported by the Project since 2008[26] have identified and avoided the invasion of large extensions of forest that otherwise would have been logged, cleared and converted to pastures. From our monitoring reports (see below) we have evidence that squatters have been trying to claim areas as far as 100Km from the BR-230 to convert them to pastures. Extracts from the official translation of the monitoring reports clearly indicate the extent of invaded areas and the intention of invaders in different opportunities from 2005 to 2011:

[26] In reality the landowner has been conducting monitoring activities since 2005, however the Project was implemented only in 2008 once the monitoring crew had gained enough monitoring experience

1. Miritizal and Gurupa - Told by ribeirinhos there was a big land claim on Miritizal, we went to the location and spoke to the invaders property keeper, he stated they owned 6,000 hectares and planned to start a project to cut and for cattle. The person's name is Soares and we have heard in the region he is very dangerous. We told the property this is private property and that it was being monitored by satellite so if any areas open up that everyone would get fines.
2. Miritizal and Gurupa - The same property keeper told us a family member of Soares is claiming 6,800 hectares next door. We told the property keeper this is private property and it is being monitored by satellite and that if any land is opened up they would get fines.

Engasgado - A land buyer came to us and asked if we knew of any land owner that was looking to sell some land or had land that he could convert into a 7,000 to 10,000 hectare cattle farm. He asked if Alvorado I, would work. We told him that this land and all the land around are private properties and told him to go north of Jaguarajó as it is all deforestested and uninhabited. Will follow up in 12 months.

Loggers: Alvorado II - Follow up to July 21, 2005 report: we went back and there is no activity on the land, however he stated they are planning on doing a cattle property on 20% of the land and 80% they plan on extraction. We again stated it was private property and that it can't be done. This involves about 4,800 hectares.

Porto do Fortuna - The Adami Family is each claiming 1,000 hectares, there are five family members for a total of 5900 hectares. We spoke to one of them and told them that IBAMA is monitoring the area. They stated they will not cut unless they get permits. However we think they are there to claim, regularize the land and to sell to a cattle buyer, or to have one of the logging companies to come in and log the wood. We will monitor this situation.

Aru and Porto do Fortuna - We went to Porto de Fortuna and came across a person by the name of Jordan Castro. He stated he has possession of 1,000 hectares in this area. He stated he was planning on setting up a cattle farm. We stated that it wouldn't be possible as this is private property.

Engasgado - Follow up: Spoke to the caseiro (property keeper) (property keeper) (property keeper) on Jaguarajó and he stated that a group has taken and claimed 7,025 hectares and is setting up a cattle farm. This appears to be the same cattle person from the May 17, 2006 report.

Miritzal and Gurupa - Follow up to April 16, 2007 - We went back to the location where Soares was and no one was there, there was no activity on the land either, potentially the property keeper left to go somewhere. There is 6,000 hectares involved here. Will follow up next time in the area. We can assume that if we deterred them for the last three years we have had success to deter them from starting to cut and do cattle.

Loggers: Miritizal, Gurupa and Alvorado I - We were approached by Agropecuária Colorado do Norte Ltda. which slightly west of Miritizal and is a big cattle operation. They asked if they could buy Miritizal, Alvorado and Gurupa to turn 20% of the land into cattle farms. We stated it is not for sale for that purpose, however we will be happy if they purchased it for preservation. They stated they would follow up with Jonas. This would cut down over 8,000 hectares of land to match the rest of their cattle farms.

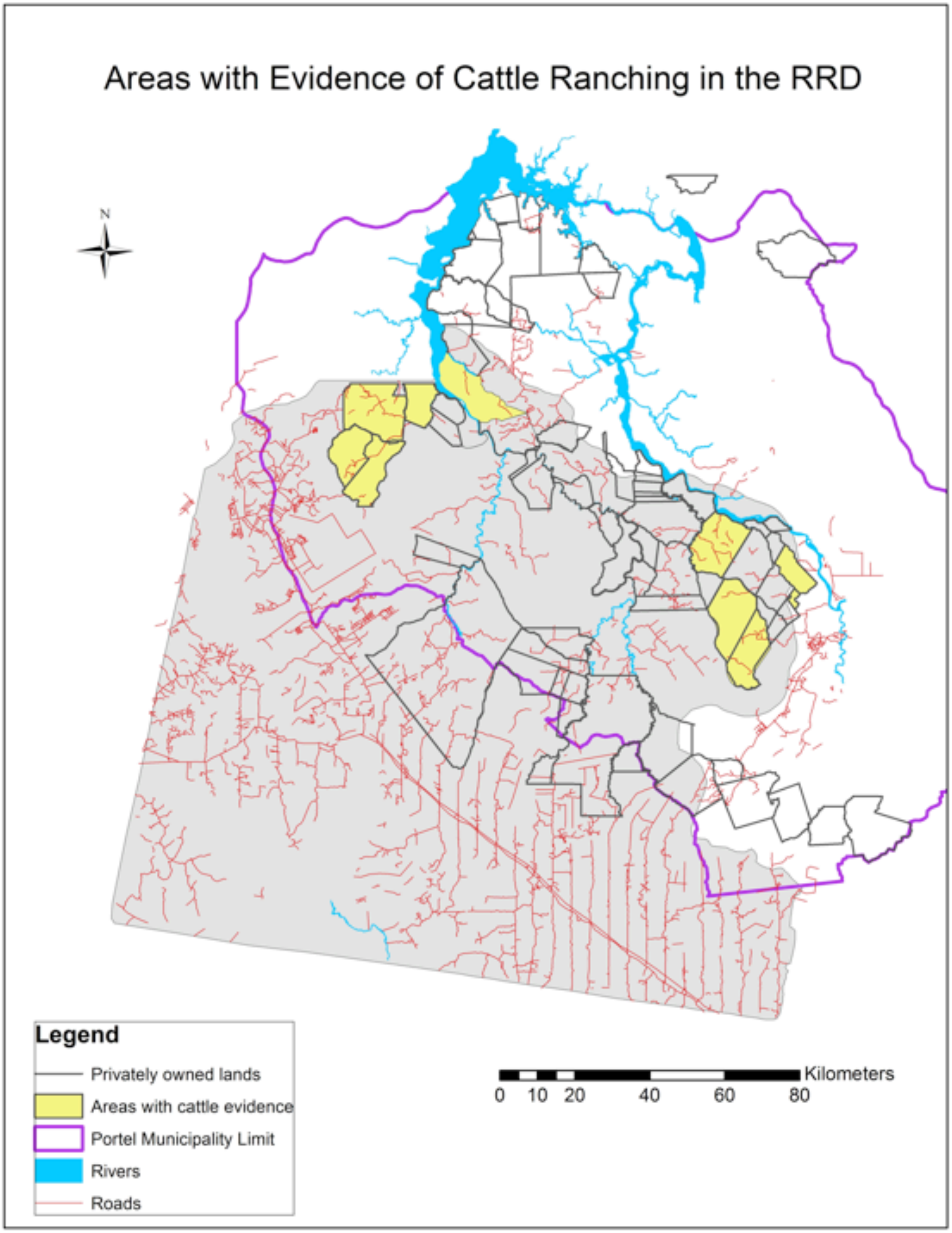
Loggers: Porto do Fortuna - Follow up to July 15, 2009 report on the Adami claim. We have gone back and there is still no activity on the land but the property keeper was present and he stated they were working to regularize the land to set up cattle farm and logging. We will follow up in Belem to see the progress. About 5,000 hectares here.

Loggers: Paraiso, Santa Maria III - We went to this property and he stated he Cleide Ferreira and was a relative of Manoel Ribeiro. We asked who is telling them they can settle in this location and he stated that no one is there to tell him to leave. We asked what his original plan was, and he stated to set up a cattle farm and extract wood. We stated that it is private property, however he can stay and live there, but is not allowed to cut. He stated he would only stay long enough to set up a homesite. We informed IBAMA that a new person was in the forest. There was about 1,700 hectares involved in this area.

Although degradation activities such as selective logging continuously try (and in some cases succeed) to gain entrance into the Project Area (because of the relative ease of getting in and out the area through use of the network of unofficial roads), it is not possible to observe deforestation and cattle ranching activities in the Project Area because of the continuous monitoring and enforcement activities held since 2005 and through the first four years of the Project lifetime. Monitoring reports from the field crews clearly indicate that many initiatives to implement pastures were stopped since 2005. Areas where cattle ranching initiatives were stopped are showed in Map 10.

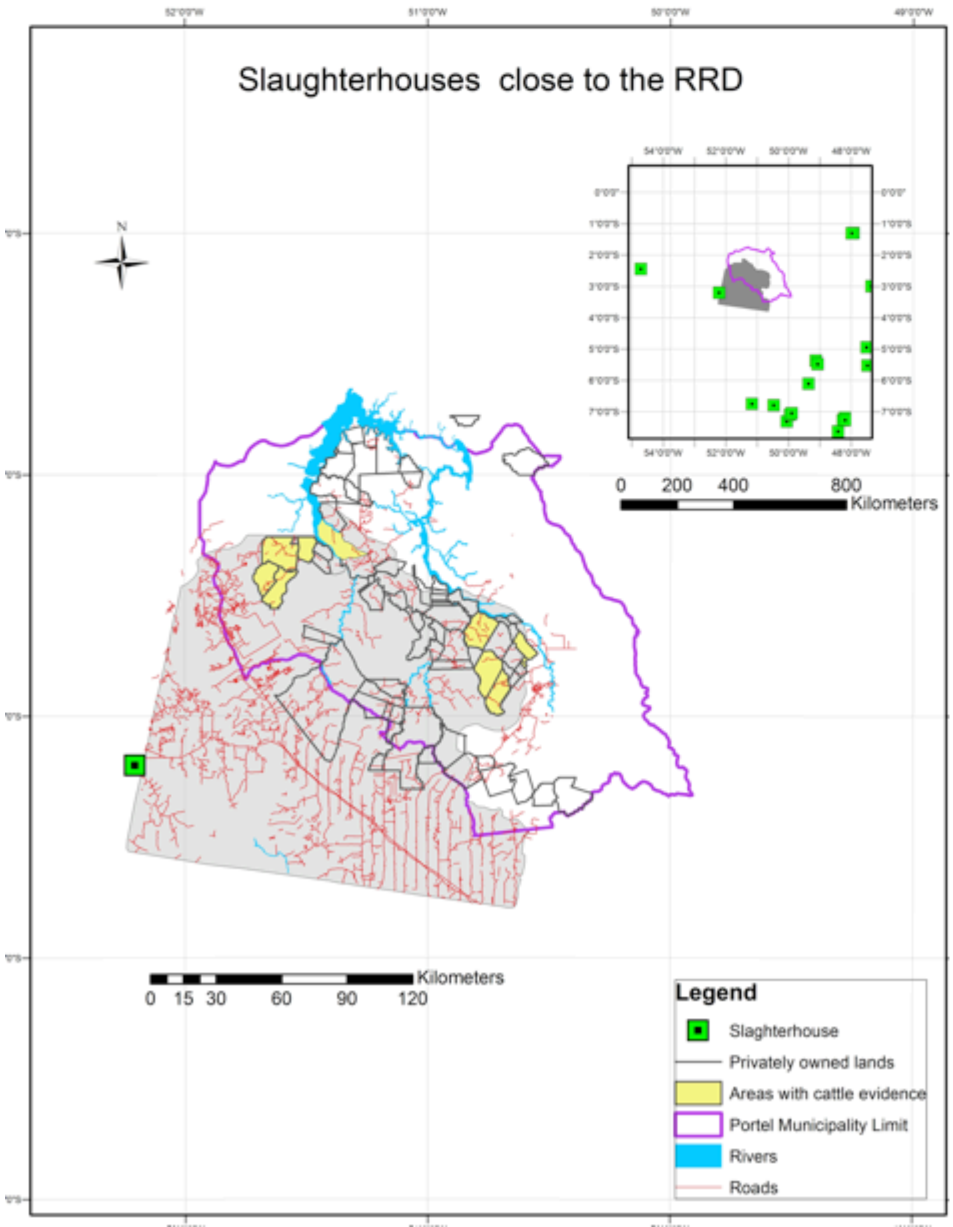
There is a clear correlation between the reach of the network of unofficial roads and the presence of initiatives to implement cattle ranching, even when such areas are located up to 100Km from primary roads. For this reason, the RRD constitutes a relevant geographical area that presents a credible proxy for possible future deforestation patterns in the Project Area, as required by the VM0015 methodology.

Map 10 Areas were cattle ranching initiatives were identified and stopped since 2005 to 2011



- Although being close to primary roads facilitated deforestation during the historical period, resource depletion and high mobility allowed loggers to encroach in new frontiers (May, Millikan et al. 2011). Such is made evident by the aggressive growth in the network of unofficial roads (Uhl, Barreto et al. 1997; Brandão Júnior, Souza Júnior et al. 2007) that expanded almost up to the junction of the Anapu and Pacaja rivers by merging with pioneer roads (map 16 of the PD). It is also contemplated by the literature that pioneer roads can expand for hundreds of kilometers (Uhl, Barreto et al. 1997).
- A study held in Brazil in 2007 shows that deforestation in the Legal Amazon is explained largely by the presence of unofficial roads. Such study indicates that 71% of all mapped roads are classified as unofficial and that 65% of all deforestation in 2003 and that 69% of the increment in 2004-2005 deforestation was located in the vicinity of unofficial roads (Brandão Júnior, Souza Júnior et al. 2007). These results are supported by literature that indicates that logged areas (which are defined by the presence of tertiary roads) have a high likelihood of being deforested (Asner, Broadbent et al. 2006).
- Monitoring reports back from 2005 indicate that that cattle ranching initiatives wanted to develop up to 100 Km from primary roads, which nowadays is very close to the edge of the road network of the BR-230 and PA-167 within the RRD. The fact that agents wanted to implement cattle up to 100Km indicates that there is access to markets. The closest slaughterhouse in the area is in Altamira, which can be reached by the BR-230 (Map 11). So, it can be implied that areas as far as 100Km upward the BR-230 had access to primary roads through the network of tertiary and secondary roads back in 2008 and before.

Map 11: Slaughterhouses close to the RRD



- More than half the monitoring reports that explicitly mentioned cattle ranching initiatives indicate that cattle is either preceded by logging or happens in parallel. This fact proves that the forests encroached by tertiary roads follow the deforestation dynamics presented in literature and verified in the RRD during the historical reference period. In this matter, there are many monitoring reports indicating plans to make large-scale invasions to conduct illegal logging (refer to the evidence "Backdating 2008_Both Projects>English Monitoring Reports>Security Reports Synopsis 4 through 7") and, although such reports do not explicitly indicate that the agent would have implemented pastures, all aforementioned evidence suggest that the deforestation dynamics presented in the literature and verified in the RRD will take place in the Project Area under the baseline scenario.

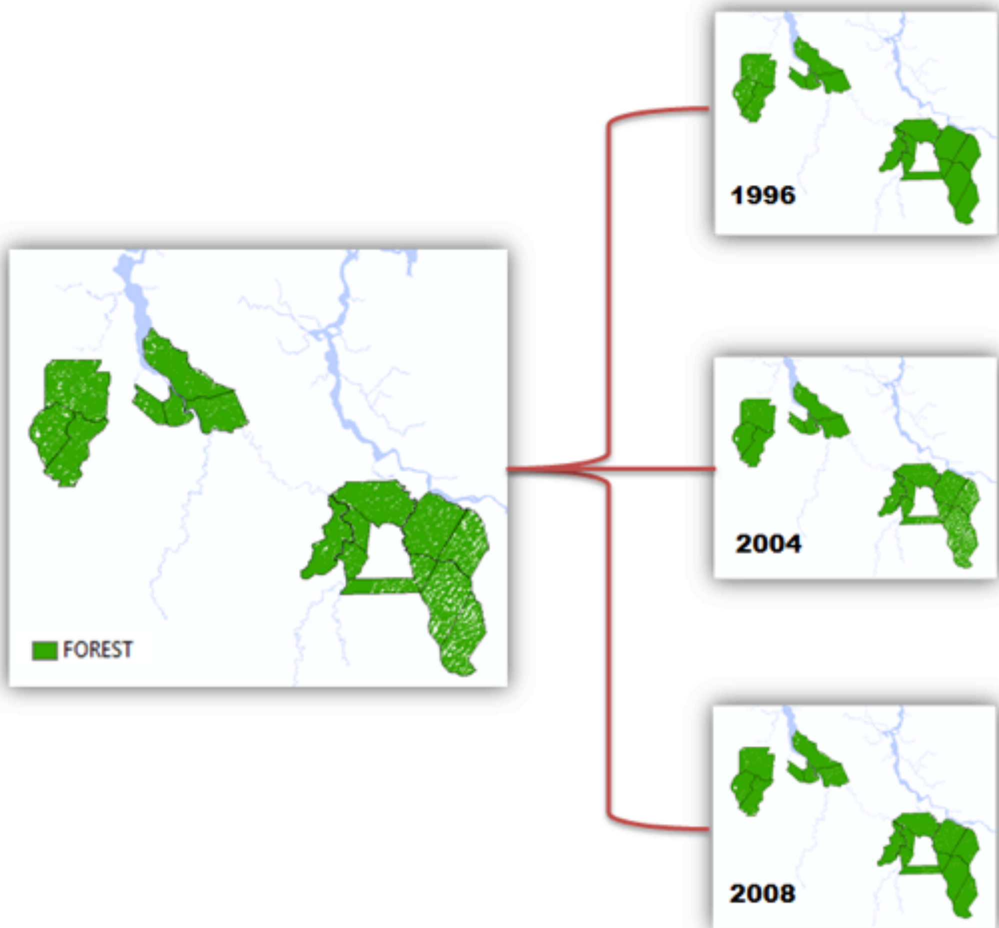
In conclusion, the selected RRD is geographic area that meets the size, landscape and socio-economic requirements of the VM0015 methodology for determining the baseline of the project area. It has been demonstrated that agents, drivers and overall deforestation patterns observed in it during the 10-15 year period preceding the start date of the proposed AUD project activity in the RRD represent a credible proxy for possible future deforestation patterns in the project area as required by the VM0015 methodology.

2.3.1.2 Project Area

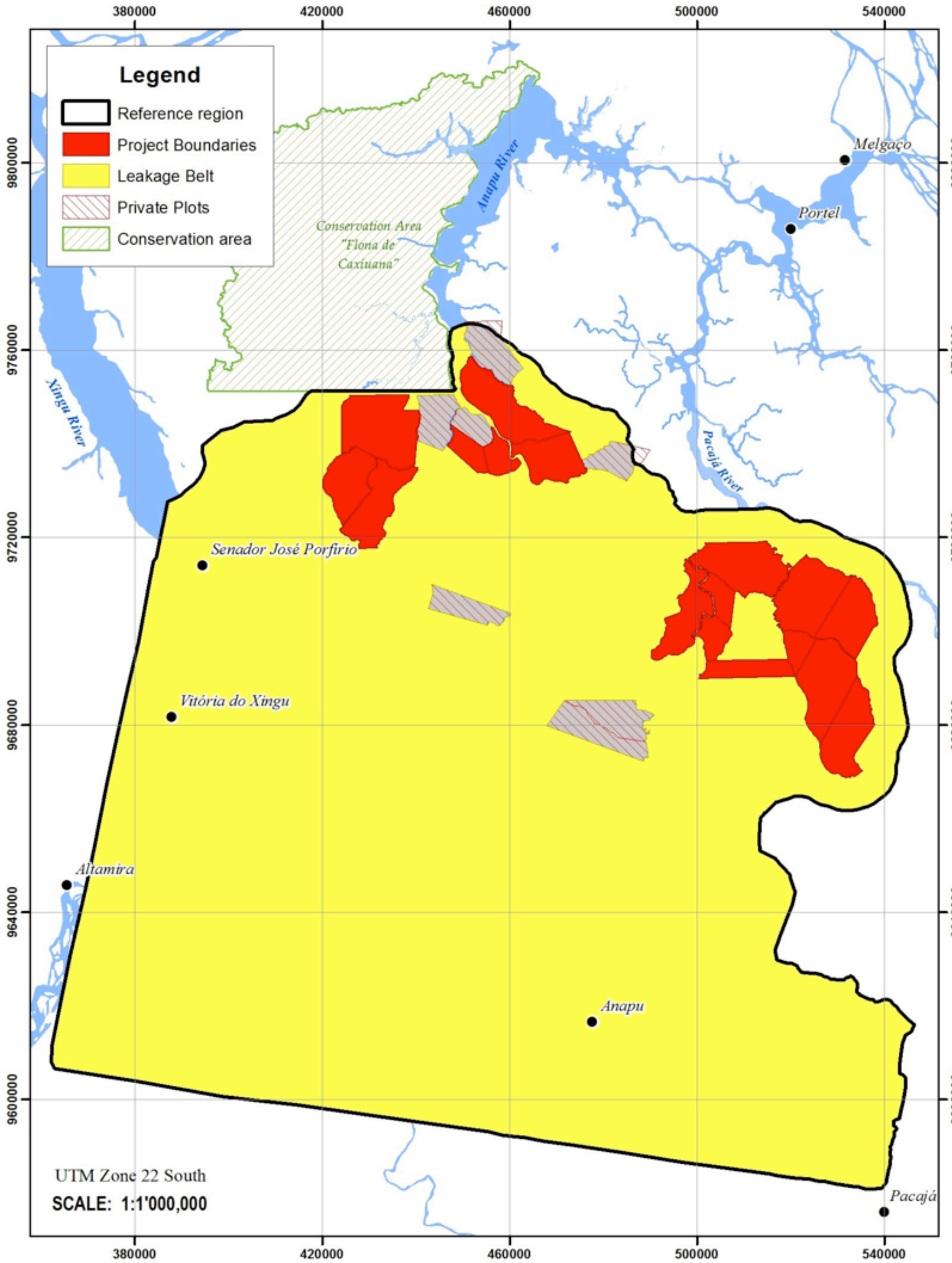
According to the UNFCCC, Brazil's definition for forest is 1 hectare with 30% crown cover and 5 meters tree height. http://cdm.unfccc.int/DNA/index.html. The Project Area includes only forestland from more than 10 years before the Project Start date (2008), obtained from satellite imagery multitemporal analysis.

Classified Landsat 5 TM images were used for three points in time: 1996, 2004 and 2008, with classes of Forest and Non-Forest. Areas of only forest in the three classified images within the project boundaries are considered as *Project Area*, this is, forest areas at a pixel level that have not experimented change over time (Map 12). For this reason, all areas of regenerating forest or non-forest areas in at least one classified image within the project boundaries have been excluded from the project area. Areas covered by clouds or shadows showing not verifiable information were also excluded from analysis. This analysis was performed using a raster data structure in a GIS environment (Figure 4)

Figure 4: Only forest cover for 1996,2004 and 2008



Map 12: Project physical boundaries



2.3.1.3 Leakage Belt (LK):

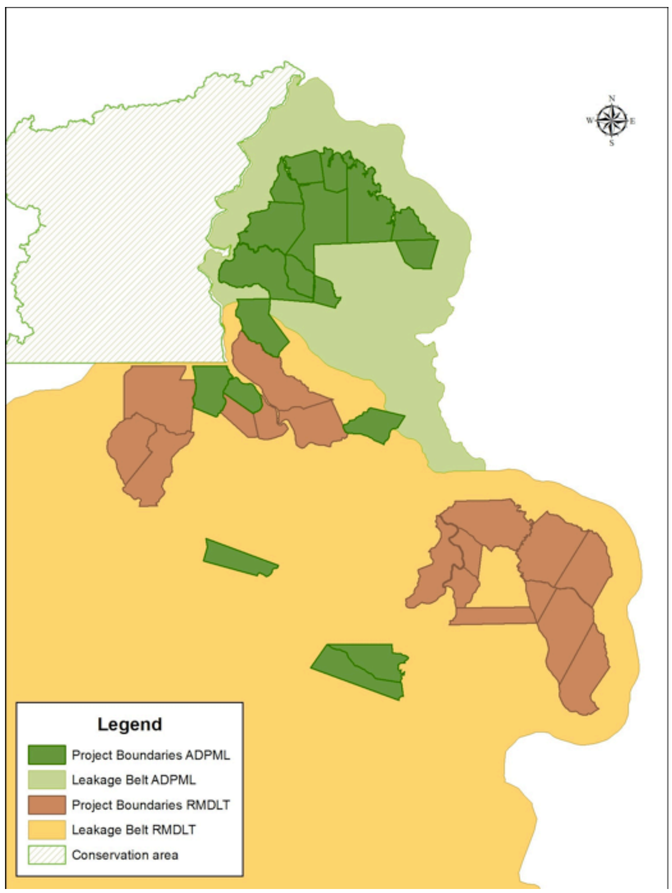
Given the high mobility of the agents and to be conservative, the whole RRD has been considered as Leakage Belt.

Because of the presence of a neighbor REDD Project (ADPML Portel-Para REDD Project) parties from both projects agreed on signing a Leakage Agreement that will enter in force once both projects are validated. Under such agreement the RMDLT project will absorb the common leakage belt areas.

In the scenario where the neighbor project does not get validated, the Leakage Agreement will not be valid.

Overlapping LKs are presented in Figure 5. The final LK to avoid overlapping is presented in Map 13.

Figure 5: Overlapping of LK between ADPML and RDMLT REDD Projects



Map 13: Final LK

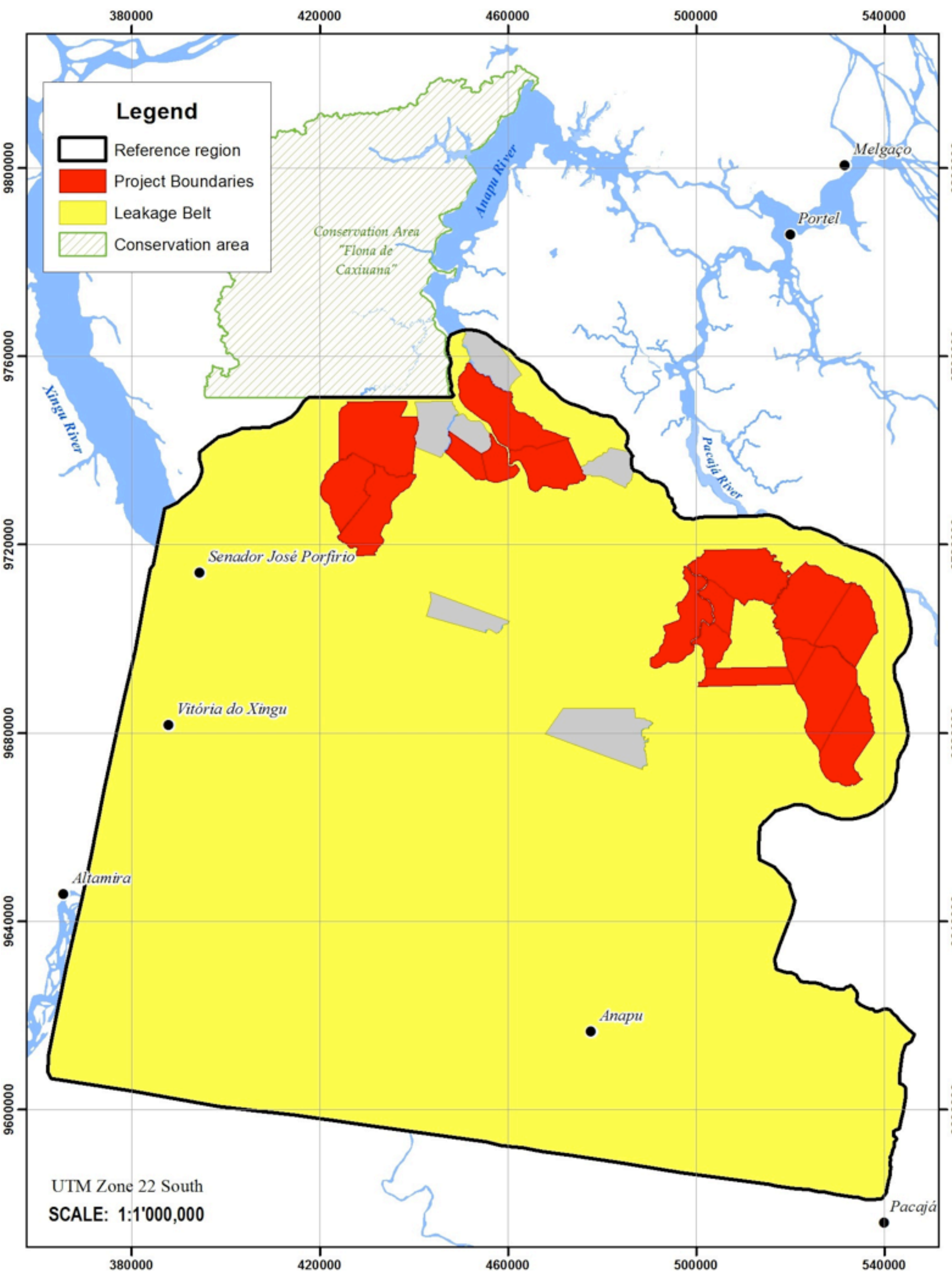


Table 5 summarizes the spatial definitions utilized for the Project:

Table 5: Physical boundaries of the project

Reference Region for Deforestation (RRD)	**Area**: 2,397,109.2 Ha **Historical deforestation rate**: 1.7% **Vegetation**: Ombrophilous Forest **Elevation range**: 0-100m **Average slope**: 6 **Annual average precipitation**: 2181mm **Agents and drivers of deforestation**: main agents of deforestation are cattle ranchers (98%) followed by small-scale farmers (Riberenhos) (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**: 194,402.8 Ha **Agents and drivers of deforestation**: small-scale farmers (Riberenhos). **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[27]. **Area**: 177,899.5 Ha **Vegetation**: Ombrophilous Forest **Elevation range**: 0-100m **Average slope**: 5.5 **Annual average precipitation**: 2345mm **Land Tenure**: private lands **Law enforcement on land tenure rights**: weak.

[27] http://cdm.unfccc.int/DNA/index.html

Leakage Belt (LK)	Cumulative of areas that presents the highest risk of deforestation due to displacement of deforestation agents by the Project Activities. **Area**: 2,149,765 Ha Agents and drivers of deforestation: illegal loggers, squatters, and small-scale farmers (Riberenhos).
Leakage Management Areas (LMA)	Non-forest areas within the PB. It is currently in these areas that Riberinhos live and where the Project Activities will take place. **Area**: 3,415.8 Ha

2.3.2 Location of each Gleba within the Project Boundary.

Table 6: Centroids for each Gleba

ID	Gleba	Group	X	Y
1	Alvorado I	1	432566	9743366
2	Gurupá	1	425679	9732048
3	Miritizal	1	431641	9727033
4	Engascado	2	458729	9748041
5	Santo Antonio 3	2	451282	9738524
6	Santo Antonio 1	2	457915	9737318
7	Gleba Pontinha	2	468883	9736858
8	Alvorado II	3	497623	9703171
9	Santa Cruz	3	503554	9698880
10	Diniz	3	505027	9707154
11	Jutahycica	3	510100	9713896
12	Ajará	3	523797	9707565
13	Sao Pedro 1	3	532921	9702824
14	Boca do Aru	3	521478	9696470
15	Porto de fortuna	3	527506	9688819
16	Aru	3	532262	9678288
17	Terra Alta	3	510801	9691908

Spatial Reference: WGS84, UTM Zone 22 South

Map 14: Centroid for each Gleba

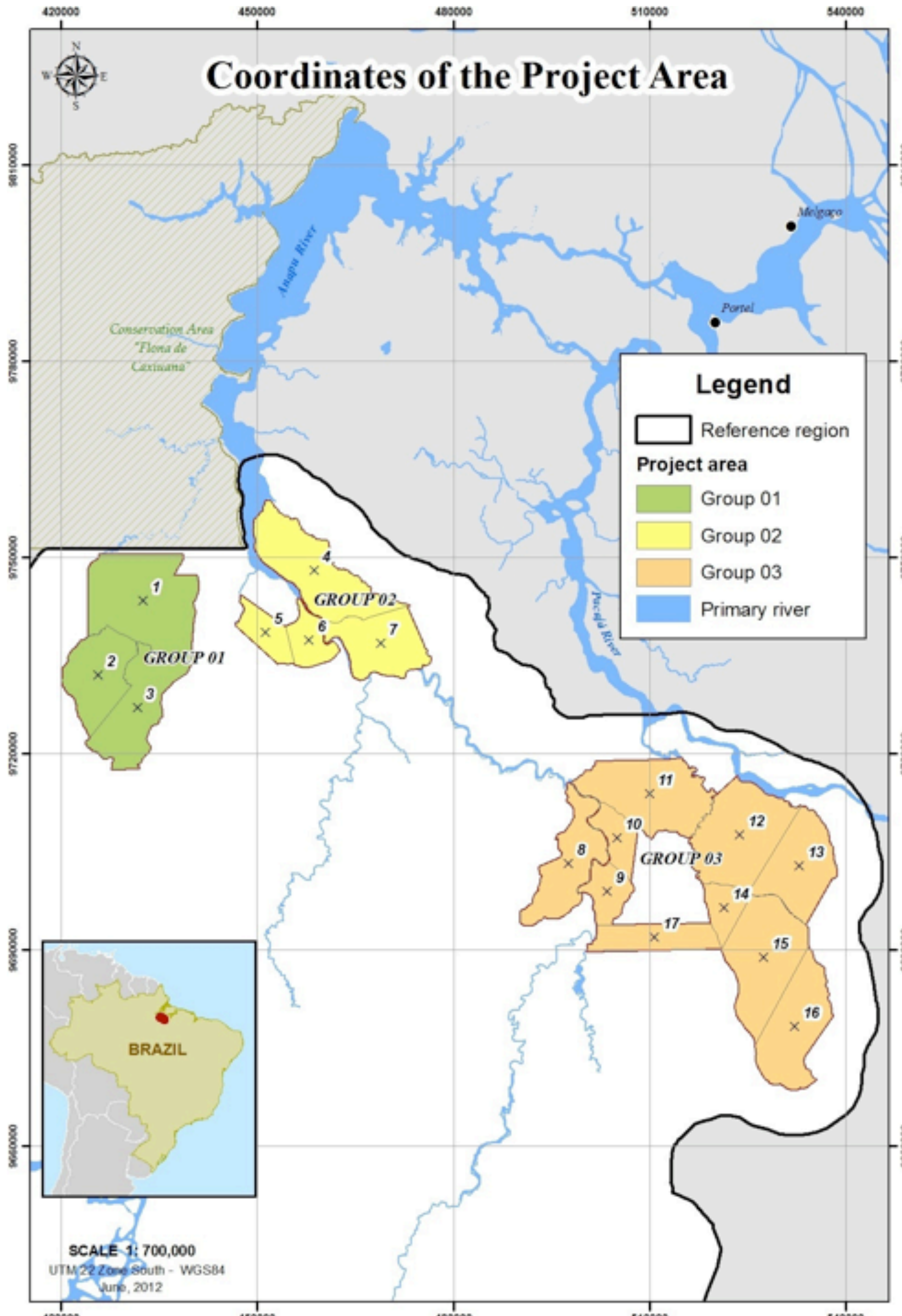
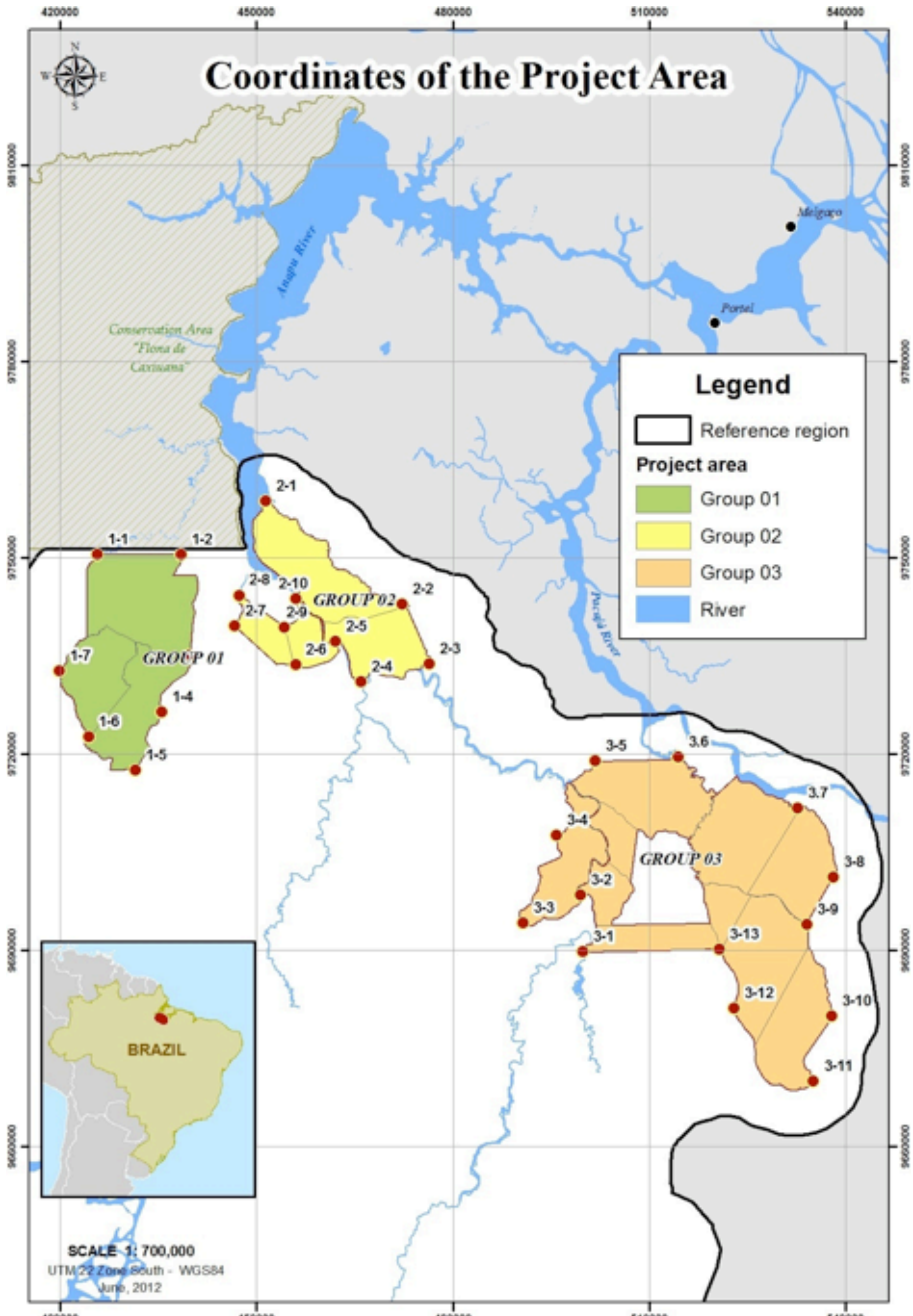


Table 7: External coordinates for each Gleba

Group	Point ID	X	Y
1	1-1	425813	9750488
1	1-2	438560	9750513
1	1-3	439729	9735060
1	1-4	435642	9726424
1	1-5	431575	9717524
1	1-6	424408	9722627
1	1-7	419966	9732748
2	2-1	451514	9758663
2	2-2	472337	9742921
2	2-3	476517	9733820
2	2-4	466104	9731037
2	2-5	462179	9737202
2	2-6	456052	9733640
2	2-7	446735	9739589
2	2-8	447418	9744266
2	2-9	454351	9739389
2	2-10	456156	9743760
3	3-1	500004	9689737
3	3-2	499656	9698391
3	3-3	490882	9694149
3	3-4	495999	9707610
3	3-5	501843	9718985
3	3.6	514565	9719510
3	3.7	532760	9711740
3	3-8	538240	9701131
3	3-9	534212	9693916
3	3-10	537999	9679970
3	3-11	535198	9670001
3	3-12	523107	9681112
3	3-13	520798	9690148

Spatial Reference: WGS84, UTM Zone 22 South

Map 15: External coordinates for each Gleba



2.3.3 Temporal Boundaries

Starting date and end date of the historical reference period: July 26th 1996 to July 11th 2008.

Starting date of the project-crediting period of the AUD project activity: January 1st 2009 until December 31st 2048.

Starting date and end date of the first fixed baseline period: starts on January 1st 2009 and ends on December 31st 2018.

2.3.4 Carbon Pools

Table 8 presents the carbon pools used to account for carbon stocks for the Project.

Table 8: Carbon pools for the Project (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 2.0) 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.

2.3.5 Sources of emissions of GHG

Carbon sources for the Project are presented in Table 9:

Table 9: Carbon sources for the Project (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**

2.4 Baseline Scenario

2.4.1 Description

The baseline scenario as identified in the additionality assessment is the progressive loss of forest cover by the advancement of the consolidated frontier and the development and consolidation of the pioneer frontier.

The main driver for both deforestation fronts is land speculation, which is generated from economic incentives, perverse regulations and an erroneous definition of what a productive forest is. 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.

Given the widespread unclear land tenure and weak law enforcement, squatters move freely in the Project Area. Squatters take advantage of the constantly evolving roads network developed by illegal loggers (pioneer roads) and invade previously inaccessible forested lands.

As the pioneer roads network keep expanding and connecting to the network of the Tansamazonica highway, deforestation agents in search of large extensions of available forested areas move towards the Project Area.

Under this process, the same agents, pressures and historical average deforestation rates that affect the consolidated frontier will replicate in the Project Area.

As mentioned before, there are two simultaneous and related deforestation fronts that conform the baseline scenario, the Pioneer Frontier and the Consolidated Frontier.

Pioneer Frontier

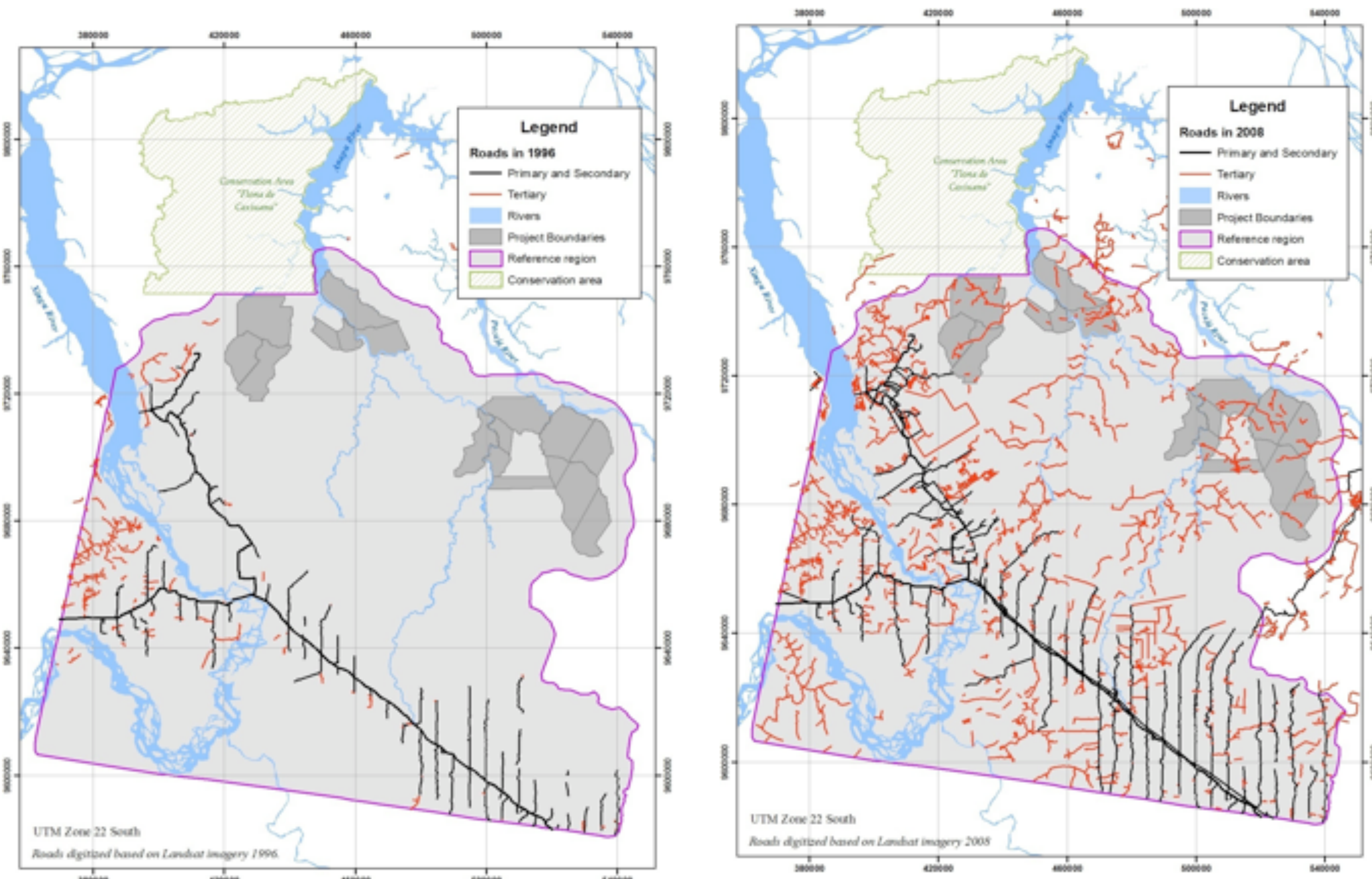
The pioneer frontier is the area of the Project Boundaries and its immediate vicinity. In this northern part of the RRD, landless people or riberinhos colonize river shores and develop small villages; illegal loggers open penetration roads to access valuable timber resources; squatters (invaders) clear-cut patches of forest through slash and burn to prove land ownership and attempt a future land re-sale.

Riberinhos –as showed in the Social Assessment – have as main economic activity cassava agriculture to produce and sale farinha. Riberinhos slash young trees in abandoned fallows[28], take the cut timber and then apply fire to clear the land and have it ready to plant cassava. This clearing process has a rotation of 3 to 4 years and often the plots are used twice without a resting period in between. As identified in the PRA, riberinhos will not set cassava fields any further than 3 Km away from the river shores. At the same time, small-scale timber extraction is limited to the gather of construction materials because as identified in the PRA, riberinhos perceive timber extraction as a difficult and dangerous activity that doesn't generate substantial revenues. The Social Assessment also shows that a household extracts between one or two trees per year.

Illegal loggers open pioneer roads that form an intricate network that connect with the network of roads that lead to the Transamazonica highway. Once connected to the Transamazonica network, pioneer roads function as tertiary roads in the network of the Transamazonica highway. These new tertiary roads allow squatters to enter the area and start an aggressive deforestation process (Map 16).

[28] Known as *Capoerias* in the area.

Map 16: Primary and secondary roads (black) and tertiary and pioneer (red) at the start (left) and end (right) of the historical reference period.



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.

Consolidated Frontier

In the case of large-scale cattle ranchers, they operate in what is known as the "consolidated frontier" which is the area closer to the Transamazonica federal highway (BR-230) and the Senador Jose Porfirio state highway (PA-167). In this area, deforestation agents have developed over the years a complex network of secondary and tertiary roads from where deforestation expands. This road-expansion process was already in place at the start of the historical deforestation period and has increased over the years.

As with the Pioneer Frontier, this area started to be colonized by logging companies and other opportunistic agents that set the infrastructure for final land users (cattle ranchers) to buy the lands with degraded forest, apply slash and burn and develop pastures. This process was the norm at the beginning as cattle ranchers establishing in the area were colonizing the area taking advantage of the economic incentives generated by the government, and at the time they would not have enough capital to cover the costs of timber extraction and transportation.

Nowadays, the situation has changed. Thanks to subsidies, 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).

Conclusion

Given the fact that pioneer roads are becoming tertiary roads by connecting with the network of the Transamazonica 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.

2.4.2 Data and Methods Uses

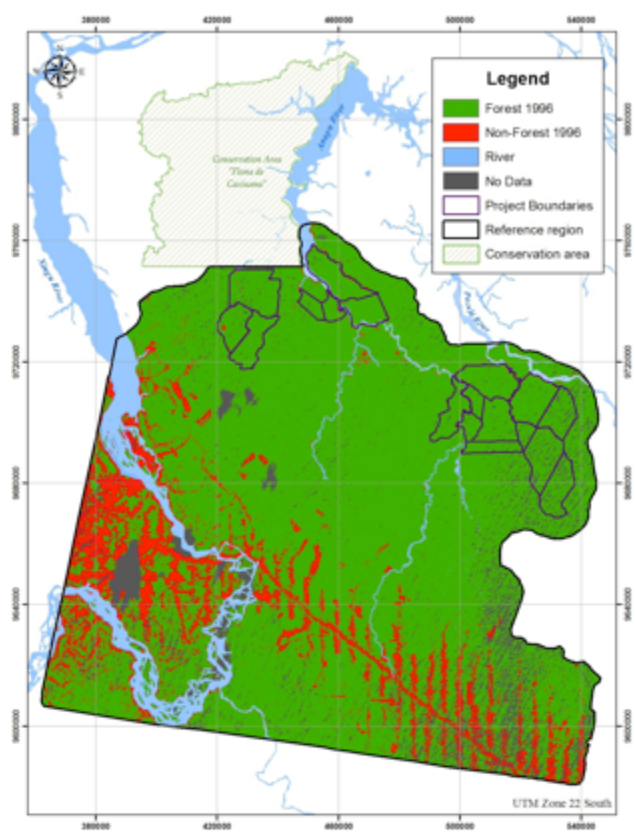
Given the fact that there aren't deforestation baselines, reference regions and deforestation rates at country level or in Para (Santos and Brito 2012) we developed our own historical analysis. For this, we selected Landsat TM images for three time points in time, from 1996 to 2008, covering the whole reference region. These images were classified into three categories: Forest, Non-forest, and water, using a supervised classification technique in the software Idrisi Selva. Then, we changed the pixel size of classified images to 90 meters, using a "resampling" method. Finally, we calculated the historical deforestation rate using Idrisi Selva, whose outcome must be the number of hectares deforested per each year of the historical reference period.

Table 10: Data used for historical LU/C change analysis (Refer to Table 5 – VM0015 methodology)

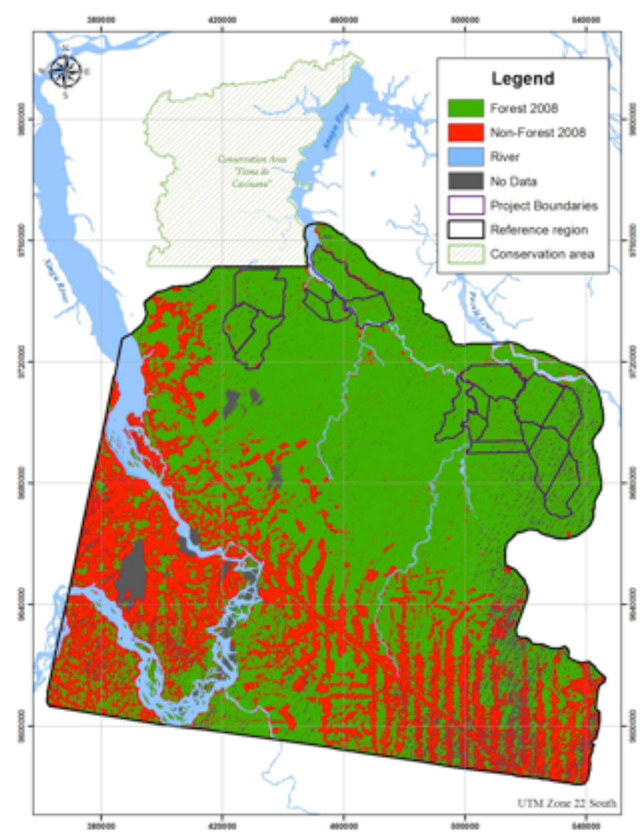
Item	Vector (Satellite or airplane)	Sensor	Source	Resolution		Coverage	Acquisition date	Scene or point identifier		Purpose of use
				Spatial	Spectral	km2	(DD/MM/YY)	Path/Latitude	Row/Longitude	
1	Landsat 5	Thematic mapper - TM	INPE web page	30 meters	7 bands	32,375 km2 (185 x 175 km)	7/26/96	225	62	Classification
2	Landsat 5	Thematic mapper - TM	INPE web page	30 meters	7 bands	32,375 km2 (185 x 175 km)	8/1/04	225	62	Classification
3	Landsat 5	Thematic mapper - TM	INPE web page	30 meters	7 bands	32,375 km2 (185 x 175 km)	7/11/08	225	62	Classification
4	Alos	Alos Palsar	Acquired	10 meters	1 band	4,060 km2 (70 x 58 km)	3/14/11	60	7140	Accuracy Assessment
5	Alos	Alos Palsar	Acquired	10 meters	1 band	4,060 km2 (70 x 58 km)	3/14/11	60	7130	Accuracy Assessment
6	Alos	Alos Palsar	Acquired	10 meters	1 band	4,060 km2 (70 x 58 km)	2/25/11	59	7140	Accuracy Assessment
7	Alos	Alos Palsar	Acquired	10 meters	1 band	4,060 km2 (70 x 58 km)	2/25/11	59	7130	Accuracy Assessment
8	Alos	Alos Palsar	Acquired	10 meters	1 band	4,060 km2 (70 x 58 km)	2/25/11	59	7120	Accuracy Assessment
9	Alos	Alos Palsar	Acquired	10 meters	1 band	4,060 km2 (70 x 58 km)	2/8/11	58	7130	Accuracy Assessment
10	Alos	Alos Palsar	Acquired	10 meters	1 band	4,060 km2 (70 x 58 km)	2/8/11	58	7120	Accuracy Assessment
11	SPOT 5	SPOT 5	Google Earth	2.5 - 5 meters	4 bands	Coverage in Google Earth	2010-2011	2°52' S	51°29' W	Accuracy Assessment
12	Geoeye	Geoeye	Google Earth	2 meters	4 bands	Coverage in Google Earth	2010-2011	3°04' S	51°50' W	Accuracy Assessment

Classified images were used to generate a forest and non-forest map of the start and end date of the historical reference period dates. Results are showed in Map 17 and 18. Base on these results, a Forest Cover Benchmark Map was generated to identify the Project Area, as showed in Map 19. Further details and thorough explanations can be in Annex 3.

Map 17: Forest cover at the start of the historical reference period



Map 18: Forest cover at the end of the historical reference period



Map 19: Forest cover benchmark in the Project Area (Project Area in dark green)

2.4.3 Land Uses and Land Cover Classes (LULC classes)

2.4.3.1 Land-Cover (LC) Classes

Land-cover in the RRD is defined by the presence or absence of forest cover according to Brazil's definition of forest[29]. It was not accurate to sub-divide further forest covers using Landsat TM images at the time so, in order to be conservative, carbon content per 1 ha of forest in the RRD, Project Area and Leakage Belt was calculated using a weighted average based on the results from our Forest Carbon Inventory as shown in Annex 5: Carbon Inventory Results and presented in Table 11.

The land-cover classes identified in the RRD are:

1. Ombrophilous Forest: This land-cover class comprises a single stratus (Ombrophilous Forests). Only for effects of calculating the most conservative carbon stock per hectare, this land-cover can be divided in two sub-classes[30] based on carbon density:

- Dense Forests (DF): forests without disturbances.

- Degraded Forest (FsD): forests with evidence of degradation caused by logging exploration, less dense than Dense Forests.

Table 11: Average carbon content in 1 ha of forest in the RRD

	Dense Forest							Degraded Forest						
	Litter	DHB< 3cm	3cm<DBH<9.9 cm	Trees ≥10cm (Overman 1994)	Total Above-ground biomass (tdm/ha)	Total Above-ground carbon stock (tCO2e/ha)	Total Below-ground carbon stock (tCO2e/ha)	Litter	DHB< 3cm	3cm<DBH<9.9cm	Trees ≥10cm (Overman 1994)	Total Above-ground biomass (tdm/ha)	Total Above-ground carbon stock (tCO2e/ha)	Total Below-ground carbon stock (tCO2e/ha)
Original values	4.73	1.14	7.46	247.55	260.89	478.30	105.23	4.89	0.90	7.22	243.44	256.45	470.16	103.43
Corrected values with lower boundary of 90% CI	4.27	0.97	6.80	222.91	234.95	430.74	94.76	4.14	0.67	5.84	192.98	203.64	373.34	82.13

2. Grassland: deforested areas where pastures have been developed. This land-cover is defined non-forest areas outside a buffer of 3Km from the river shores. Nevertheless, according to the Project's patrolling reports[31], grassland can be found in this buffer. Total average carbon stock in this land-cover was obtained from IPCC's Good Practice Guidance for Land Use – Table 3.3.8 (IPCC 2003)

3. Cropland: deforested areas currently used for Cassava crops. This land-cover is defined as non-forest areas extending up to 3Km form the river shores wherever exist associated villages of riberinhos (based on the results of the Social Assessment).

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[29] According to the UNFCCC, Brazil's definition for forest is 1 hectare with 30% crown cover and 5 meters tree height. http://cdm.unfccc.int/DNA/index.html

[30] The Carbon Inventory identifies 3 land-covers in the RRD. However, one of these (Regenerated Forest) includes former grasslands/croplands that are under regeneration. Because the VM0015 methodology requires to consider as Project Area only forest that has remain forest for at least the past 10 years and because of the short-rotational periods of cassava agriculture, this land-cover category was not included in the calculations for the weighted-average carbon stock of the initial forest cover.

[31] Patrolling reports were submitted to the validation team as part of the proofs of evidence for the project activities started in 2009.

2.4.3.2 Land-Use (LU) Classes:

Identification of land-use classes was based on the information provided by the ZEE developed by SEMA (2010). With this information as a base, Landsat TM images were classified and land-use classes were determined (Table 12). From our analysis we identified the following LU classes:

1. Forest: natural forest includes undisturbed forest and forest under different stages of natural regeneration. This is the only land-use in the Project Area.

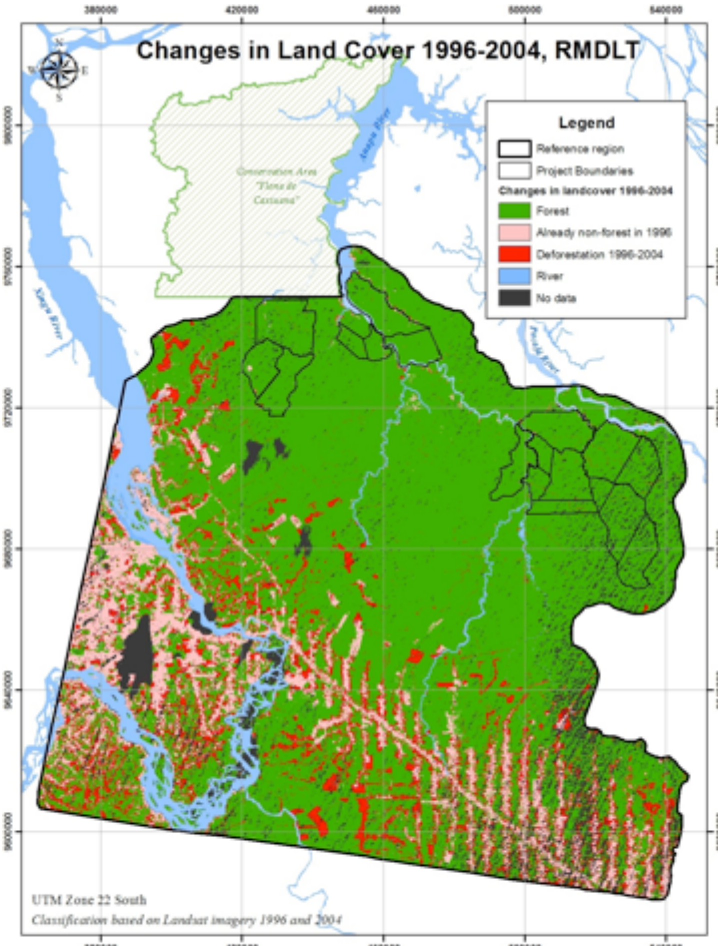
2. Cattle ranching: this land use is the most common in the RRD. It is a final land use after squatters or /and illegal loggers intervene natural forests land-use. Cattle ranching is expected to be the main agent promoting deforestation throughout the RRD and encroaching into the Project Area, based on the results from our historical deforestation analysis (98% of the historical deforestation is attributed to this class).

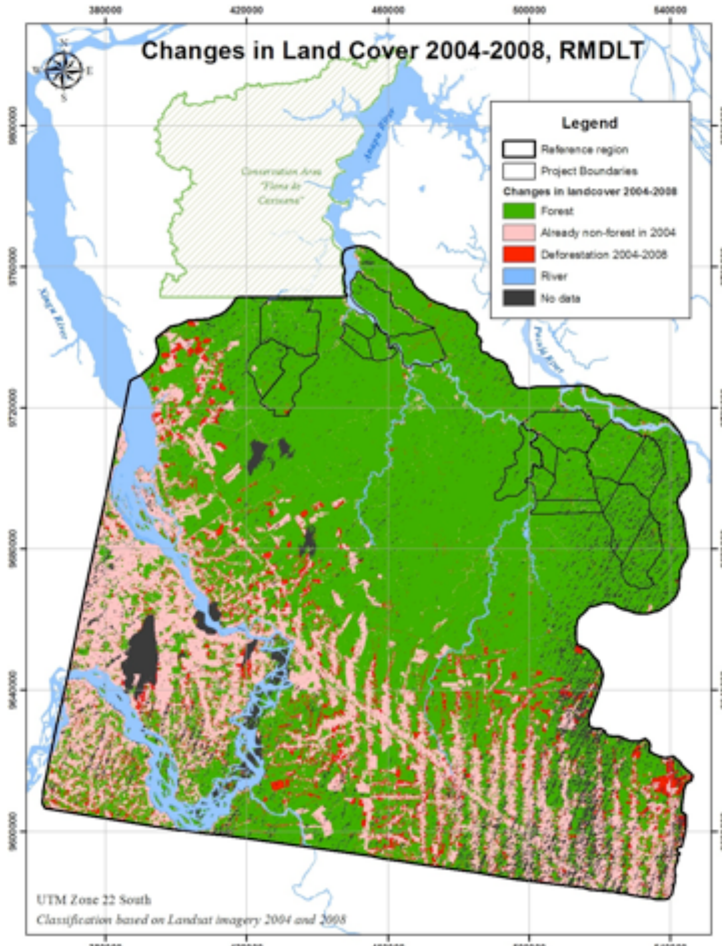
3. Small-scale agriculture: this land-use occurs on the shores of navigable rivers in the RRD. This is the second most common land-use in the Project Boundary based on the results from our historical deforestation analysis (2% of the historical deforestation is attributed to this class). Based on Landsat imagery for 2008/2007 it is expected that cattle ranching will replace this class because of ranching's notably higher rentability and ease to manage.

Table 12: Land use and land cover classes existing at the Project start date within the reference region (Refer to Table 6 of the vm0015)

Class Identifier		Broad class	Trend in Carbon stock[1]	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

Map 20: LULC change at the last sub-period 2004 (left) to 2008 (right)





2.4.4 Land Uses and Land Cover Categories (LULC-categories)

Table 13: Potential land-use and land-cover matrix (Refer to Table 7.a. of the vm015)

	ID_{cl}	Initial LU/LC class 001	002	003	004	007	008	009
Final LU/LC class	001	I001/F001						
	002	I001/F002	I002/F002					
	003	I001/F003		I003/F003				
	004				I004/F004			
	005				I004/F005			
	006				I004/F006			
	007					I007/F007		
	008					I007/F008	I008/F008	
	009					I007/F009		I009/F009

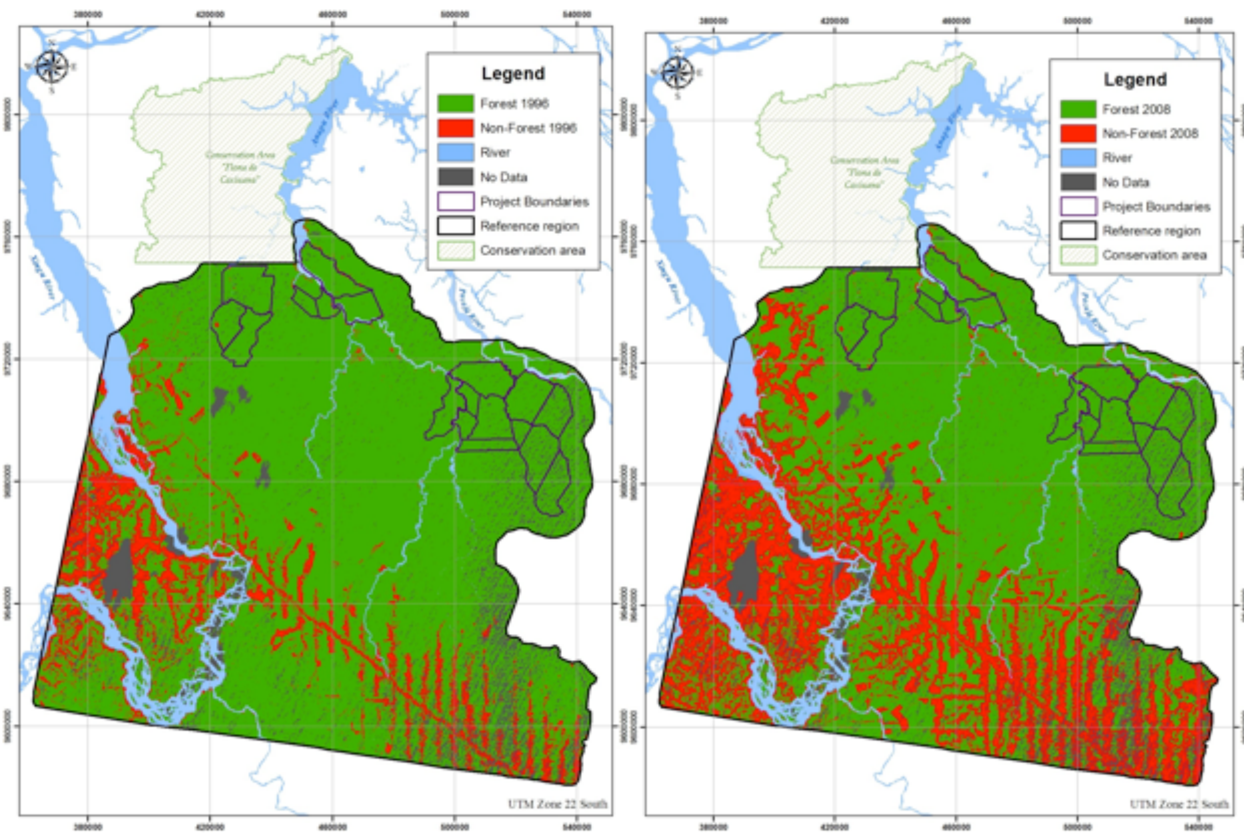
Table 14: List of land-use and land-cover categories (Refer to Table 7.b. of the vm0015)

Category identifier		Initial class		Broad class	Trend in Carbon stock[1]	Presence in[2]	Activity in the baseline case[3]			Final class		Broad class	Trend in Carbon stock[1]	Presence in[2]	Activity in the project case		
ID_{ct}	Name	ID_{icl}	Name				LG	FW	CP	ID_{fcl}	Name				LG	FW	CP
I001/F001	FRRD-FRRD	001	Ombrofile forest in the Reference Region	Forest Land	decreasing	RRD	yes	no	no	001	Ombrofile Forest	Forest Land	decreasing	RR	no	no	no
I001/F002	FRRD-GR	001	Ombrofile forest in the Reference Region	Forest Land	decreasing	RRD	yes	no	no	002	Grassland	Grassland	constant	RR	no	no	no
I001/F003	FRRD-CR	001	Ombrofile forest in the Reference Region	Forest Land	decreasing	RRD	yes	no	no	003	Cropland	Crop Land	constant	RR	no	no	no
I002/F002	GR-GR	002	Grassland in the Reference Region	Grassland	constant	RRD	no	no	no	002	Grassland	Grassland	constant	RR	no	no	no
I003/F003	CR-CR	003	Cropland in the Reference Region	Crop Land	constant	RRD	no	no	no	003	Cropland	Crop Land	constant	RR	no	no	no
I004/F004	FPA-FPA	004	Ombrofile forest in the Project Area	Forest Land	decreasing	PA	yes	no	no	004	Ombrofile Forest	Forest Land	decreasing	PA	no	no	no
I004/F005	FPA-GR	004	Ombrofile forest in the Project Area	Forest Land	decreasing	PA	yes	no	no	005	Grassland	Grassland	constant	PA	no	no	no
I004/F006	FPA-CR	004	Ombrofile forest in the Project Area	Forest Land	decreasing	PA	yes	no	no	006	Cropland	Crop Land	constant	PA	no	no	no
I007/F007	FLK-FLK	007	Ombrofile forest in the Leakage Belt	Forest Land	decreasing	LK	yes	no	no	007	Ombrofile Forest	Forest Land	constant	LK	no	no	no
I007/F008	FLK-GR	007	Ombrofile forest in the Leakage Belt	Forest Land	decreasing	LK	yes	no	no	008	Grassland	Grassland	constant	LK	no	no	no
I007/F009	FLK-CR	007	Ombrofile forest in the Leakage Belt	Forest Land	decreasing	LK	yes	no	no	009	Cropland	Crop Land	decreasing	LK	no	no	no
I008/F008	GR-GR	008	Grassland in the Leakage Belt	Grassland	constant	LK	no	no	no	008	Grassland	Grassland	constant	LK	no	no	no
I009/F009	CR-CR	009	Cropland in the Leakage Belt	Crop Land	constant	LK	no	no	no	009	Cropland	Crop Land	constant	LK	no	no	no

2.4.5 Analysis of historical land-use and land-cover change

From the model analysis on the historical period, we now the average deforestation rate in the RRD is 1.7% (Map 21).

Map 21: Forest and non-forest classes at the start and end of the historical reference period



Change analysis results in the RRD show a decrease in forest cover of 344,791,08 ha as showed in Table 15:

Table 15: Change in Land Cover during the reference period

	Area in Ha	
	1996	2008
Forest	1,853,595.09	1,508,804.01
Non-forest	251,761.77	596,552.85
Rivers	88,452.00	88,452.00

2.4.6 Agents, Drivers and Underlying Causes of Deforestation

This section identifies all the agents, their drivers and underlying causes that generate LULC- changes in the RRD.

This section is structured with each agent and its respective drivers (and variables) grouped together. Underlying causes act in similar way for all the agents thus are presented at the end in one single section.

2.4.6.1 Riberinhos

- Brief description

In Pará, poverty is widespread in rural areas, particularly for subsistence farmers of which one-third does not have an income (SEMA 2010). In Portel, the total area covered by agricultural activities is 263.736 hectares, from which: permanent agriculture covers 6,959 ha, agroforestry systems cover 2,235 ha and temporary agriculture covers 37.883 ha. Therefore, temporary agriculture is the most important farming activity in the area (IBGE, 2011).

Riberinhos live on non-forest areas that fall within the Leakage Management Area. From our PRA (and confirmed by Landsat imagery) agricultural activities occur up to 3Km alongside river shores. Such delimitation responds to the fact that riberinhos move around the area by foot and, in their own words "it is exhausting and dangerous" to cover greater distances to conduct agriculture or to extract timber as raw material. It is also in this 3Km buffer where riberinhos collect timber as raw materials for their constructions. However, riberinhos do not occupy the shores of every single river in the area thus in some cases the Project Area can be delimited by a river. It is only when settlers' activities have been historically present in the area that this 3Km buffer is identified.[32]

They are a mix of settlers (re-located in the area by INCRA after being removed from a private area) and squatters (migrant people that appropriate a piece of land assuming is public lands) (Greene 2011-2012;

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[32] Based on the RRD Forest Benchmark Map it is possible to identify areas where LULC have changed during the historical reference period, from forest to other uses. So, any area that has been used for or is currently being used for agriculture, is not considered as part of the Project Area. Under this premise, the 3Km buffer applies only to areas that have supported settlers or/and agricultural activities during the historical reference period or do so nowadays. Therefore, there it is possible for some sections of the Project Area to borders with a river shore if that section has remained under the LULC "forest" during the historical reference period.

ESLLC 2012). However, Riberinhos are considered more as settlers than squatters since the latter are more interested in appropriating lands for a later re-sale (Araujo 2009; Branco 2011; May 2011; Greene 2011-2012; ESLLC 2012). Although Riberinhos do not have legal land titles in some very few cases they possess documents that grant land use rights but not ownership (ESLLC 2012).

The Social Assessment (ESLLC 2012) shows that riberinhos perform small-scale cassava agriculture to produce and sale farinha as their main economic activity. Riberinhos slash young trees in abandoned fallows[33], take the cut timber and then apply fire to clear the land and have it ready to plant cassava. The inefficient farming systems in slash-and-burn agriculture, soil impoverishment and increasing population augment the pressure on forests to create new farmland.

- Brief assessment of the most likely development of the population size

Population in rural areas has increased in the past ten years. According to the latest census from IBGE (IBGE 2011 and based on the equations used by IMAZON to estimate population growth (Barreto 2011) the expected population growth through the first fixed baseline period in the RRD is presented in Table 16:

Table 16: Expected Population Size for the First Fixed Baseline Period

Population within the RRD	
Year	**Rural**
2000	13,152.83
2010	17,983.59
2018	32,771.44

Source: IBGE census years 2000 and 2010. Formulas by IMAZON 2011[34].Calculations by ESLLC

- Statistics on historical deforestation attributable to each main agent group in the reference region, Project Area and leakage belt.

From the historical LULC analysis it has been identified that small-scale agriculture by Riberinhos is not the main agent of deforestation in the RRD as showed in Table 17:

[33] Known as *Capoerias* in the area. Riberinhos clear Capoeiras as these present less difficulties to be cleared than already mature forests.

[34] Equations obtained from the paper developed by Barreto, P., Brandão, A., Martins, H., Silva, D., Souza, C., Sales, M., Feitosa, T. (2011). "Risco de desmatamento associado à hidrelétrica de Belo Monte."

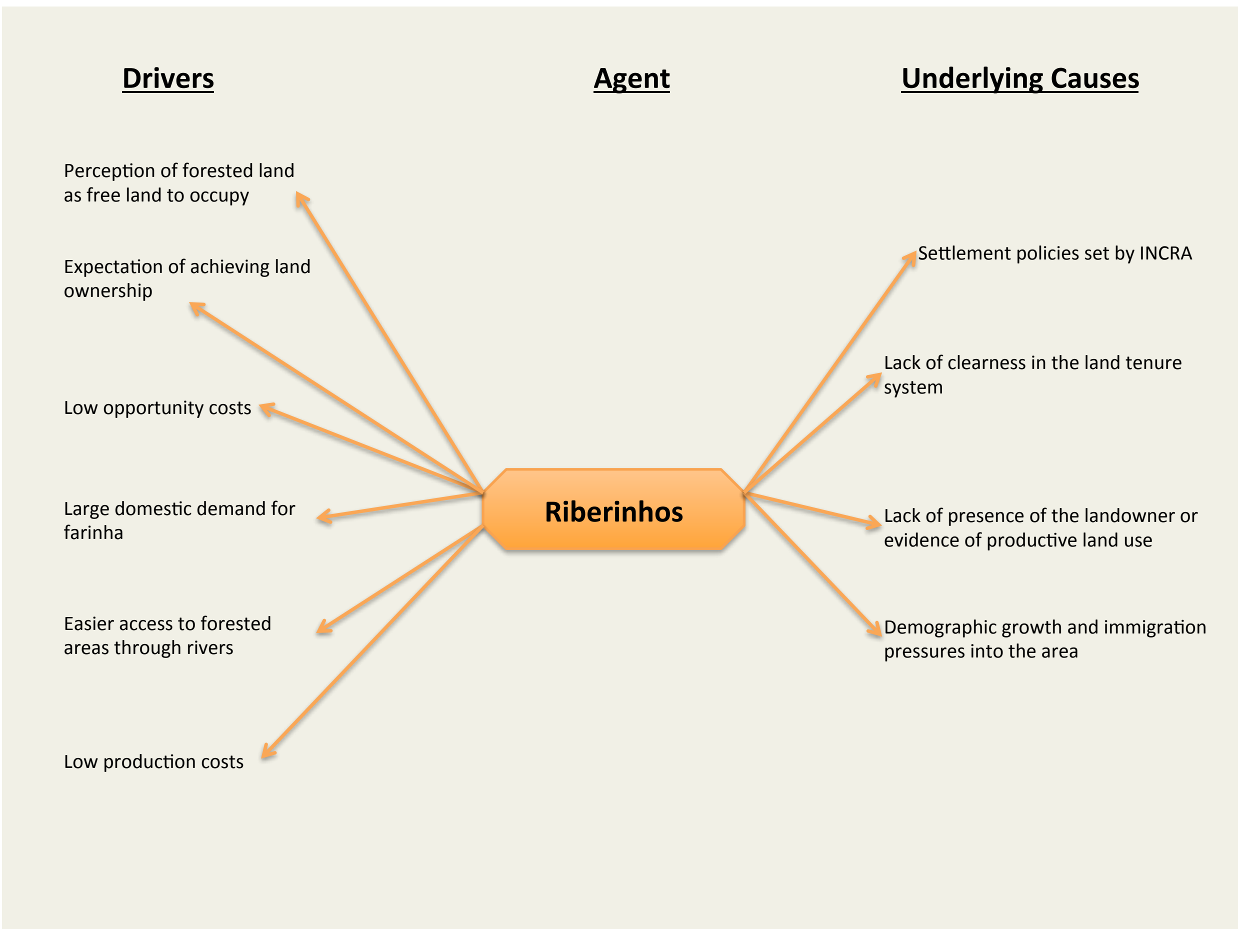
Table 17: Attributed Deforestation to Riberinhos

Category	Description	Contribution
1	Forest to Grassland	98%
2	Forest to Cropland	2%
Total		100%

- Drivers and Underlying Causes of Deforestation for Riberinhos

Drivers and Underlying Causes of Deforestation for Riberinhos are diverse and are related among them creating –in some cases- synergies. Figure 6 summarizes such relations.

Figure 6: Summary of Drivers and Underlying Causes of Deforestation for Riberinhos



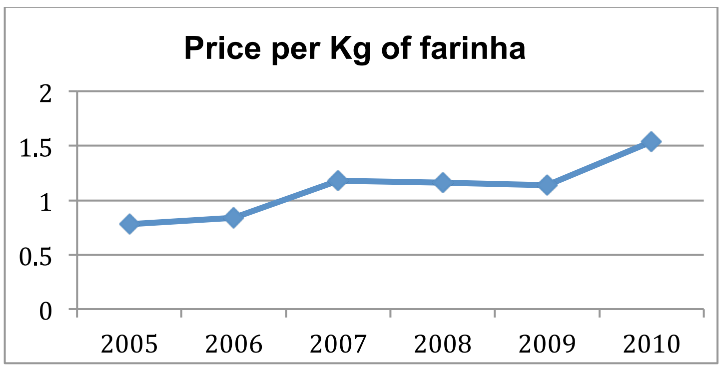
- Driver variables explaining the quantity (hectares) of deforestation for the driver:

1. Price of "*farinha*": farinha production is a very energy demanding process that requires large volumes of firewood. Firewood is obtained from the residues of performing slash and burn in capoeiras but not from timber extracted from mature forests. In addition, farinha is derived from cassava, and cassava is growth in a non-intensive way (ESLLC 2012) so the more cassava is needed, the more farming area is required..

As a result, an increase in the price of farinha will also increase the supply and thus requiring more agricultural land for cassava and more firewood which in turn results in more deforestation.

In the Project Boundary the average income per "farinha" sales is 600 reais per person/month, which is obtained by selling 600 kilos (ESLLC 2012). Average prices in Pará are shown in Figure 7.

Figure 7: Price in Reais per Kg of Farinha in Para



Source: Conab – Minister of agriculture, livestock, fishing (presentation July 2010)

2. Migration: migration to villages in the LMA generates higher demand for agricultural lands thus more forested area need to be cleared (ESLLC 2012).

3. Inefficient agricultural practices: shifting cultivation is known to be an inefficient practice that leads to soil impoverishment and low productivity that requires plots rotation and increasing deforestation.

- Driver variables explaining the location of deforestation:

A. Distance to river shores: As mentioned in the description of this agent, they are limited to the first 3km from the rivers shores as they find it difficult to cover larger distances from their agricultural fields to the river shores where they have their houses. They depend on the river to sell their product (farinha and occasionally timber) and to mobilize to Portel.

- Measures to address the agent

- Generation of job opportunities as monitoring staff to diversify income sources and avoid increasing pressures over forested land.

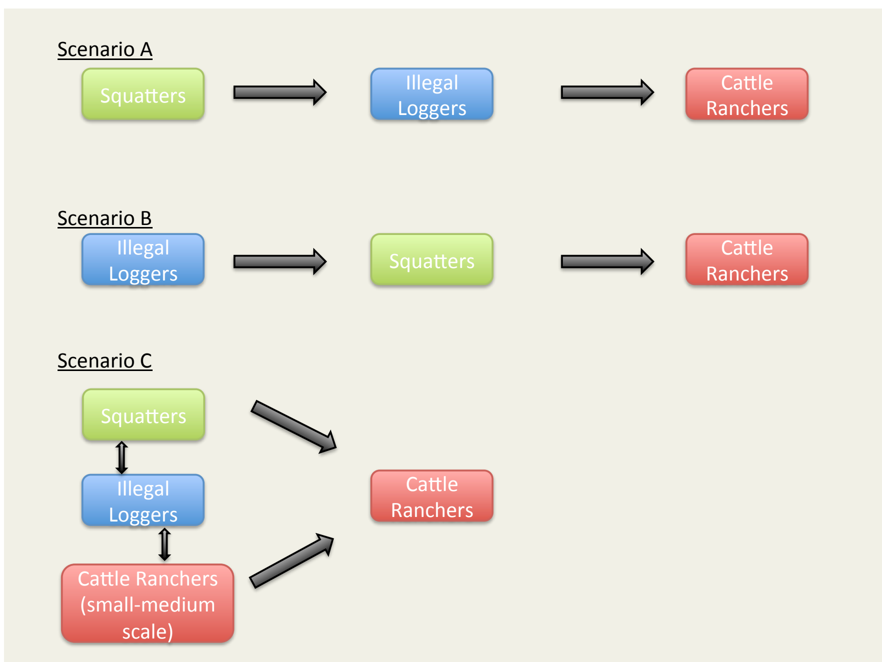
- Grant land-use rights to villagers already living in the LMA to prevent migration to the area.

Implement agroforestry activities to increase soil productivity to diversify agricultural products and reduce the pressure over forested land.

2.4.6.2 Cattle Ranching

Cattle ranching is a final LULC class that usually results from a process that includes squatters and illegal loggers. Such process can develop in different approaches and not always includes all the actors (Walker, Moran et al. 2000; May 2011). Such actors can interact in different ways (Figure 8) and share a complex interaction of drivers and underlying causes of deforestation (Figure 9).

Figure 8: Possible interactions among Loggers, Squatters and Ranchers



In Scenario A, squatters initiate the process by clearing patches of forested land, then re-selling the land to logging operations that degrade the forest and finally re-sale the land to cattle ranchers that take advantage of the built road network to implement and expand their pastures.

In Scenario B, illegal loggers open pioneer roads for exploration and selective timber extraction. Squatters take the opportunity to use this road network (once logging activities leave the area) to clear forested patches to claim ownership. Finally, squatters sell the land to cattle ranchers that slash and burn the remaining forest and develop pastures.

In Scenario C, squatters, illegal loggers and small-scale ranchers co-exist. Squatters and ranchers will benefit from the road network developed by loggers. On one side, Squatters will repeat Scenario B, on the other side, after the first period of selective timber extraction, small and medium-scale ranchers will start developing pastures underneath the canopy of the non-logged trees. Pastures will keep developing and animals will start grazing during the second or third periods of timber extraction. Finally, when all valuable timber individuals have been extracted, cattle ranchers will take over the land and slash and burn the remaining trees to set large-scale ranching operations (Margulis 2004; Araujo, Bonjean et al. 2009; Barreto 2011).

Those scenarios are expected to happen in the pioneer frontier. In the consolidated frontier, well-capitalized large-scale ranchers do not need to depend on squatters or loggers to open road networks to expand their pastures. Large-scale ranchers can start the extraction of valuable timber species on their own and then slash and burn what is left thus expanding the consolidated frontier northwards towards the Project Area (Margulis 2004).

Drivers and underlying causes of deforestation are also diverse and inter-related. Figure 9 presents drivers and underlying causes of deforestation for cattle ranching as an agent and squatters and illegal logging as intermediary steps.

Figure 9: Summary of drivers and underlying causes of deforestation for Cattle Ranchers as final land users

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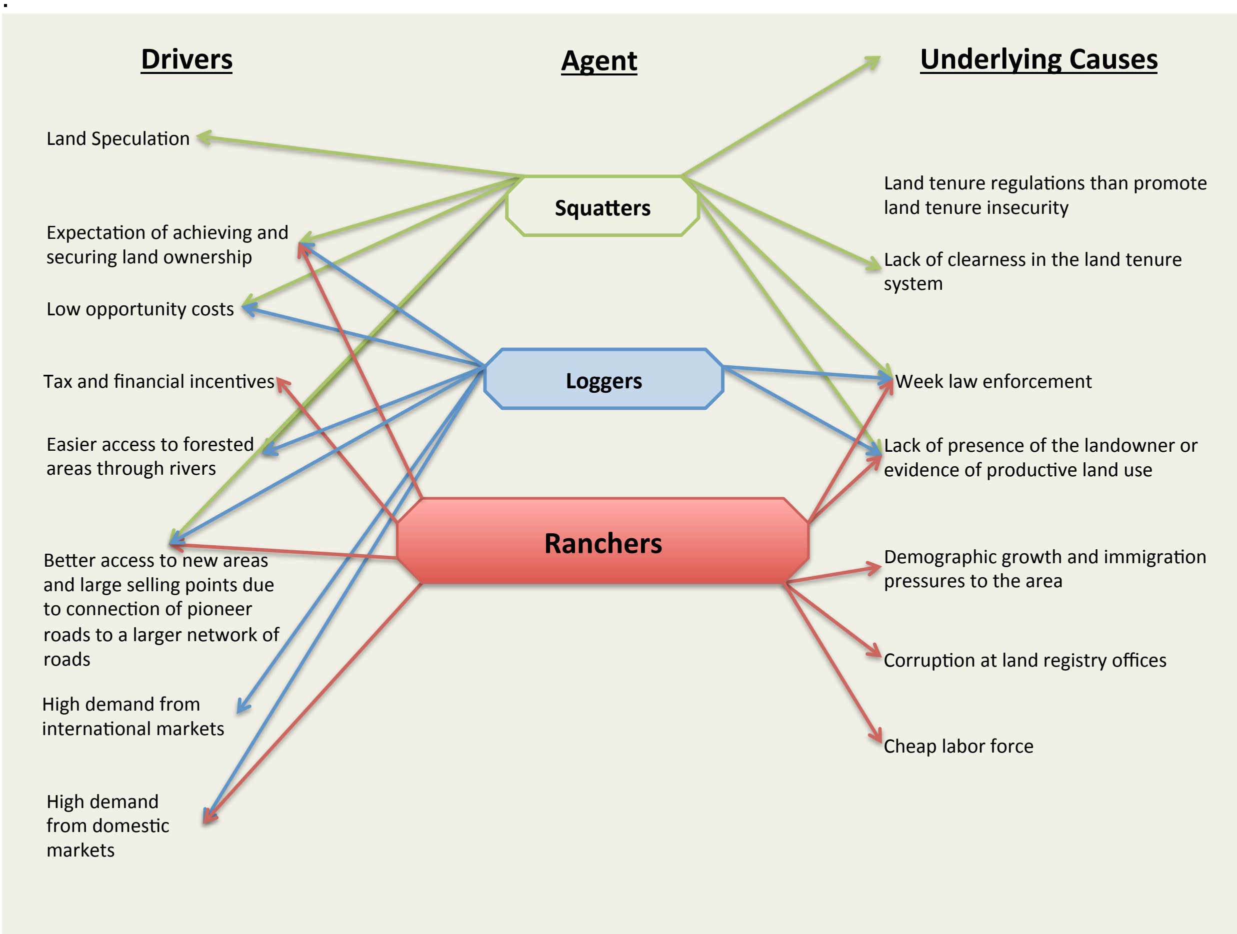


The process showed before is very complex but can be summarized as follows:

Logging operations away from primary roads will initiate pioneer roads from river shores into the forest on what is known as “varzea” logging (where logging takes place close to the river shores and timber is transported by river) and, in time, the process will evolve to “interfluvial terra firme” logging (roads are generated from river shores but timber is transported by road once pioneer roads connect to a larger network) (Uhl, Barreto et al. 1997). Loggers will expand pioneer roads regardless distance to main selling points, as long as there is a demand for high and low value species (Pfaff 2009). Pioneer roads eventually connect to larger and more consolidated network of roads, in this case the network of the Transamazonica highway. Once this connection takes place, pioneer roads become tertiary roads and may reduce the time of transportation from an average of 24 hours by river to 6 hours by road to a selling point (ESLLC 2012). Logging operations are often followed by rapid deforestation not only because of the aforementioned access to the forest but also because selective logging operations in Brazil highly damage the forest (Asner, Broadbent et al. 2006).

Squatters are the agents that initiate the land speculation process by clearing forested areas to prove ownership. Such invasion of public or private forested areas obey to the idea that areas with forest are areas under no-productive use and it is supported by the Brazilian Constitution (Araujo, Bonjean et al. 2009). After squatters obtain land titles, they sale the land to cattle ranchers (Kirby, Laurance et al. 2006). Most of the times squatters get access to forested areas through the network of penetration or pioneer roads developed by selective loggers (Margulis 2004).

Once lands are bought by ranchers, they slash and burn remaining forest and implement pastures (Margulis 2004). Grazing is implemented not just because of its short and medium terms profitability (Hecht 1993), but because grazing constitute a cheap and easy mean to prevent forest from re-growing and hence to prove ownership (Kirby, Laurance et al. 2006).

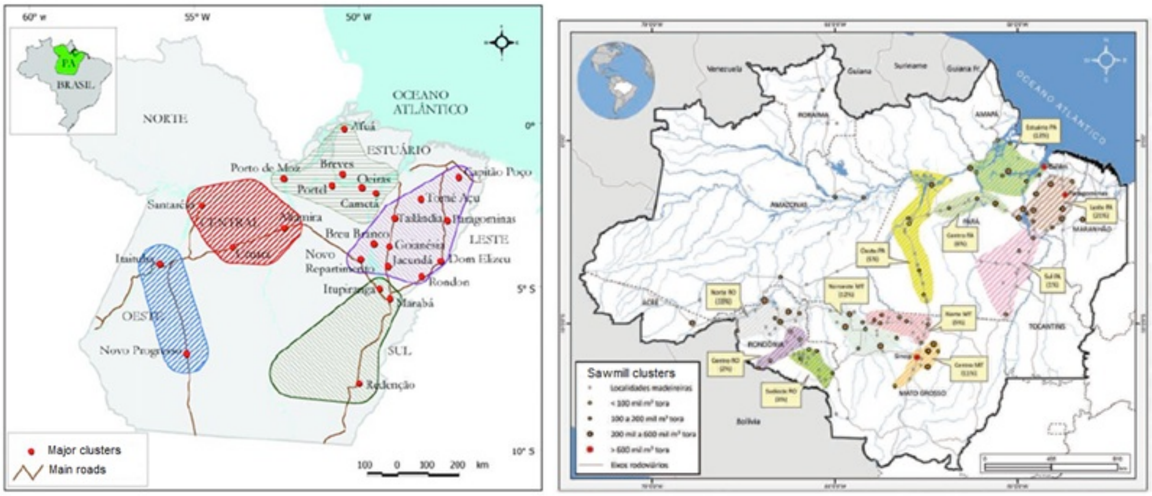
We will describe each agent that takes part in the process of cattle ranching implementation, starting by loggers, then squatters and finally with ranchers.

2.4.6.2.1 Selective Illegal Loggers

- Brief description

Logging companies were clustered in new urban areas along the roads, forming what are called ‘wood clusters’. To be considered as a cluster, a location must produce and consume an annual volume of 100 thousand m^3/year or more of logs. Figure 10 shows the wood clusters and areas of the legal amazon (Pereira, Santos et al. 2010)

Figure 10: Major Logging (left) and Sawmill (right) Clusters in Para



There are 2.226 logging companies in the Amazon region and 1.067 operate in Pará. Mato Grosso, which is the second ranked state, has 592 logging companies. Consequently, wood logging activities generate 92.423 jobs and an income of more than 2 billion Reais (Pereira, Santos et al. 2010). Much of the volume of timber in the Brazilian Amazon comes from illegal sources (May, Millikan et al. 2011).

The Project Boundary is located in the limits of an estuarine region and it is considered, on the timeline expansion of wood exploration in Pará, an intermediary deforestation frontier (10 – 30 years old) (Pereira, Santos et al. 2010).

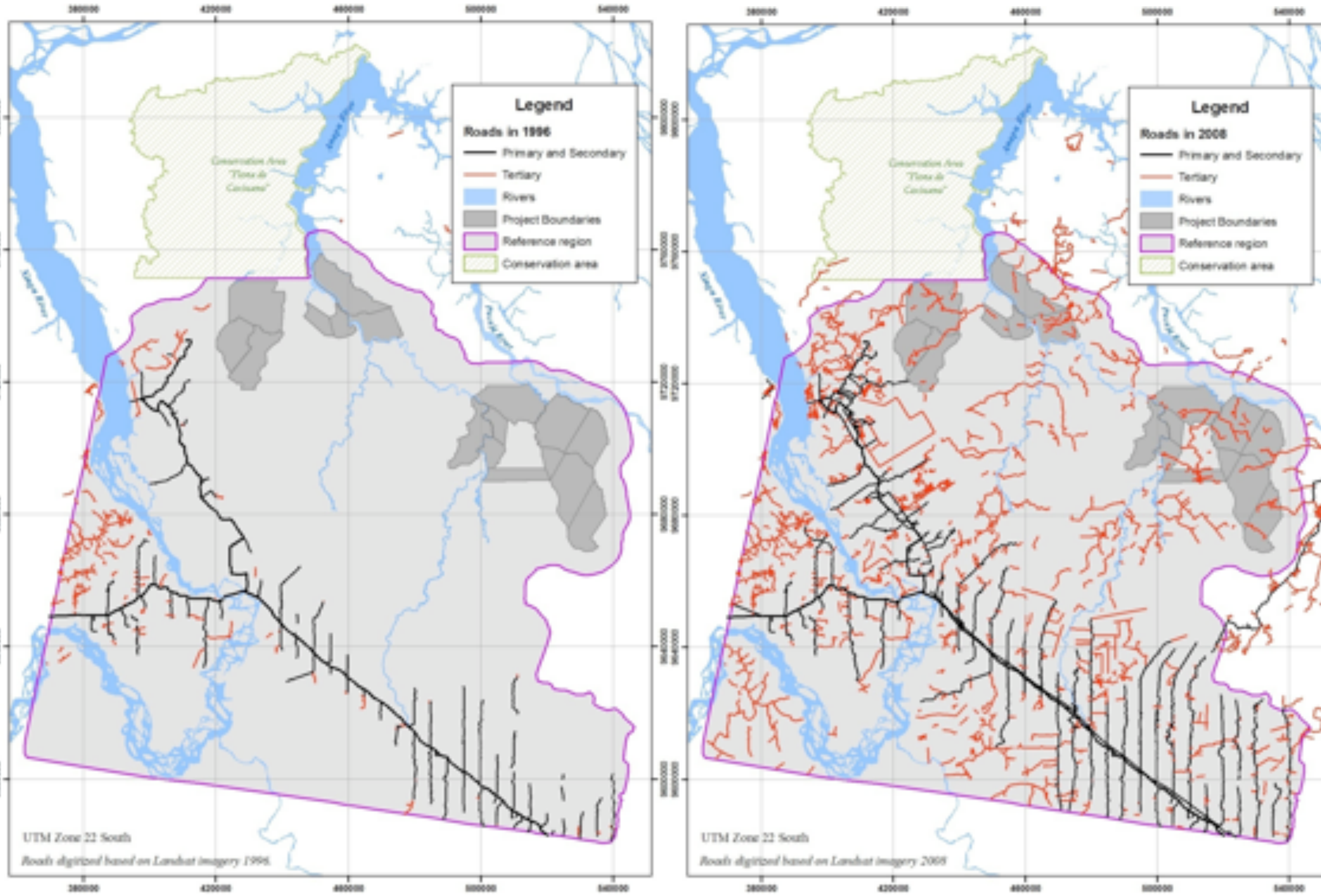
Portel has only 7 registered logging companies, but it is located near a major wood production cluster – Breves – which has 159 companies and produces approximately 500.000 m^3 per year of tropical wood logs. Portel has also other small and medium size clusters within its territory and on its surroundings (Porto de Moz – 14 companies, Anapu – 41 companies) (Pereira, Santos et al. 2010).

Logging operations can be defined as varzea logging and terra firme logging. Varzea logging is concentrated in the estuary and along the main stem of the Amazon River whereas terra firme logging is generally concentrated along government highways (Uhl, Barreto et al. 1997).

As prices for sawn timber go up in main selling points as Belem or Breves, it becomes cheaper to establish small mills not only in the estuary but also in more remote areas of the varzea and under business as usual market dynamics, it is possible that large mills will be established in these areas (Uhl, Barreto et al. 1997). Additionally, it is known that loggers will build roads as long as these provide access to profitable timber, even at the expense of increase distance to markets (Pfaff 2009).

Nowadays, these pioneer roads have begun to connect with the network of tertiary and secondary roads that lead to the Transamazonica highway, which has been verified by on-the ground testimonies, the results from the PRA and through the analysis of Alos Palsar imagery from 2011 (Map 22). By doing so, pioneer roads cannot longer be differentiated from tertiary roads thus becoming part of one single network.

Map 22: Primary and secondary roads (black) and tertiary and pioneer (red) at the start (left) and end (right) of the historical reference period.



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), thus reducing the time the gap for the creation of a consolidated deforestation frontier (Margulis 2004). Without roads access there wouldn't be deforestation (Kirby, Laurance et al. 2006).

- Brief assessment of the most likely development of the number of illegal selective loggers

The wood sector directly drives the economy of many municipalities. In 1998, wood logging and processing activities were concentrated on 24 wood clusters in the state of Pará. There were 676 companies and 534 sawmills in these clusters from which 457 companies were located on the estuarine region. Table 18 shows a temporal variation of the number of the existing wood companies in the estuarine region of Pará from 1998 to 2009 (Pereira, Santos et al. 2010)

Table 18: Number of wood logging companies in the estuarine region

Municipality	Number of companies 1998	Number of companies 2009
Afuá	256	219
Breves	97	159
Cametá	77	39
Portel	11	7
Porto de Moz	16	14

There are not many logging companies operating in Portel, but it is important to remark that the Project Area reference region and leakage belt are under the influence of the Breves' wood cluster, which is the second cluster with the greatest number of wood companies in the whole state. It expected to have a bigger number of logging companies given the current weak law enforcement regimes.

During the historical reference period (twelve years), length of pioneer/tertiary roads increased in 675% while the length of secondary roads (the fish spine from the Transamazonica, which is attributed to large scale ranchers) increased only in 127%[35]. For this reason it is possible to state that logging operations will increase over time.

- Statistics on historical deforestation attributable to this agent in the reference region, Project Area and leakage belt.

As explained in Section 2.4.6.2, loggers are not agents of deforestation contribute in the process of implementation of cattle ranchers who are the actual deforestation agents. Nevertheless, there is a direct and strong correlation between logging operations and fast post-extraction deforestation (Uhl, Barreto et al. 1997). A study from 2006 that covered more than 2 million Km^2 of Brazilian Amazon forest shows that selective logging are highly damaging operations that are often followed by rapid deforestation. As a matter of fact, the study shows that 16 ± 1% of selectively logged areas were deforested within 1 year of logging, with a subsequent annual deforestation rate of 5.4% for 4 years after timber harvests (Asner, Broadbent et al. 2006).

[35] Results from the analysis of historical data using Landsat TM imagery performed by ESLLC.

- Driver variables explaining the quantity (hectares) of deforestation

Although selective logging does not deforest but degrades the forest, it is important to understand which are the variables motivating timber extraction.

Log wood price has been a driver for loggers in Pará, and affects directly the economy of many municipalities (Pereira, Santos et al. 2010). The prices of wood are driven mostly by the domestic market, which presents a high demand for timber (Hecht 1993).

Picture 1: Logging operations in the Project Area

Lack of surveillance: IBAMA is the governmental organisms in charge of environmental surveillance and control, so it is in charge of preventing and removing illegal logging operations. However, it is known that IBAMA is not efficient at these tasks because of the large forest extension, its lack the resources and capacity to address illegal logging (BRITO 2005).

- Driver variables explaining the location of deforestation

The RRD is very homogeneous in terms of biophysical and socio-economic variables (see Annex 2: validation of the RRD) so biophysical factors don't constitute mobility barriers for selective loggers.

Varzea loggers start roads from river shores into forested land, transporting timber downstream by the river into Breves. As pioneer roads become tertiary roads, varzea logging is replaced by inter fluvial terra firme logging, which is characterized by access to forests by rivers and transport of timber through roads to main selling points (Uhl, Barreto et al. 1997)

- Measures to address the agent

The Project's ongoing monitoring activities will continue and will be scaled-up by involving local villagers as monitoring staff. Any illegal logging activity will be reported to the policy in Portel and to IBAMA in Breves.

2.4.6.2.2 Squatters

- Brief description

Squatters are important because they "open the door" for the deforestation agent class 'Cattle Ranchers' to intervene on untouched forest. Squatters are people willing to appropriate larger extensions of land in the expectation of re-selling such land in the future (Araujo 2009).

According to the Brazilian Constitution, Squatters are allowed to claim public or private land that in not under a productive use (Araujo, Bonjean et al. 2009). By definition, a land with forest cover is understood to be under no use. For this reason, a piece of land without forest is worth 5 to 10 times more than the same area with forest cover (Kirby, Laurance et al. 2006).

Squatters get access to forested areas through the network of roads opened by loggers. Squatters clear an area through slash and burn, implement pastures and small scale grazing activities to prove the land is under a productive. Finally, after five years squatters can get land-use rights and then after another 5 years they can get land titles (Araujo, Bonjean et al. 2009).

Once Squatters get land titles they can sale a land to medium and large-scale ranchers.

- Brief assessment of the most likely development of the population size

The number of squatters grows with the increase in population in the area. Having more people in the area places more pressure over forest resources. Given the low opportunity cost of this pioneer agents and the expectancy of future sale of lands, it is expected for the number of squatters to be directly related to population growth.

Population in rural areas has increased in the past ten years. According to the latest census from IBGE (IBGE 2011) and based on the equations used by IMAZON (Barreto 2011) to estimate the geometric population growth rate and expected population size, the population in the RRD at the end of the first fixed baseline period is presented in Table 19:

Table 19: Expected Population Size for the First Fixed Baseline Period

Population within the RRD	
Year	Rural
2000	13,152.83
2010	17,983.59
2018	32,771.44

- Statistics on historical deforestation attributable to each main agent group in the reference region, Project Area and leakage belt.

Squatters are not the final user of the land and are not those who generate significant deforestation. However, squatters are directly related to the deforestation generated by cattle ranchers.

- Driver variables explaining the quantity (hectares) of deforestation

Land Speculation: a deforested area is worth 5 to 10 times more than the same area with forest cover. Squatters have very low opportunity costs and they undertake land grabbing under the expectation of future land sales to cattle ranchers (Kirby, Laurance et al. 2006).

Weak control/enforcement: without the proper control from a landowner, squatters can invade and claim large extensions of land. It is only when a landowner makes an official claim to INCRA that squatters cannot claim private lands (Araujo, Bonjean et al. 2009).

Penetration roads: the network of roads developed by selective loggers allows squatters to invade large extensions of forested areas (Mertens, Poccard-Chapuis et al. 2002).

- Driver variables explaining the location of deforestation

Forest Cover: forested areas are assumed to be “free to take” as it is understood that are under no-productive use (Araujo, Bonjean et al. 2009).

- Measures to address the agent

The Project will continue and scale-up its monitoring and enforcement activities to identify and remove illegal logging operations and land invasions.

2.4.6.2.3 Cattle ranchers

- Brief description

Large and medium size cattle ranchers are the main agents of deforestation in Amazonia (Margulis 2004). Brazil is now a world leading beef producer. It produces approximately 16% of the world’s beef, exporting 2.02 Million tons with a total production of 9.4 mn tons, 37% of it to the EU. While, at a national level, the pasture area has declined slightly since 1985, in Amazonia Legal there was a 44.2% increase between 1985 and 2006 (May, Millikan et al. 2011). Deforestation by cattle ranching is not driven by international meat markets but from domestic demand (Hecht 1993)

Ranchers are more interested in securing land tenure than in getting profits. This because securing land ownership is critical due to invasions and governmental land-redistribution programs. Most cost-effective way of maintaining cleared land is by cattle grazing (Kirby, Laurance et al. 2006).

Nevertheless, as long as there is an increasing market for cattle ranching products, there will be always a demand for new lands. The fact that a final activity such as cattle ranching exists makes it profitable to keep occupying and clearing forested land (Margulis 2004). Also, as transport is not a significant constraint for large-scale cattle ranching, the emergence of the livestock commodity chain explains the presence of farmers in remote and isolated areas. Remote frontiers are becoming integrated and are rapidly evolving (Mertens, Poccard-Chapuis et al. 2002).

- Brief assessment of the most likely development of the cattle herd population size

From 1999 to 2004 cattle grew 100% in Pará. Table 20 shows cattle size evolution in Para state (Pereira, Santos et al. 2010).

Table 20: Cattle in Pará over time (livestock units)

2003	2004	2005	2006	2007	2010
13.376.606	17.430.496	18.063.669	17.501.678	15.353.989	17.633.339

Source: IBGE – Pesquisa pecuária municipal

The Project RRD is located on the Marajó integration area (Portel) and although this region is not the largest beef producer (it represented only 1,8% of all Para beef production in 2007) there is a major selling point in the southern area of the reference region – Altamira – that has a direct impact on cattle raising activities (Interview with Seta Ambiental). Altamira has an important slaughterhouse that in 2006 produced, 8.362 Ktons of beef.

Table 21: Cattle in Marajó integration region (livestock units)

2003	2004	2005	2006	2007
368.184	327.458	344.962	274.722	281.728

Source: Zoneamento Ecologico- economico da zona leste e calha norte do estado do Para 2010

- Statistics on historical deforestation attributable to this agent in the reference region, Project area and leakage belt.

From the historical LULC analysis it has been identified that cattle ranching is the main agent of deforestation in the RRD as shown in Table 22:

Table 22: Attributed deforestation to Cattle Ranchers

Category	Description	Contribution
1	Forest to Grassland	98%
2	Forest to Cropland	2%
Total		100%

Although cattle ranchers are not currently present in the Project Area and leakage belt, the baseline scenario indicates that this agent group will expand towards the Project Area.

- Driver variables explaining the quantity (hectares) of deforestation

The forces favoring deforestation in the future are: growing demand for beef, weak environmental and social impact assessment and development of infrastructure (Barreto 2011)

A. Land speculation: Ranchers are more interested in securing land tenure than in getting profits. This because securing land ownership is critical due to invasions and governmental land-redistribution programs (Kirby, Laurance et al. 2006). Cattle ranching as a way to claim land ownership (Hecht 1993)

B. Beef price: Cattle ranching is driven by the domestic market (Hecht 1993) thus variations in international prices of meet don't affect the demand for new lands where to expand grazing activities (Margulis 2004).

C. Lack of pastures management: as pastures are not properly managed they degraded rapidly, due to this fact, there is a constant need to expand deforestation to increase the area of pastures and relocate cattle.

D. Government credit lines: There are persistent rural credit programs that stimulate deforestation, especially from cattle ranching. Between 1989 and 2007, a single credit program (Fundo Constitucional do Norte; FNO) invested US $3.5 billion in cattle ranching in the Brazilian Amazon. The Brazilian National Bank for Economic and Social Development (BNDES) has recently been strongly criticized for its major role as a source of capital for expansion of huge beef-processing facilities in the Amazon, without installing due safeguards to avoid the purchase of cattle from areas of deforestation (including indigenous lands) (Hans P 1991; May 2011)

- Driver variables explaining the location of deforestation

Given the high demand for lands, ranchers will locate anywhere they can find suitable lands regardless distance from main roads. Transport is not a significant constraint for large-scale cattle ranching and the emergence of the livestock commodity chain explains the presence of farmers in remote and isolated areas. Remote frontiers are becoming integrated and are rapidly evolving (Mertens, Poccard-Chapuis et al. 2002).

Ranchers will locate anywhere there are paved or unpaved roads and weak law enforcement (Kirby, Laurance et al. 2006).

- Measures to address the agent

Monitoring and enforcement activities will prevent the generation of tertiary roads thus avoiding the deforestation process (Kirby, Laurance et al. 2006).

As a second line of defense, ranchers that will get to the Project's Boundary will be addressed and offered the opportunity to participate in workshops to learn about pasture management. 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.

2.4.6.3 Analysis of chain of events leading to deforestation

Section 2.4.1 of this document presents the dynamics of agents that lead to final land-use classes and deforestation. Dynamics can be analyzed as the same process in different stages:

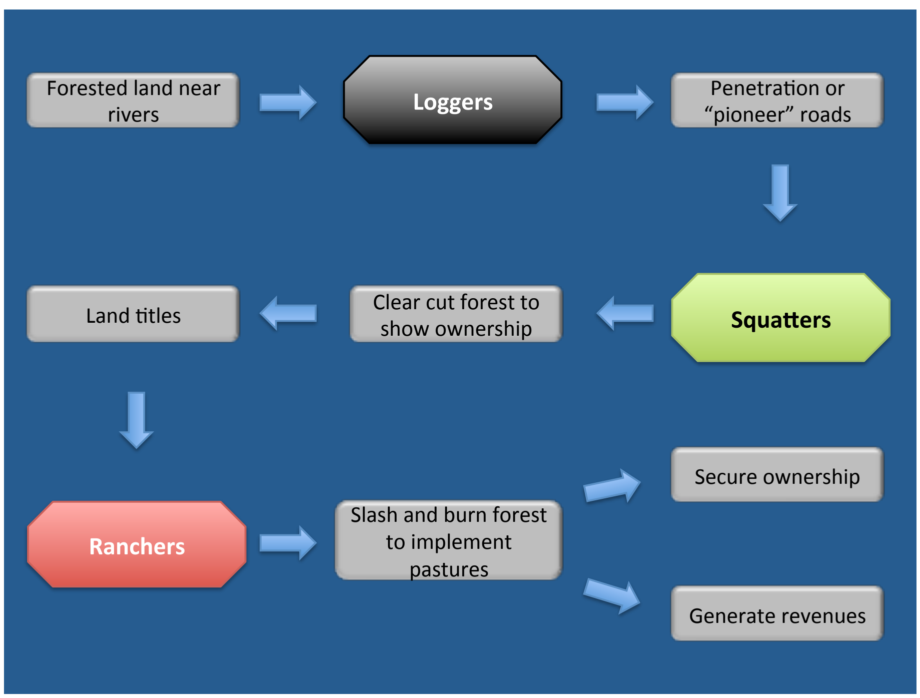
1. The consolidated frontier is the advanced stage of the deforestation process in the RRD, where final LULC classes are already implemented. This is what is expected to occur in the Project Area.

2. The pioneer frontier represents the early stages of the consolidated frontier. It is characterized by the presence of pioneer agents such as loggers and squatters. These pioneer agents are those who initiate the process that leads to deforestation.

Having presented and explained the agents, drivers and underlying causes of deforestation, Figure 11 presents a simplified explanation of the relations among agents and the sequence of deforestation in the RRD.

In any case, the deforestation process starts wherever there are roads that allow access to forested areas, so without penetration roads there shouldn't be deforestation. Also, deforestation is strongly correlated to previous clearings (as those developed by squatters), so if land grabbing activities are stopped, the deforestation process doesn't begin.

Figure 11: Chain of events leading to deforestation



2.4.6.4 Conclusion

There is an increase in the deforestation rate however no conclusive evidence emerges from the analysis of agents and drivers explaining the increasing trend thus Approach A “Historical Average” will be used to calculate the quantitative projection of future deforestation.

Although the fact that deforestation in the Legal Amazon had been increasing since August 2010 possibly because of the provisions in the old Forest Code (May, Millikan et al. 2011) and the fact that there is a concern about an increase in deforestation if a new version of the Forest Code would reduce forest protection (Barreto 2011) these assumpltions are plausible but not conclusive.

2.5 Additionality

In accordance with the approved VCS Tool VT0001, a list of plausible land-use scenarios in the Project Area should be identified and evaluated. Then it should be determined the most feasible and credible scenarios that will develop in the absence of the AUD REDD+ Project.

Afterwards, 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.

As for the Additionality analysis section, Project Proposers need to complete the following steps:

a) STEP 1. Identification of alternative land-use scenarios to the AFOLU Project activity;

b) 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; or

c) STEP 3. Barriers analysis; and

d) STEP 4. Common practice analysis.

2.5.1 STEP 1: Identification of alternative land-use scenarios to the AFOLU Project activity

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

2.5.1.1 Identification of credible land-use scenarios

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 2011 and January-February 2012.

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

2.5.1.1.1 Forest encroachment by pioneer activities followed by deforestation to implement pastures

This baseline scenario is a continuation of Business as Usual (BaU) activities in the region if the landowner doesn't implement any tipe of monitoring or productive activity in the Project Area. All the following has also been mentioned in Section 1.10 of this document.

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[36] or at least of commensalism[37]. 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).

Be as it may, 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 (Kirby, Laurance et al. 2006), 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) 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).

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[38]. 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 (Larson 2008) and regardless increasing distances to selling points (Pfaff 2009). 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.

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[36] A relationship where the two agents benefit from each other's actions.

[37] A relationship where at least one of the agents benefits from the other agent's actions but the last one is not affected.

[38] A land with forest cover is assumed to be unused thus susceptible to be claimed or expropriated. For this reason, deforestation is the main way to prove that a land has an owner and that is currently under productive use (Araujo, Bonjean et al. 2009)

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), 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 Transamazonica 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.

2.5.1.1.2 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).

The issue is that as long as the landowner keeps 80% of his land under the Brazilian definition of forest[39], any exploratory activity will be legal. However, such definition won’t prevent the forest ecosystem to become fragmented thus loosing biological richness.

2.5.1.1.3 Proposed AUD activities under REDD+ Project.

The Project 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 an agreement and in close participation with the landowner, will provide legal land titles to villagers within the

[39] According to the UNFCCC, Brazil’s definition for forest is 1 hectare with 30% crown cover and 5 meters tree height. http://cdm.unfccc.int/DNA/index.html

Project's Boundary who develop their activities in the LMA and actively participate –and provide proven results- on forest conservation.

Below is presented a detailed description of each activity (it can also be found in Section 1.8.2 of this document):

1. **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 Portel. The staff at the Portel 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 12 shows how brigades will be organized and Figure 13 shows the process to report illegal activities in the Project Area:

Figure 12: Local organization of monitoring tasks

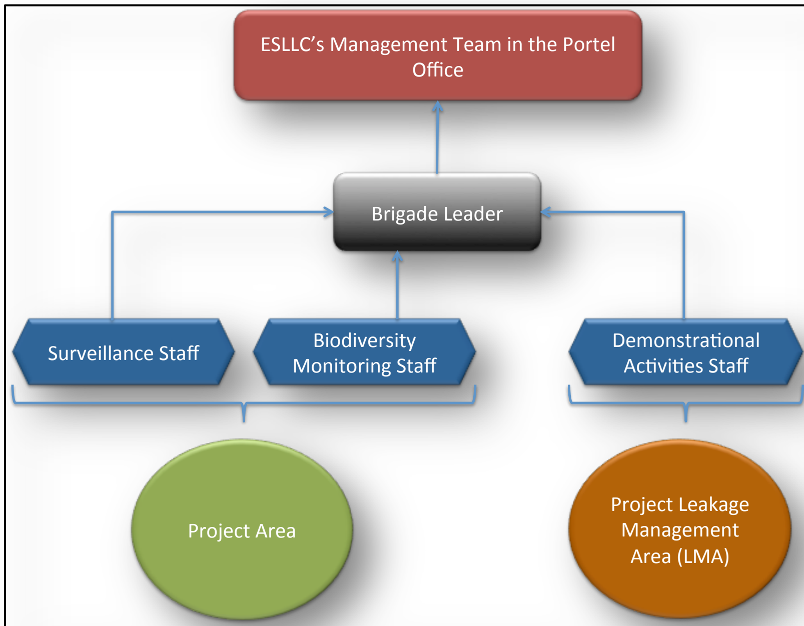
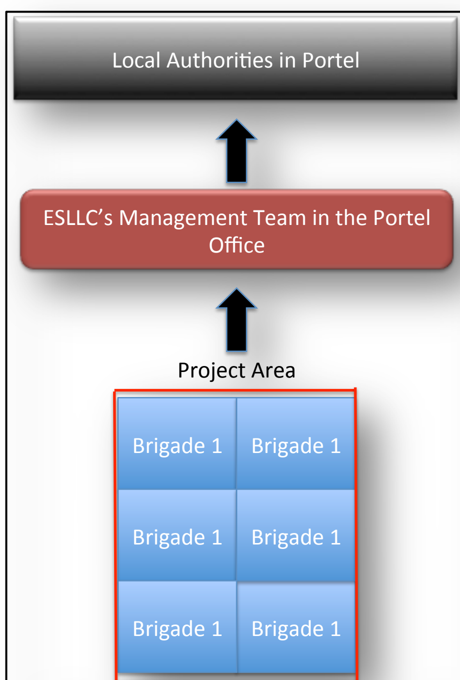


Figure 13: Reporting sequence for illegal activities in the Project Area



2. 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.

3. 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 (Fearnside 2001; Larson 2011).

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.

4. 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.

5. 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.

6. Providing capacity building on improved efficiency cook stoves and implement cook stove pilots

In order to reduce the amount of firewood needed to produce farinha, 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.

7. 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 NGOs[40]- 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.

[40] To be determined once the Project activities start.

8. **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 the find some benefit in changing their business as usual behavior.

   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.

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

We base our consistency analysis in the laws and regulations already presented in Table 2 and those presented in Table 24 below:

Table 24: 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 1o The Sustainable Forest Management Plan (PMFS) must follow. I – the intensity of harvest no higher than 30 m^3/hectare in case machines are used for harvest. In this case the initial rotation is 35 years; II – harvest intensity no higher to 10 m^3/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 2o 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.

2.5.1.2.1 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 (Portel), 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) (ESLCC 2012). 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 (ESLLC 2012).

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; May 2011; ESLLC 2012).

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; May, Millikan et al. 2011). Lack of enforcement in Portel – 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 Portel (which is the smallest administrative unit that encompasses the Project) but in the state of Para as well (Pereira, Santos et al. 2010; Monteiro, Cardoso et al. 2010-2009-2008-2007; Branco 2011).

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 (Monteiro, Cardoso et al. 2010-2009-2008-2007).

Within the Project region, between August 2009 and July 2010, Portel was ranked as the municipality with the 7th highest rate of illegal logging activities in Pará, with a harvest area of 4.088 hectares (Monteiro, Cardoso et al. 2010-2009-2008-2007)

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.

2.5.1.2.2 Timber extraction by the legal landowner

As mentioned before in item 2.5.1.1.2 of this document, 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.

2.5.1.2.3 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 Portel but also in Para.

2.5.2 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

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

Due to the fact that the Project is a conservation Project with no other sources of income besides carbon revenues, a simple cost analysis (Annex 1) 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.

Since the beginning of the Project, the AUD activities were envisioned to be feasible only if carbon credits revenue would be available. This is made evident by the documents presented (Annex 1). 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.

In conclusion it is demonstrated that a large amount of initial capital is required for the set-up of the Project. For details refer to Annex 1: Simple Cost Analysis.

2.5.3 STEP 3: Barriers Analysis

Not applicable.

2.5.4 STEP 4: Common practice analysis

The approach to assess the existence of similar activities to the proposed Project that are not registered as VCS AFOLU Projects, will be as follow:

First, a list of similar Projects in the geographic area, here assumed to be the state of Pará because in the Portel municipality there are no similar AUD activities going on will be presented.

Second, the characteristics of each identified Project, comparing each to our proposed AUD REDD+ Project, will be presented (see Table 25).

It is important to mention that any of the following Projects have been validated or approved by any GHG standard.

List of REDD Projects in the State of Para:

- Projeto REDD Calha Norte - Project developers: SEMA (Pará State Environment Institution, Conservation International (CI), IMAZON

- REDD Pilot Project of São Felix do Xingú – Project Developers: The Nature Conservancy (TNC); São Felix do Xingu Municipality, Government of the State of Pará

- Transamazonica REDD Pilot Project – Project developers: Research Institute of Amazon (IPAM), FVPP (Foundation of Preservation Production and Living).

Table 25: Comparison between the Project and Similar Initiatives in the Region

		Proposed AUD Project	**Projeto REDD Calha Norte**	**REDD Pilot Project of São Felix do Xingú**	**Transamazonica REDD Pilot Project**
Variables	Forest type	Mainly Ombrofila Dense	Similar with minor differences	Same with minor differences	Same with minor differences
	Scale (area)	A little more than 120,000 Ha	Different (more than 5 million ha)	Different (8,4 million ha)	Different (32,745 ha)
	Funding	Funded by privately own funds	Different	Different	Different
			Government funded	Government funded	Government funded
	Land legal status	Privately own lands and lands under buying option	Different	Different	Different
			State lands and federal government lands under concession	state lands,federal government lands and private lands	Small private lands on INCRA settlement area
	Project activities	Project Area:	No info available	Not yet defined (pilot)	Different
		Strict Forest Ecosystem Conservation			Direct payments for avoiding deforestation
		Leakage Management Area			
		Land tenure rights to settlers against conservation results			
		Agroforestry			
		Improved cookstoves			
		Seed collection and seedlings replanting			
	Type of institutional arrangement	Private initiative	Different	Different	Different
			Government + NGOs	Government + NGOs	Government + NGOs

Sources: http://sendosustentavel.blogspot.com/2010/02/seminario-sobre-metodologia-de-projetos.html
www.ipam.org.br

2.5.5 Conclusion of the additionality analysis

From the evidence presented in all the sections of the Additionality Analysis, it is concluded that the proposed AUD Project Activities are certainly additional.

2.6 Methodology Deviations

The Project does not involve any deviations from the vm0015 methodology.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

A thourough explanation with detailed information about the process of modeling future deforestation can be found in Annex 3. This section will present highlights of the process.

3.1 Baseline Emissions

3.1.1 Selection of the baseline approach

For the projection of future deforestation in the baseline scenario, approach "A" of the VM0015 methodology was selected, given that the rate of baseline deforestation is assumed to be a continuation of the average annual rate measured during the historical reference period (1996-2008) within the reference region. The past observed deforestation rate is calculated by comparing the area under forest cover in satellite imagery classifications for the reference region at two different times.

According to the VM0015 methodology, the annual rate of forest change must be calculated as follows:

$$RBSLRR_t = \left[\frac{ARR_{t2}}{ARR_{t1}}\right]^{\frac{1}{t2 - t1}} - 1$$

Where:

$RBSLRR_t$ = Deforestation rate within the reference region (Puyravaud, 2003)

ARR_{t1} = Area with forest cover at year 1996 (ha) = 1,853,595.1 ha

ARR_{t2} = Area with forest cover at year 2008 (ha) = 1,508,804.0 ha

$t1$ = Start date of the historical reference period (year=1996)

$t2$ = End date of the historical reference period (year=2008)

$\boxed{\textbf{RBSLRR}_t\textbf{ = -1.70 \%}}$

Then, a Similarity-Weighted Instance-based Machine Learning algorithm with a Markov chain model based on the past observed deforestation rate is performed to predict areas vulnerable to forest changes using multi-temporal remote sensing data.

Transition probability matrices are used to predict land-cover distributions and to generate land-cover projections, based on the real change observed in the historical reference period. Probability-based transition tables, such as Markovian models or cross-tabulation matrices, are often obtained from area-based transition as a theoretical tool of landscape ecology (Takada, Hasegawa and Miyamoto, 2009).

In the Markovian process, the state of a system at time 2 can be predicted by the state of the system at time 1 given a matrix of transition. This is performed through the analysis of a pair of land cover images (from the historical reference period 1996-2008) that outputs a transition probability matrix, which records the probability that each land cover category will change to every other category. The software used to run this quantitative prediction is Idrisi Selva, with the Land Change Modeler tool, which allows to rapidly analyze land cover change, simulate future land change scenarios, and model species impacts and biodiversity.

Area of classes 1996-2008 (ha)

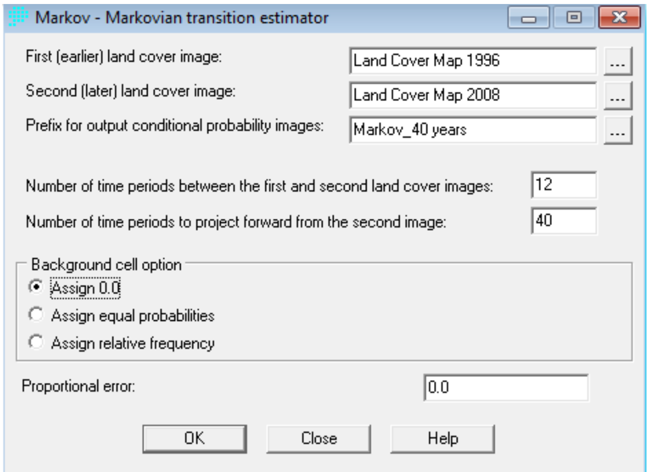
	Forest	Non-forest	Rivers	Total
1996	1,853,595.1	251,761.8	88,452.0	2,193,808.9
2008	1,508,804.0	596,552.9	88,452.0	2,193,808.9

Transition probability matrix 1996-2008 : 12 years

	Forest 2008	Non-forest 2008	Rivers 2008	Marginal Total 1996
Forest 1996	0.8140	0.1860	0.0000	1.0000
Non-forest 1996	0.0000	1.0000	0.0000	1.0000
Rivers 1996	0.0000	0.0000	1.0000	1.0000

The basic transition probability matrix is the result of cross-tabulation of the two images (1996 and 2008), and is calculated using the table entries and the marginal totals. For any 12 year period (starting at any point), we therefore expect 81.40% of forest to persist and 18.60% to change to non-forest, with no reversion back to forest. The 2008-2009 transition probabilities give 98.30% for persistence and show the annual rate of change is 1.70%, which is the annual rate of deforestation for the historical period 1996-2008, and it is the same annual deforestation rate obtained when calculated using equation 4a of methodology VM0015. Taking these to the 12th power yields the basic 12-year rate for each yet again.

Markov calculation requires the number of time periods between the first (1996) and second (2008) input landcover images (12 years) and the number of time periods to project into the future (40 years) for the output images. A crosstabulation is undertaken between the land cover maps for two dates, where the training period is from 1996 to 2008 (12 years).



Here are the results yielded by Land Change Modeler as the projection date is changed from 2008 to 2048 (but in every case, projecting from a starting date of 2008).

Transition probability matrix: 2008 - 2048

	Forest 2048	Non-forest 2048	Water
Forest 2008	0.5019	0.4981	0.0000
Non-forest 2008	0.0000	1.0000	0.0000
Water	0.0000	0.0000	1.0000

Based on: Takada, T., Miyamoto, A., and Hasegawa, S.F., (2010) Derivation of a yearly transition probability matrix for land-use dynamics and its applications, Landscape Ecology, 25, 561–572.

3.1.2 Data and Methods Uses

To project deforestation into the future, we used classified images from Landsat TM for 1996, 2004 and 2008. The module "Land Change Modeler" from Idrisi Selva software is appropriate for these calculations.

The software calculated the deforestation rate based on the classified images using a Markov Matrix. Once the deforestation rate was calculated, the model estimates the quantity and location of future deforestation. Further details and a thorough explanation regarding the method and steps for the calculation of the deforestation rate and future deforestation modeling can be found in Annex 3.

3.1.3 Projected Deforestation Results

The RRD is not stratified because there is only one forest type and strata. For this reason Table 8 of the vm0015 methodology for stratification of the reference region does not apply to the Project.

To project baseline deforestation we used classified Landsat 5 TM imagery for 1996, 2004 and 2008, using the classes Forest and Non-Forest. The module "Land Change Modeler" (LCM) from Idrisi Selva1 software is appropriate for these calculations. To develop the model we used the method of Similarity-

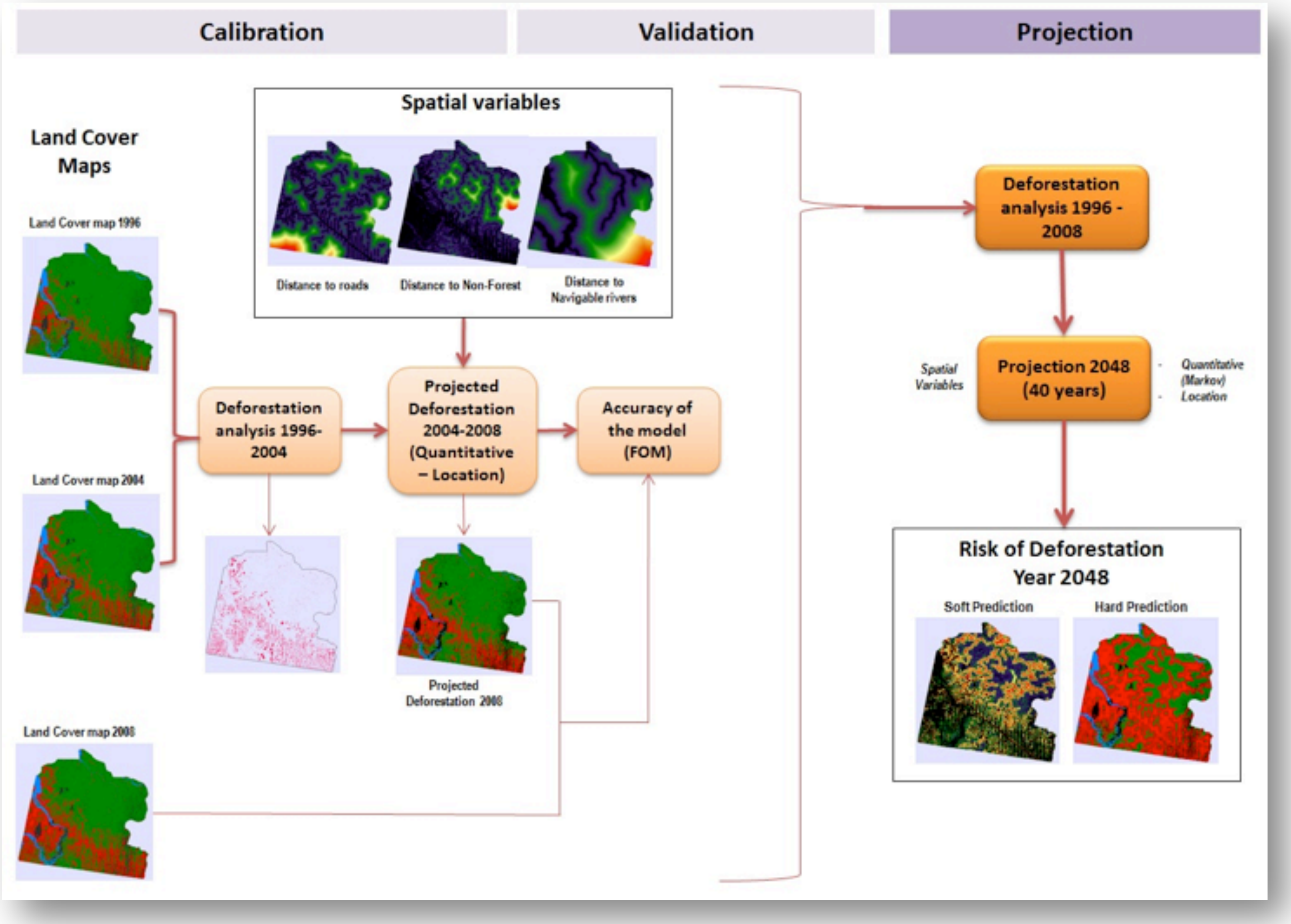
Weighted Instance-based Machine Learning (SimWeight). The transition that will be evaluated is Forest to Non-Forest.

The software calculated the deforestation rate based on the classified images using a Markov Matrix. Once the deforestation rate was calculated, the model estimates the quantity and location of future deforestation.

First, we needed to create a validation model that will test a set of driver variables that are assumed to describe the change from Forest to Non-Forest in the RRD. Land cover maps from three points in time have been created for this purpose: 1996, 2004 and 2008. This procedure will model the forest loss occurred between 1996 and 2004, make a prediction to 2008, and then validate the predicted 2008 map against the actual 2008 map. Through this step, we get to test and identify the various driver variables to better match the predicted map to the map of reality.

Once the appropriate drivers have been identified and the model validated, we will use this set of driver variables to model the change between 1996 and 2008, and then predict forest loss between 2008 and 2048, assuming that the historical rate of change continues without REDD project intervention. A flowchart of the process is presented below (Figure 14):

Figure 14: Flowchart of the process type model developed in the dynamic program-EGO



Preparation of factor maps

In this section, spatial variables that most likely explain the pattern of baseline deforestation in the RRD are identified. Each spatial variable on its own is a statement of basic suitability for the transition Forest to Non-Forest.

Variables were identified from the literature such as:

Distance from roads: (Uhl, Barreto et al. 1997; Asner, Broadbent et al. 2006; Brandão Júnior, Souza Júnior et al. 2007)

Forest Cover: (Kirby, Laurance et al. 2006; Larson 2008; May, Millikan et al. 2011)

It has been found that the RRD is very homogeneous in terms of biophysical and socio-economic variables, so biophysical factors (as elevation, slope) don't constitute mobility barriers for deforestation.

Spatial variables and Distance Maps (Factor Maps) for the RRD are presented below (Table 26):

Table 26 List of Factor Maps (Refer to Table 10 – VM0015 methodology)

Factor Maps		Source	Variable represented		Meaning of the categories or pixel values		Other maps and variables used to create the Factor Maps		Algorithm or equation used	Original scale of spatial data
ID	File Name		Unit	Description	Range	Meaning	ID	File name		
1	Distance to official roads	Landsat TM	meters	Continuos data	(0 - 116385)	Distance to official roads	1	Official Roads	Euclidean distance from the lines representing roads	1:75,000
2	Distance to non-official roads	Landsat TM	meters	Continuos data	(0 - 18102)	Distance to non-official roads	2	Non-official Roads	Euclidean distance from the lines representing roads	1:75,000
3	Distance to Non-Forest	Landsat TM and maps for each simulated year (Idrisi)	meters	Continuos data	Varies depending of the model stages	Distance to Non-Forest	3			8100 m2 (pixel of 90 meters)
4	Distance to navegable rivers	Landsat TM and Imazon	meters	Continuos data	(0 - 87753)	Distance to navegable rivers	4	Navegable rivers	Euclidean distance from the lines representing rivers	1:75,000

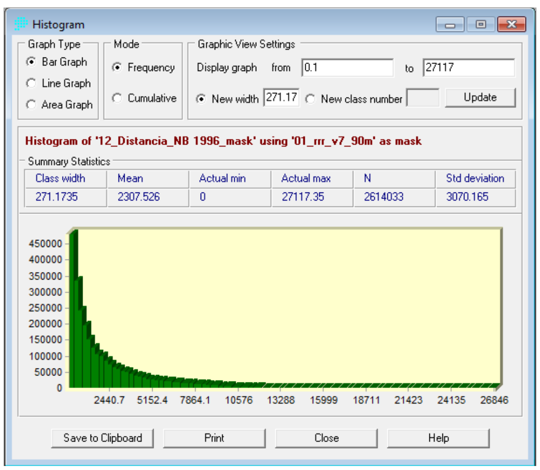
Based on the results from the historical reference period analysis, future deforestation was projected into the year 2048 (see Figure 15). A detailed explanation on how future deforestation was modeled can be found in Annex 3.

Model Uncertainty

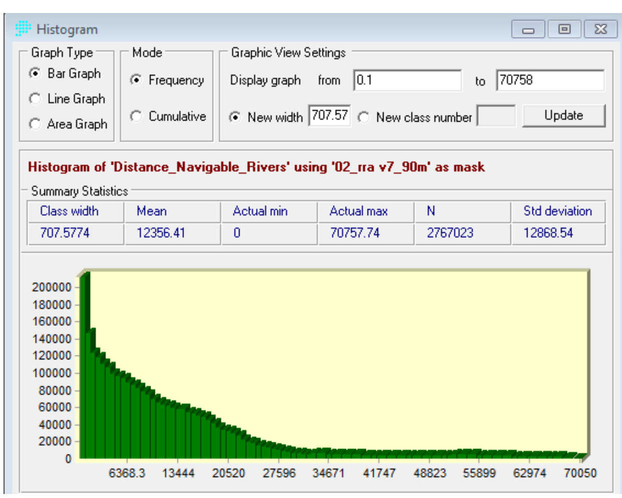
The VM0015 methodology do not includes a procedure to assess uncertainty of the deforestation rate. For this reason, the uncertainty assessment was performed following the method described in the REDD Methodological Module: Estimation of Uncertainty for REDD Project Activities from VCS' VMD0017 methodology – Step 1. Based on this module, uncertainty of the deforestation rates used in all RRD Strata are considered zero as they use historic rates calculated from a long term average.

The uncertainty of the environmental variables recommends measurement, according to IPCC GPG 2006, using the standard deviation of the distribution (because the distribution of the distance variables are asymmetric - not a normal distribution). The standard deviation is calculated on the basis of class frequencies. The standard deviations of the driver variables are in units of meters and are presented here:

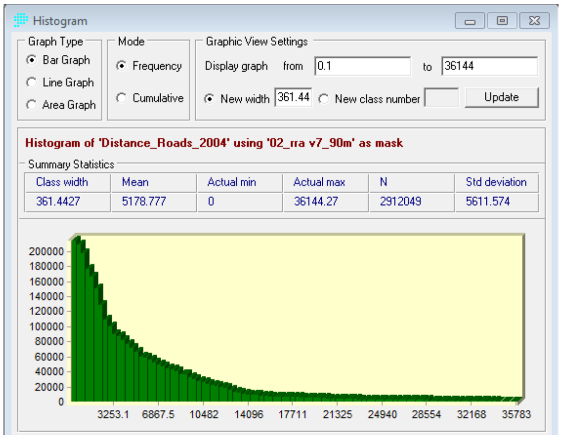
Distance to previously Non-Forest:



Distance to Navigable Rivers:



Distance to Roads:



There are three user-defined variables in IDRISI Selva's Land Change Modeler SimWeight module: Sample Size, Number of nearest neighbors (k), and Relevance threshold. The recommended guidance for selection of those parameters and our experience in testing them differed as follows:

Sample size:

The sample size is supposed to be a healthy percentage of the change pixels that contains a representative number of cells. While a minimum sample could be one and the maximum sample could be equal to the maximum number of pixels undergoing change, the real number chosen for use is going to be based on: a) the shape of the histograms for each environmental variable of sampled pixels vs. changed pixels, and b) the amount of time needed to make a model run (Sangermano, 2011). The software defaults to a sample size of 1000, and recommends that a sample size of 1000-2000 pixels will likely be suitable for use (but in practice, this will depend on the number of transitions; in our case, the maximum transitions was about 260,000). We tried sample sizes of 1000, 2000, 5000, 26000, and 52000, and found that the histograms of the environmental variables, while taking significantly longer and longer to run, but the shapes were not appreciably different.

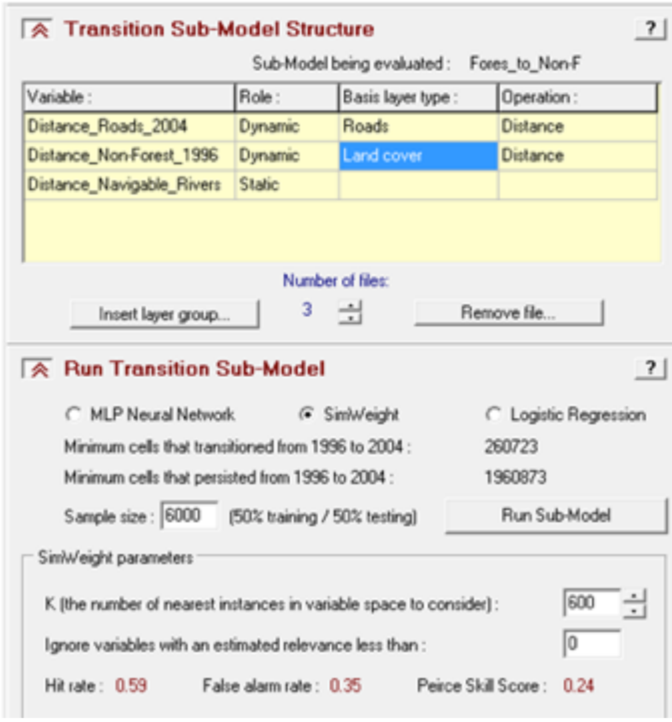
K value:

The value of K is the number of nearest neighbors (in variable space) that are considered. The software and literature (Sangermano, 2011) recommends that K be about 10% of the sample size, but also recommends an iterative sensitivity type analysis to assess different K-sizes against the difference in FOM accuracy experienced. Thus here, we tried (corresponding to our sample sizes and guidance literature) values of 50, 100, 150, 300, 500, 2600, and 5200, and yet there was no difference in the accuracy experienced by measuring FOM for each of the attempts, yet model run time took appreciably longer, with the max run time being more than 2 hrs.

Relevance threshold:

The use of the relevance threshold is mandatory (without it, SimWeight does not proceed). Weights choose whether there is equal use of all environmental variables or larger emphasis placed on one or more versus another, by setting a threshold on the degree of relevance. If a coverage has a relevance of less than 0.01 (as measured by the IDRISI's Land Change Modeler for various Sample Sizes), then a

SimWeight threshold of 0.01 will disable the use of such variable in the model to predict changes). The use of a value of 0.0 will force SimWeight to use all of the variables equally. Multiple iterations using thresholds of 0.0 and 0.1 (given different sample sizes and K values) presented higher accuracy than when variables, other than distance from rivers, were emphasized.



Selection of the method

We can reference studies or papers that have used IDRISI and the Land Change Modeler (LCM) tool for modeling deforestation and changes over time:

a. IMAZON,2011. "*Risco de desmatamento associado à hidrelétrica de Belo Monte*". Belém, Pará.

b. CIMA, 2012. "*Cordillera Azul National Park REDD Project, Perú*".

c. Fuller, Douglas O, Martin Hardiono, and Erik Meijaard. 2011*. "Deforestation projections for carbon-rich peat swamp forests of central Kalimantan, Indonesia"*. Environmental Management. http://www.ncbi.nlm.nih.gov/pubmed/21359865.

d. Sangermano, F., Eastman, J.R., Zhu, H. (2010) "*Similarly weighted instance based learning for the generation of transition potentials in land change modeling*," Transactions in GIS, 14, 5, 569-580.

Results of the annual areas of baseline deforestation for the RRD, Project Area and Leakage Belt are presented below (Tables 27, 28 and 29)

Table 27: Annual areas deforested in each zone within the reference region in the baseline case (Refer to Table 9.a – VM0015 methodology)

Project year t	Stratum i in the reference region $ABSLRR_{i,t}$ ha	Total RR annual $ABSLRR_t$ ha	Total RR cumulative $ABSLRR$ ha
1	18,788	18,788	18,788
2	18,788	18,788	37,576
3	18,788	18,788	56,364
4	18,788	18,788	75,152
5	18,788	18,788	93,940
6	18,788	18,788	112,727
7	18,788	18,788	131,515
8	18,788	18,788	150,303
9	18,788	18,788	169,091
10	18,788	18,788	187,879
11	18,788	18,788	206,667
12	18,788	18,788	225,455
13	18,788	18,788	244,243
14	18,788	18,788	263,031
15	18,788	18,788	281,819
16	18,788	18,788	300,606
17	18,788	18,788	319,394
18	18,788	18,788	338,182
19	18,788	18,788	356,970
20	18,788	18,788	375,758
21	18,788	18,788	394,546
22	18,788	18,788	413,334
23	18,788	18,788	432,122
24	18,788	18,788	450,910
25	18,788	18,788	469,698
26	18,788	18,788	488,485
27	18,788	18,788	507,273
28	18,788	18,788	526,061
29	18,788	18,788	544,849
30	18,788	18,788	563,637
31	18,788	18,788	582,425
32	18,788	18,788	601,213
33	18,788	18,788	620,001
34	18,788	18,788	638,789
35	18,788	18,788	657,577
36	18,788	18,788	676,364
37	18,788	18,788	695,152
38	18,788	18,788	713,940
39	18,788	18,788	732,728
40	18,788	18,788	751,516

Table 28: Annual areas deforested in each zone within the project area in the baseline case (Refer to Table 9.b – VM0015 methodology)

Project year *t*	Stratum *i* of the reference region in the project area	Total PA	
		annual	cumulative
	$ABSLPA_{i,t}$	$ABSLPA_t$	$ABSLPA$
	ha	ha	ha
1	1,034	1,034	1,034
2	1,407	1,407	2,441
3	1,610	1,610	4,052
4	1,538	1,538	5,590
5	1,411	1,411	7,001
6	1,198	1,198	8,199
7	1,217	1,217	9,416
8	1,069	1,069	10,485
9	986	986	11,471
10	903	903	12,374
11	841	841	13,215
12	830	830	14,045
13	789	789	14,834
14	710	710	15,544
15	766	766	16,310
16	776	776	17,086
17	759	759	17,845
18	759	759	18,604
19	756	756	19,360
20	768	768	20,128
21	812	812	20,939
22	795	795	21,734
23	965	965	22,699
24	1,018	1,018	23,717
25	1,011	1,011	24,728
26	1,100	1,100	25,828
27	1,103	1,103	26,931
28	1,142	1,142	28,073
29	1,375	1,375	29,448
30	1,555	1,555	31,004
31	1,582	1,582	32,585
32	1,865	1,865	34,450
33	1,762	1,762	36,212
34	1,430	1,430	37,642
35	1,508	1,508	39,151
36	1,501	1,501	40,651
37	1,502	1,502	42,153
38	1,499	1,499	43,653
39	1,516	1,516	45,169
40	1,490	1,490	46,659

Table 29: Annual areas deforested in each zone within the leakage belt in the baseline case (Refer to Table 9.c – VM0015 methodology)

Project year *t*	Stratum *i* of the reference region in leakage belt $ABSLK_{i,t}$ ha	Total LM annual $ABSLK_t$ ha	Total LM cumulative *ABSLK* ha
1	12,361	12,360.6	12,360.6
2	2,901	2,900.6	15,261.2
3	2,675	2,675.4	17,936.6
4	2,381	2,381.4	20,318.0
5	2,236	2,235.6	22,553.6
6	1,929	1,928.6	24,482.3
7	1,843	1,842.8	26,325.0
8	1,729	1,728.5	28,053.5
9	1,658	1,658.1	29,711.6
10	1,586	1,586.0	31,297.6
11	1,528	1,528.5	32,826.1
12	1,254	1,253.9	34,079.9
13	1,302	1,302.5	35,382.4
14	1,412	1,411.8	36,794.3
15	1,627	1,627.3	38,421.5
16	1,537	1,536.6	39,958.1
17	1,547	1,547.1	41,505.2
18	1,733	1,732.6	43,237.8
19	1,805	1,804.7	45,042.5
20	1,902	1,901.9	46,944.4
21	1,867	1,867.1	48,811.4
22	2,039	2,038.8	50,850.2
23	2,223	2,223.5	53,073.6
24	2,448	2,447.8	55,521.5
25	2,406	2,405.7	57,927.2
26	2,699	2,698.9	60,626.1
27	2,927	2,927.3	63,553.4
28	3,384	3,384.2	66,937.6
29	3,741	3,741.4	70,679.0
30	3,839	3,838.6	74,517.6
31	3,985	3,985.2	78,502.8
32	4,107	4,106.7	82,609.5
33	3,966	3,965.8	86,575.2
34	3,592	3,592.4	90,167.6
35	3,833	3,832.9	94,000.5
36	3,788	3,787.6	97,788.1
37	3,424	3,423.9	101,211.9
38	3,466	3,466.0	104,677.9
39	3,317	3,317.0	107,994.9
40	3,440	3,440.1	111,434.9

Figure 15: Projected deforestation results

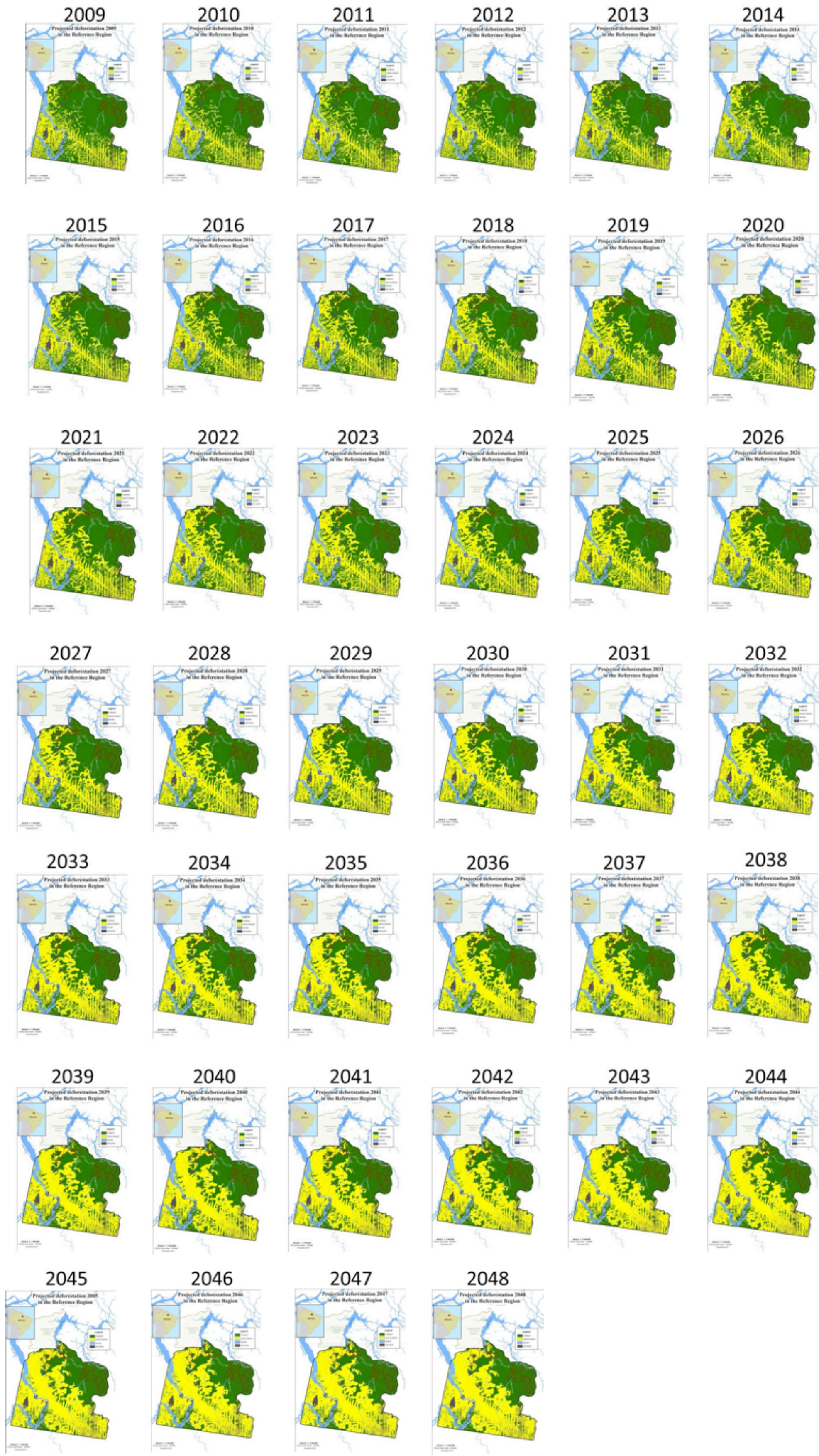


Table 30: Annual areas deforested per forest class within the Reference Region in the baseline case (activity data per forest class) (Refer to Table 11.a – VM0015 methodology)

Area deforested per forest class *icl* within the Reference Region			Total baseline deforestation in the reference region	
ID$_{icl}$>				
Name >	Ombrophile Dense	Ombrophile Degraded	annual	cumulative
Project year *t*	*ha*	*ABSLPA$_{icl,t}$* ha	*ABSLRR$_t$* ha	*ABSLRR* ha
1	18,787.9		18,787.9	18,787.9
2	18,787.9		18,787.9	37,575.8
3	18,787.9		18,787.9	56,363.7
4	18,787.9		18,787.9	75,151.6
5	18,787.9		18,787.9	93,939.5
6	18,787.9		18,787.9	112,727.4
7	18,787.9		18,787.9	131,515.3
8	18,787.9		18,787.9	150,303.2
9	18,787.9		18,787.9	169,091.1
10	18,787.9		18,787.9	187,879.0
11	18,787.9		18,787.9	206,666.9
12	18,787.9		18,787.9	225,454.8
13	18,787.9		18,787.9	244,242.7
14	18,787.9		18,787.9	263,030.6
15	18,787.9		18,787.9	281,818.5
16	18,787.9		18,787.9	300,606.4
17	18,787.9		18,787.9	319,394.3
18	18,787.9		18,787.9	338,182.2
19	18,787.9		18,787.9	356,970.1
20	18,787.9		18,787.9	375,758.0
21	18,787.9		18,787.9	394,545.9
22	18,787.9		18,787.9	413,333.8
23	18,787.9		18,787.9	432,121.7
24	18,787.9		18,787.9	450,909.6
25	18,787.9		18,787.9	469,697.5
26	18,787.9		18,787.9	488,485.4
27	18,787.9		18,787.9	507,273.3
28	18,787.9		18,787.9	526,061.2
29	18,787.9		18,787.9	544,849.1
30	18,787.9		18,787.9	563,637.0
31	18,787.9		18,787.9	582,424.9
32	18,787.9		18,787.9	601,212.8
33	18,787.9		18,787.9	620,000.7
34	18,787.9		18,787.9	638,788.6
35	18,787.9		18,787.9	657,576.5
36	18,787.9		18,787.9	676,364.4
37	18,787.9		18,787.9	695,152.3
38	18,787.9		18,787.9	713,940.2
39	18,787.9		18,787.9	732,728.1
40	18,787.9		18,787.9	751,516.0

Table 31: Annual areas deforested per forest class within the Project Area in the baseline case (activity data per forest class) (Refer to Table 11.b – VM0015 methodology)

Area deforested per forest class *icl* within the project area			Total baseline deforestation in the project area	
ID_{icl}>				
Name >	Ombrophile Dense	Ombrophile Degraded	annual	cumulative
Project year *t*	*ha*	$ABSLPA_{icl,t}$ ha	$ABSLPA_t$ ha	*ABSLPA* ha
1	622.1	412.3	1,034.4	1,034.4
2	869.1	537.8	1,407.0	2,441.3
3	972.0	638.3	1,610.3	4,051.6
4	953.4	584.8	1,538.2	5,589.8
5	912.9	498.2	1,411.0	7,000.8
6	751.7	446.3	1,198.0	8,198.8
7	787.3	430.1	1,217.4	9,416.3
8	713.6	355.6	1,069.2	10,485.5
9	692.5	293.2	985.8	11,471.2
10	615.6	287.6	903.2	12,374.4
11	618.8	221.9	840.8	13,215.2
12	633.4	196.8	830.3	14,045.4
13	599.4	189.5	788.9	14,834.3
14	541.9	167.7	709.6	15,543.9
15	579.2	187.1	766.3	16,310.2
16	578.3	197.6	776.0	17,086.1
17	584.0	175.0	759.0	17,845.1
18	572.7	186.3	759.0	18,604.1
19	582.4	173.3	755.7	19,359.8
20	590.5	177.4	767.9	20,127.7
21	620.5	191.2	811.6	20,939.3
22	636.7	158.0	794.6	21,733.9
23	795.4	169.3	964.7	22,698.6
24	846.4	171.7	1,018.2	23,716.8
25	832.7	178.2	1,010.9	24,727.7
26	928.3	171.7	1,100.0	25,827.7
27	925.8	177.4	1,103.2	26,930.9
28	969.6	172.5	1,142.1	28,073.0
29	1,138.9	236.5	1,375.4	29,448.4
30	1,328.4	226.8	1,555.2	31,003.6
31	1,370.5	211.4	1,581.9	32,585.5
32	1,632.2	232.5	1,864.6	34,450.1
33	1,556.8	204.9	1,761.8	36,211.9
34	1,290.3	140.1	1,430.5	37,642.3
35	1,372.1	136.1	1,508.2	39,150.5
36	1,377.0	123.9	1,500.9	40,651.5
37	1,394.8	106.9	1,501.7	42,153.2
38	1,401.3	98.0	1,499.3	43,652.5
39	1,405.4	111.0	1,516.3	45,168.8
40	1,380.2	110.2	1,490.4	46,659.2

Table 32: Annual areas deforested per forest class within the leakage belt in the baseline case (activity data per forest class) (Refer to Table 11.c – VM0015 methodology)

Area deforested per forest class *icl* within the leakage belt			Total baseline deforestation in the leakage belt	
ID_{icl}>				
Name >	Ombrophile Dense	Ombrophile Dense	annual	cumulative
Project year *t*	*ha*	$ABSLPA_{icl,t}$ ha	$ABSLLK_t$ ha	*ABSLLK* ha
1	12,360.6		12,360.6	12,360.6
2	2,900.6		2,900.6	15,261.2
3	0.0		-	15,261.2
4	2,381.4		2,381.4	17,642.6
5	2,235.6		2,235.6	19,878.2
6	1,928.6		1,928.6	21,806.8
7	1,842.8		1,842.8	23,649.6
8	1,728.5		1,728.5	25,378.1
9	1,658.1		1,658.1	27,036.2
10	1,586.0		1,586.0	28,622.2
11	1,528.5		1,528.5	30,150.6
12	1,253.9		1,253.9	31,404.5
13	1,302.5		1,302.5	32,707.0
14	1,411.8		1,411.8	34,118.8
15	1,627.3		1,627.3	35,746.1
16	1,536.6		1,536.6	37,282.7
17	1,547.1		1,547.1	38,829.8
18	1,732.6		1,732.6	40,562.4
19	1,804.7		1,804.7	42,367.1
20	1,901.9		1,901.9	44,268.9
21	1,867.1		1,867.1	46,136.0
22	2,038.8		2,038.8	48,174.8
23	2,223.5		2,223.5	50,398.2
24	2,447.8		2,447.8	52,846.0
25	2,405.7		2,405.7	55,251.7
26	2,698.9		2,698.9	57,950.6
27	2,927.3		2,927.3	60,878.0
28	3,384.2		3,384.2	64,262.2
29	3,741.4		3,741.4	68,003.6
30	3,838.6		3,838.6	71,842.1
31	3,985.2		3,985.2	75,827.3
32	4,106.7		4,106.7	79,934.0
33	3,965.8		3,965.8	83,899.8
34	3,592.4		3,592.4	87,492.2
35	3,832.9		3,832.9	91,325.1
36	3,787.6		3,787.6	95,112.6
37	3,423.9		3,423.9	98,536.5
38	3,466.0		3,466.0	102,002.5
39	3,317.0		3,317.0	105,319.4
40	3,440.1		3,440.1	108,759.5

3.1.3.1 Calculation of baseline activity data per post-deforestation forest class

It will be assumed that Grassland is the only post-deforestation land-use implemented in the RRD because it can be developed anywhere in the RDD, it is the land-use with most historical participation in deforestation, and the one with the highest average carbon stock per hectare (which makes it the most conservative choice for post-deforestation land-use) (Table 33).

LU/LC classes were projected using Method 1 (Historical LU/LC-change). The Project identifies only one Zone (Table 33) for the development of post-deforestation land-uses. Because Method 1 has been used then Tables 14a,b, and c (Method 2) do not apply to the Project.

Table 33: Criteria to justify the selection of only one Zone with Grassland as the only post-deforestation LU/LC-class

	Grassland	Cropland
Historical participation in deforestation within the RRD	98%	2%
Occurrence	Anywhere in the RRD	Only within a 3Km buffer from the river shores
Average Total Carbon Stock (tCO_2e/ha)	51.46	18.33

Average Total Carbon Stock values were taken from IPCC 2003. Original values are increased in 75% to account for the highest boundary of the error range according to the requirements of the VM0015 methodology

Table 34: Zones of the reference region encompassing different combinations of potential post-deforestation LU/LC classes (Refer to Table 12 - VM0015)

Zone		Name: Grassland		Total area of each Zone	
		ID$_{fcl}$	002		
		Area	% of Zone	Area	% of Zone
IDz	*Name*	ha	%	ha	%
1	Zone 1	1,508,804.01	100.00%	1508804.01	100.00%
Total area of each class *fcl*		1508804.01	100.00%		

Table 35: Annual areas deforested in each zone within the reference region in the baseline case (Refer to Table 13.a – VM0015 methodology)

IDz >	1	Total baseline deforestation in the reference region	
Name >	Zone 1	*$ABSLRR_t$*	*ABSLRR*
Project year *t*	ha	ha	ha
0	-	-	-
1	18,788	18,788	18,788
2	18,788	18,788	37,576
3	18,788	18,788	56,364
4	18,788	18,788	75,152
5	18,788	18,788	93,940
6	18,788	18,788	112,727
7	18,788	18,788	131,515
8	18,788	18,788	150,303
9	18,788	18,788	169,091
10	18,788	18,788	187,879
11	18,788	18,788	206,667
12	18,788	18,788	225,455
13	18,788	18,788	244,243
14	18,788	18,788	263,031
15	18,788	18,788	281,819
16	18,788	18,788	300,606
17	18,788	18,788	319,394
18	18,788	18,788	338,182
19	18,788	18,788	356,970
20	18,788	18,788	375,758
21	18,788	18,788	394,546
22	18,788	18,788	413,334
23	18,788	18,788	432,122
24	18,788	18,788	450,910
25	18,788	18,788	469,698
26	18,788	18,788	488,485
27	18,788	18,788	507,273
28	18,788	18,788	526,061
29	18,788	18,788	544,849
30	18,788	18,788	563,637
31	18,788	18,788	582,425
32	18,788	18,788	601,213
33	18,788	18,788	620,001
34	18,788	18,788	638,789
35	18,788	18,788	657,577
36	18,788	18,788	676,364
37	18,788	18,788	695,152
38	18,788	18,788	713,940
39	18,788	18,788	732,728
40	18,788	18,788	751,516

Table 36: Annual areas deforested in each zone within the project area in the baseline case (Refer to Table 13.b – VM0015 methodology)

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	1,034	1,034.37	1,034.37
2	1,407	1,406.97	2,441.34
3	1,610	1,610.28	4,051.62
4	1,538	1,538.19	5,589.81
5	1,411	1,411.02	7,000.83
6	1,198	1,197.99	8,198.82
7	1,217	1,217.43	9,416.25
8	1,069	1,069.20	10,485.45
9	986	985.77	11,471.22
10	903	903.15	12,374.37
11	841	840.78	13,215.15
12	830	830.25	14,045.40
13	789	788.94	14,834.34
14	710	709.56	15,543.90
15	766	766.26	16,310.16
16	776	775.98	17,086.14
17	759	758.97	17,845.11
18	759	758.97	18,604.08
19	756	755.73	19,359.81
20	768	767.88	20,127.69
21	812	811.62	20,939.31
22	795	794.61	21,733.92
23	965	964.71	22,698.63
24	1,018	1,018.17	23,716.80
25	1,011	1,010.88	24,727.68
26	1,100	1,099.98	25,827.66
27	1,103	1,103.22	26,930.88
28	1,142	1,142.10	28,072.98
29	1,375	1,375.38	29,448.36
30	1,555	1,555.20	31,003.56
31	1,582	1,581.93	32,585.49
32	1,865	1,864.62	34,450.11
33	1,762	1,761.75	36,211.86
34	1,430	1,430.46	37,642.32
35	1,508	1,508.22	39,150.54
36	1,501	1,500.93	40,651.47
37	1,502	1,501.74	42,153.21
38	1,499	1,499.31	43,652.52
39	1,516	1,516.32	45,168.84
40	1,490	1,490.40	46,659.24

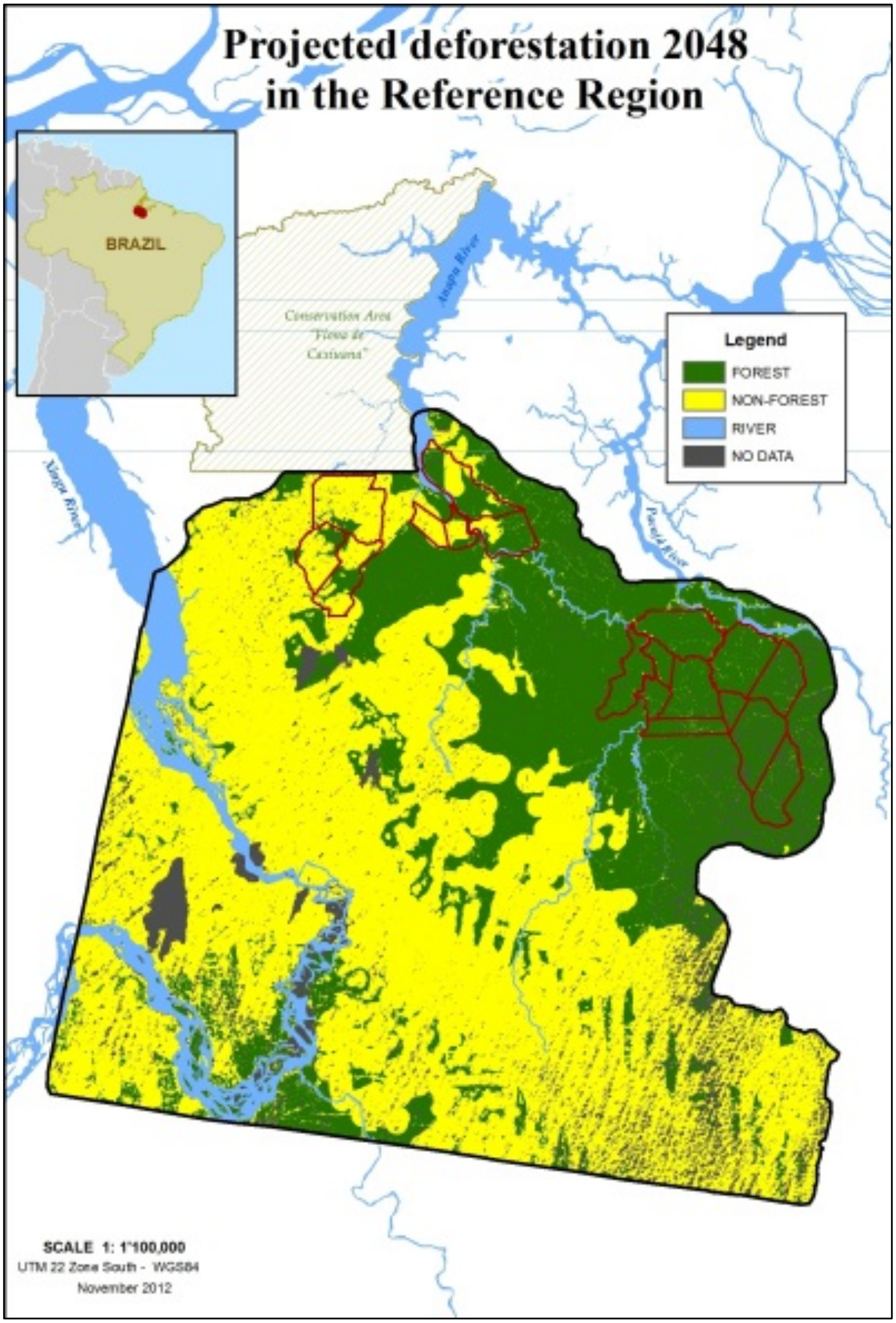
Table 37: Annual areas deforested in each zone within the leakage belt in the baseline case (Refer to Table 13.c – VM0015 methodology)

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	12,360.60	12,360.60	12,360.60
2	2,900.61	2,900.61	15,261.21
3	2,675.43	2,675.43	17,936.64
4	2,381.40	2,381.40	20,318.04
5	2,235.60	2,235.60	22,553.64
6	1,928.61	1,928.61	24,482.25
7	1,842.75	1,842.75	26,325.00
8	1,728.54	1,728.54	28,053.54
9	1,658.07	1,658.07	29,711.61
10	1,585.98	1,585.98	31,297.59
11	1,528.47	1,528.47	32,826.06
12	1,253.88	1,253.88	34,079.94
13	1,302.48	1,302.48	35,382.42
14	1,411.83	1,411.83	36,794.25
15	1,627.29	1,627.29	38,421.54
16	1,536.57	1,536.57	39,958.11
17	1,547.10	1,547.10	41,505.21
18	1,732.59	1,732.59	43,237.80
19	1,804.68	1,804.68	45,042.48
20	1,901.88	1,901.88	46,944.36
21	1,867.05	1,867.05	48,811.41
22	2,038.77	2,038.77	50,850.18
23	2,223.45	2,223.45	53,073.63
24	2,447.82	2,447.82	55,521.45
25	2,405.70	2,405.70	57,927.15
26	2,698.92	2,698.92	60,626.07
27	2,927.34	2,927.34	63,553.41
28	3,384.18	3,384.18	66,937.59
29	3,741.39	3,741.39	70,678.98
30	3,838.59	3,838.59	74,517.57
31	3,985.20	3,985.20	78,502.77
32	4,106.70	4,106.70	82,609.47
33	3,965.76	3,965.76	86,575.23
34	3,592.35	3,592.35	90,167.58
35	3,832.92	3,832.92	94,000.50
36	3,787.56	3,787.56	97,788.06
37	3,423.87	3,423.87	101,211.93
38	3,465.99	3,465.99	104,677.92
39	3,316.95	3,316.95	107,994.87
40	3,440.07	3,440.07	111,434.94

It is predicted that 27% of the forest in the project area will disappear under the baseline scenario within the 40 years[41]. Results from the deforestation modeling for the baseline scenario are shown in Map 23:

[41] Project Area = 177,899.5 ha, then 48,334.32.4ha / 177,899.5ha = 0.27

Map 23: Baseline deforestation results for the year 2048



3.2 Project Emissions

3.2.1 Calculation of GHG emissions in the baseline scenario due to LULC change

The Project does not account for soil organic carbon thus Tables 18a,b as well as Tables 19a,b,c of the vm0015 methodology do not apply to the Project.

Above-ground biomass calculations for DBH < 10cm were performed using allometric equations as described in Annex 5.

Above-ground biomass for a DBH ≥ 10cm was calculated using Overman's equation (Overman, Witte et al. 1994) corrected for biomass moisture content (Araujo, Higuchi et al. 1999). Overman's equation is presented below (Figure 16):

Figure 16: 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		

Source: Overman 1994

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 coeficients: 0.465 and 2.202

Biomass results for 1 hectare of forest in the RRD, Project Area and Leakage Belt are (Table 38):

Table 38: 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
Biomass (tdm/ha)	N 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	85.58	53.84
	Max	11.93	7.89	8.83	4.85	2.21	1.56	15.67	14.51	17.97	583.66	541.59	162.68	616.11	566.21	191.04
	Mean	4.73	4.89	6.50	1.14	0.90	1.06	7.46	7.22	7.48	247.55	243.44	104.29	260.89	256.45	119.33
	SD	2.22	1.75	1.60	0.85	0.55	0.36	3.23	3.24	6.09	118.90	118.81	47.80	125.19	124.35	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	52.81	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 39) based on the results from the Carbon Inventory (Annex 5).

Table 39: Area proportion factors for forest classes

	Area Proportion Factors		
	Dense Forest	**Degraded Forest**	**Total**
Sample area	830,631.10	75,368.04	905,999.14
Area-weight	92%	8%	100%

An uncertainty assessment was done for the results as required by the VM0015 methodology[42]. 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*."

An uncertainty assessment at 95% Confidence Interval was applied to the results from the Carbon Inventory (Table 40).

[42] 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.

Table 40: 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

		Dense Forest	Degraded Forest
$Uncertainty_{BSL,SS,i}$	$\sum_1^n (U_{BSL,SS,i,pool\#} * E_{BSL,SS,i,pool\#})^2$	862.9478649	3618.31092
	$\sqrt{\sum_1^n (U_{BSL,SS,i,pool\#} * E_{BSL,SS,i,pool\#})^2}$	29.37597428	60.15239746
	$\frac{\sqrt{\sum_1^n (U_{BSL,SS,i,pool\#} * E_{BSL,SS,i,pool\#})^2}}{\sum_1^n E_{BSL,SS,i,pool\#}}$	11%	23%
		Fails	**Fails**

None of the initial values (Table 41) 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 42):

Table 41: 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*								Initial forest class *icl*							
	Name:	Ombrophile Dense							Name:	Ombrophile Degraded						
	IDicl	1							IDicl	2						
	Average carbon stock per hectare ± 90% CI								Average carbon stock per hectare ± 90% CI							
	Cab_{icl}		Cbb_{icl}		Cl_{icl}		$Ctot_{cl}$		Cab_{icl}		Cbb_{icl}		Cl_{icl}		$Ctot_{cl}$	
	C stock	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI
	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
1	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
2	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
3	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
4	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
5	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
6	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
7	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
8	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
9	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
10	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
11	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
12	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
13	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
14	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
15	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
16	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
17	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
18	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
19	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
20	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
21	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
22	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
23	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
24	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
25	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
26	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
27	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
28	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
29	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
30	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
31	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
32	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
33	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
34	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
35	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
36	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
37	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
38	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
39	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1
40	469.6	46.7	105.2	10.5	8.68	0.8	583.5	58.0	461.2	95.5	103.43	21.3	8.96	1.36	573.6	118.1

Table 42: Values to be used after discounts for uncertainties (Refer to Table 15.b – VM0015 methodology)

Project year *t*	Initial forest class *icl* Name: Ombrophile Dense IDicl 1 Average carbon stock per hectare ± 90% CI								Initial forest class *icl* Name: Ombrophile Degraded IDicl 2 Average carbon stock per hectare ± 90% CI							
	*Cab*icl		*Cbb*icl		*Cl*icl		*Ctot*cl		*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*	*C stock*	*C stock change*	*C stock*	*C stock change*	*C stock*	*C stock change*	*C stock*	*C stock change*
	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
1	422.90		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
2	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
3	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
4	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
5	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
6	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
7	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
8	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
9	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
10	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
11	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
12	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
13	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
14	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
15	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
16	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
17	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
18	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
19	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
20	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
21	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
22	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
23	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
24	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
25	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
26	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
27	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
28	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
29	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
30	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
31	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
32	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
33	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
34	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
35	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
36	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
37	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
38	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
39	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	
40	422.9		94.8		7.8		525.5		365.7		82.1		7.6		455.5	

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 43):

Table 43: 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)

Project year *t*	Post deforestation class *fcl* Name: Grassland ID*fcl* ´002 Average carbon stock per hectare ± 90% CI								
	*Cab*fcl		*Cbb*fcl		*Cl*fcl		*Ctot*fcl	
	C stock	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI
	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
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 44):

Table 44: 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								
		Cabfcl		*Cbbfcl*		*Clfcl*		*Cabz*	*Cbbz*	*Clz*	*Ctot z*
		C stock	± 90% CI	*C stock*	± 90% CI	*C stock*	± 90% CI	*C stock*	*C stock*	*C stock*	*C stock*
ID*z*	Name	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
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 45 and 46). 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 Method2.

Table 45: Carbon stock change factors for initial forest classes icl (Refer to Table 20.a – VM0015 methodology)

Year after deforestation		Dense Forest			Degraded Forest		
		$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$	$\Delta Cl_{icl,t}$	$\Delta Cab_{icl,t}$	$\Delta Cbb_{icl,t}$	$\Delta Cl_{icl,t}$
1	t*	-422.9	-9.48	-7.84	-365.74	-8.21	-7.6
2	t*+1	0	-9.48	0	0	-8.21	0
3	t*+2	0	-9.48	0	0	-8.21	0
4	t*+3	0	-9.48	0	0	-8.21	0
5	t*+4	0	-9.48	0	0	-8.21	0
6	t*+5	0	-9.48	0	0	-8.21	0
7	t*+6	0	-9.48	0	0	-8.21	0
8	t*+7	0	-9.48	0	0	-8.21	0
9	t*+8	0	-9.48	0	0	-8.21	0
10	t*+9	0	-9.48	0	0	-8.21	0
11	t*+10	0	0.00	0	0	0.00	0
12	t*+11	0	0.00	0	0	0.00	0
13	t*+12	0	0.00	0	0	0.00	0
14	t*+13	0	0.00	0	0	0.00	0
15	t*+14	0	0.00	0	0	0.00	0
16	t*+15	0	0.00	0	0	0.00	0
17	t*+16	0	0.00	0	0	0.00	0
18	t*+17	0	0.00	0	0	0.00	0
19	t*+18	0	0.00	0	0	0.00	0
20	t*+19	0	0.00	0	0	0.00	0
21	t*+20	0	0.00	0	0	0.00	0
22	t*+21	0	0.00	0	0	0.00	0
23	t*+22	0	0.00	0	0	0.00	0
24	t*+23	0	0.00	0	0	0.00	0
25	t*+24	0	0.00	0	0	0.00	0
26	t*+25	0	0.00	0	0	0.00	0
27	t*+26	0	0.00	0	0	0.00	0
28	t*+27	0	0.00	0	0	0.00	0
29	t*+28	0	0.00	0	0	0.00	0
30	t*+29	0	0.00	0	0	0.00	0
31	t*+30	0	0.00	0	0	0.00	0
32	t*+31	0	0.00	0	0	0.00	0
33	t*+32	0	0.00	0	0	0.00	0
34	t*+33	0	0.00	0	0	0.00	0
35	t*+34	0	0.00	0	0	0.00	0
36	t*+35	0	0.00	0	0	0.00	0
37	t*+36	0	0.00	0	0	0.00	0
38	t*+37	0	0.00	0	0	0.00	0
39	t*+38	0	0.00	0	0	0.00	0
40	t*+39	0	0.00	0	0	0.00	0

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 45):

Table 46: Carbon stock change factors for final forest classes icl (Refer to Table 20.b – VM0015 methodology)

Year after deforestation		Zone 1 $\Delta Cab_{z,t}$	Zone 1 $\Delta Cbb_{z,t}$	Zone 1 $\Delta Cl_{z,t}$	Zone 1 $\Delta Tot_{z,t}$
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	1.72	1.72	1.72	5.17
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
31	t*+30	0.00	0.00	0.00	0.00
32	t*+31	0.00	0.00	0.00	0.00
33	t*+32	0.00	0.00	0.00	0.00
34	t*+33	0.00	0.00	0.00	0.00
35	t*+34	0.00	0.00	0.00	0.00
36	t*+35	0.00	0.00	0.00	0.00
37	t*+36	0.00	0.00	0.00	0.00
38	t*+37	0.00	0.00	0.00	0.00
39	t*+38	0.00	0.00	0.00	0.00
40	t*+39	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 47, 48, 49, 50, 51, 52, 53, 54 and 55). 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 47: 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		**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		Total net carbon stock change in the above-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	Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
-	-	-	-	-	-	-	-	-	-
1	(7,945,403)	(7,945,403)	(7,945,403)	1	32,347	32,347	32,347	(7,977,749)	(7,977,749)
2	(7,945,403)	(7,945,403)	(15,890,806)	2	32,347	32,347	64,693	(7,977,749)	(15,955,499)
3	(7,945,403)	(7,945,403)	(23,836,209)	3	32,347	32,347	97,040	(7,977,749)	(23,933,248)
4	(7,945,403)	(7,945,403)	(31,781,612)	4	32,347	32,347	129,386	(7,977,749)	(31,910,998)
5	(7,945,403)	(7,945,403)	(39,727,015)	5	32,347	32,347	161,733	(7,977,749)	(39,888,747)
6	(7,945,403)	(7,945,403)	(47,672,417)	6	32,347	32,347	194,079	(7,977,749)	(47,866,496)
7	(7,945,403)	(7,945,403)	(55,617,820)	7	32,347	32,347	226,426	(7,977,749)	(55,844,246)
8	(7,945,403)	(7,945,403)	(63,563,223)	8	32,347	32,347	258,772	(7,977,749)	(63,821,995)
9	(7,945,403)	(7,945,403)	(71,508,626)	9	32,347	32,347	291,119	(7,977,749)	(71,799,745)
10	(7,945,403)	(7,945,403)	(79,454,029)	10	32,347	32,347	323,465	(7,977,749)	(79,777,494)
11	(7,945,403)	(7,945,403)	(87,399,432)	11	32,347	32,347	355,812	(7,977,749)	(87,755,244)
12	(7,945,403)	(7,945,403)	(95,344,835)	12	32,347	32,347	388,158	(7,977,749)	(95,732,993)
13	(7,945,403)	(7,945,403)	(103,290,238)	13	32,347	32,347	420,505	(7,977,749)	(103,710,742)
14	(7,945,403)	(7,945,403)	(111,235,641)	14	32,347	32,347	452,851	(7,977,749)	(111,688,492)
15	(7,945,403)	(7,945,403)	(119,181,044)	15	32,347	32,347	485,198	(7,977,749)	(119,666,241)
16	(7,945,403)	(7,945,403)	(127,126,447)	16	32,347	32,347	517,544	(7,977,749)	(127,643,991)
17	(7,945,403)	(7,945,403)	(135,071,849)	17	32,347	32,347	549,891	(7,977,749)	(135,621,740)
18	(7,945,403)	(7,945,403)	(143,017,252)	18	32,347	32,347	582,237	(7,977,749)	(143,599,489)
19	(7,945,403)	(7,945,403)	(150,962,655)	19	32,347	32,347	614,584	(7,977,749)	(151,577,239)
20	(7,945,403)	(7,945,403)	(158,908,058)	20	32,347	32,347	646,930	(7,977,749)	(159,554,988)
21	(7,945,403)	(7,945,403)	(166,853,461)	21	32,347	32,347	679,277	(7,977,749)	(167,532,738)
22	(7,945,403)	(7,945,403)	(174,798,864)	22	32,347	32,347	711,623	(7,977,749)	(175,510,487)
23	(7,945,403)	(7,945,403)	(182,744,267)	23	32,347	32,347	743,970	(7,977,749)	(183,488,236)
24	(7,945,403)	(7,945,403)	(190,689,670)	24	32,347	32,347	776,316	(7,977,749)	(191,465,986)
25	(7,945,403)	(7,945,403)	(198,635,073)	25	32,347	32,347	808,663	(7,977,749)	(199,443,735)
26	(7,945,403)	(7,945,403)	(206,580,476)	26	32,347	32,347	841,009	(7,977,749)	(207,421,485)
27	(7,945,403)	(7,945,403)	(214,525,879)	27	32,347	32,347	873,356	(7,977,749)	(215,399,234)
28	(7,945,403)	(7,945,403)	(222,471,281)	28	32,347	32,347	905,702	(7,977,749)	(223,376,984)
29	(7,945,403)	(7,945,403)	(230,416,684)	29	32,347	32,347	938,049	(7,977,749)	(231,354,733)
30	(7,945,403)	(7,945,403)	(238,362,087)	30	32,347	32,347	970,395	(7,977,749)	(239,332,482)
31	(7,945,403)	(7,945,403)	(246,307,490)	31	32,347	32,347	1,002,742	(7,977,749)	(247,310,232)
32	(7,945,403)	(7,945,403)	(254,252,893)	32	32,347	32,347	1,035,088	(7,977,749)	(255,287,981)
33	(7,945,403)	(7,945,403)	(262,198,296)	33	32,347	32,347	1,067,435	(7,977,749)	(263,265,731)
34	(7,945,403)	(7,945,403)	(270,143,699)	34	32,347	32,347	1,099,781	(7,977,749)	(271,243,480)
35	(7,945,403)	(7,945,403)	(278,089,102)	35	32,347	32,347	1,132,128	(7,977,749)	(279,221,229)
36	(7,945,403)	(7,945,403)	(286,034,505)	36	32,347	32,347	1,164,474	(7,977,749)	(287,198,979)
37	(7,945,403)	(7,945,403)	(293,979,908)	37	32,347	32,347	1,196,821	(7,977,749)	(295,176,728)
38	(7,945,403)	(7,945,403)	(301,925,311)	38	32,347	32,347	1,229,167	(7,977,749)	(303,154,478)
39	(7,945,403)	(7,945,403)	(309,870,713)	39	32,347	32,347	1,261,514	(7,977,749)	(311,132,227)
40	(7,945,403)	(7,945,403)	(317,816,116)	40	32,347	32,347	1,293,860	(7,977,749)	(319,109,976)

Table 48: 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 > / 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	-	-	-	-	-
1	(178,053)	(178,053)	(178,053)	1	32,347	32,347	32,347	(145,706)	(145,706)
2	(178,053)	(178,053)	(356,106)	2	32,347	32,347	64,693	(145,706)	(291,413)
3	(178,053)	(178,053)	(534,159)	3	32,347	32,347	97,040	(145,706)	(437,119)
4	(178,053)	(178,053)	(712,212)	4	32,347	32,347	129,386	(145,706)	(582,826)
5	(178,053)	(178,053)	(890,265)	5	32,347	32,347	161,733	(145,706)	(728,532)
6	(178,053)	(178,053)	(1,068,318)	6	32,347	32,347	194,079	(145,706)	(874,239)
7	(178,053)	(178,053)	(1,246,370)	7	32,347	32,347	226,426	(145,706)	(1,019,945)
8	(178,053)	(178,053)	(1,424,423)	8	32,347	32,347	258,772	(145,706)	(1,165,651)
9	(178,053)	(178,053)	(1,602,476)	9	32,347	32,347	291,119	(145,706)	(1,311,358)
10	(178,053)	(178,053)	(1,780,529)	10	32,347	32,347	323,465	(145,706)	(1,457,064)
11	(178,053)	(178,053)	(1,958,582)	11	32,347	32,347	355,812	(145,706)	(1,602,771)
12	(178,053)	(178,053)	(2,136,635)	12	32,347	32,347	388,158	(145,706)	(1,748,477)
13	(178,053)	(178,053)	(2,314,688)	13	32,347	32,347	420,505	(145,706)	(1,894,184)
14	(178,053)	(178,053)	(2,492,741)	14	32,347	32,347	452,851	(145,706)	(2,039,890)
15	(178,053)	(178,053)	(2,670,794)	15	32,347	32,347	485,198	(145,706)	(2,185,596)
16	(178,053)	(178,053)	(2,848,847)	16	32,347	32,347	517,544	(145,706)	(2,331,303)
17	(178,053)	(178,053)	(3,026,900)	17	32,347	32,347	549,891	(145,706)	(2,477,009)
18	(178,053)	(178,053)	(3,204,953)	18	32,347	32,347	582,237	(145,706)	(2,622,716)
19	(178,053)	(178,053)	(3,383,006)	19	32,347	32,347	614,584	(145,706)	(2,768,422)
20	(178,053)	(178,053)	(3,561,059)	20	32,347	32,347	646,930	(145,706)	(2,914,129)
21	(178,053)	(178,053)	(3,739,111)	21	32,347	32,347	679,277	(145,706)	(3,059,835)
22	(178,053)	(178,053)	(3,917,164)	22	32,347	32,347	711,623	(145,706)	(3,205,541)
23	(178,053)	(178,053)	(4,095,217)	23	32,347	32,347	743,970	(145,706)	(3,351,248)
24	(178,053)	(178,053)	(4,273,270)	24	32,347	32,347	776,316	(145,706)	(3,496,954)
25	(178,053)	(178,053)	(4,451,323)	25	32,347	32,347	808,663	(145,706)	(3,642,661)
26	(178,053)	(178,053)	(4,629,376)	26	32,347	32,347	841,009	(145,706)	(3,788,367)
27	(178,053)	(178,053)	(4,807,429)	27	32,347	32,347	873,356	(145,706)	(3,934,074)
28	(178,053)	(178,053)	(4,985,482)	28	32,347	32,347	905,702	(145,706)	(4,079,780)
29	(178,053)	(178,053)	(5,163,535)	29	32,347	32,347	938,049	(145,706)	(4,225,486)
30	(178,053)	(178,053)	(5,341,588)	30	32,347	32,347	970,395	(145,706)	(4,371,193)
31	(178,053)	(178,053)	(5,519,641)	31	32,347	32,347	1,002,742	(145,706)	(4,516,899)
32	(178,053)	(178,053)	(5,697,694)	32	32,347	32,347	1,035,088	(145,706)	(4,662,606)
33	(178,053)	(178,053)	(5,875,747)	33	32,347	32,347	1,067,435	(145,706)	(4,808,312)
34	(178,053)	(178,053)	(6,053,800)	34	32,347	32,347	1,099,781	(145,706)	(4,954,019)
35	(178,053)	(178,053)	(6,231,852)	35	32,347	32,347	1,132,128	(145,706)	(5,099,725)
36	(178,053)	(178,053)	(6,409,905)	36	32,347	32,347	1,164,474	(145,706)	(5,245,431)
37	(178,053)	(178,053)	(6,587,958)	37	32,347	32,347	1,196,821	(145,706)	(5,391,138)
38	(178,053)	(178,053)	(6,766,011)	38	32,347	32,347	1,229,167	(145,706)	(5,536,844)
39	(178,053)	(178,053)	(6,944,064)	39	32,347	32,347	1,261,514	(145,706)	(5,682,551)
40	(178,053)	(178,053)	(7,122,117)	40	32,347	32,347	1,293,860	(145,706)	(5,828,257)

Table 49: 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>	*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	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	(147,297)	(147,297)	(147,297)	1	32,347	32,347	32,347	(114,951)	(114,951)
2	(147,297)	(147,297)	(294,594)	2	32,347	32,347	64,693	(114,951)	(229,901)
3	(147,297)	(147,297)	(441,891)	3	32,347	32,347	97,040	(114,951)	(344,852)
4	(147,297)	(147,297)	(589,189)	4	32,347	32,347	129,386	(114,951)	(459,803)
5	(147,297)	(147,297)	(736,486)	5	32,347	32,347	161,733	(114,951)	(574,753)
6	(147,297)	(147,297)	(883,783)	6	32,347	32,347	194,079	(114,951)	(689,704)
7	(147,297)	(147,297)	(1,031,080)	7	32,347	32,347	226,426	(114,951)	(804,654)
8	(147,297)	(147,297)	(1,178,377)	8	32,347	32,347	258,772	(114,951)	(919,605)
9	(147,297)	(147,297)	(1,325,674)	9	32,347	32,347	291,119	(114,951)	(1,034,556)
10	(147,297)	(147,297)	(1,472,971)	10	32,347	32,347	323,465	(114,951)	(1,149,506)
11	(147,297)	(147,297)	(1,620,268)	11	32,347	32,347	355,812	(114,951)	(1,264,457)
12	(147,297)	(147,297)	(1,767,566)	12	32,347	32,347	388,158	(114,951)	(1,379,408)
13	(147,297)	(147,297)	(1,914,863)	13	32,347	32,347	420,505	(114,951)	(1,494,358)
14	(147,297)	(147,297)	(2,062,160)	14	32,347	32,347	452,851	(114,951)	(1,609,309)
15	(147,297)	(147,297)	(2,209,457)	15	32,347	32,347	485,198	(114,951)	(1,724,260)
16	(147,297)	(147,297)	(2,356,754)	16	32,347	32,347	517,544	(114,951)	(1,839,210)
17	(147,297)	(147,297)	(2,504,051)	17	32,347	32,347	549,891	(114,951)	(1,954,161)
18	(147,297)	(147,297)	(2,651,348)	18	32,347	32,347	582,237	(114,951)	(2,069,111)
19	(147,297)	(147,297)	(2,798,646)	19	32,347	32,347	614,584	(114,951)	(2,184,062)
20	(147,297)	(147,297)	(2,945,943)	20	32,347	32,347	646,930	(114,951)	(2,299,013)
21	(147,297)	(147,297)	(3,093,240)	21	32,347	32,347	679,277	(114,951)	(2,413,963)
22	(147,297)	(147,297)	(3,240,537)	22	32,347	32,347	711,623	(114,951)	(2,528,914)
23	(147,297)	(147,297)	(3,387,834)	23	32,347	32,347	743,970	(114,951)	(2,643,865)
24	(147,297)	(147,297)	(3,535,131)	24	32,347	32,347	776,316	(114,951)	(2,758,815)
25	(147,297)	(147,297)	(3,682,428)	25	32,347	32,347	808,663	(114,951)	(2,873,766)
26	(147,297)	(147,297)	(3,829,726)	26	32,347	32,347	841,009	(114,951)	(2,988,717)
27	(147,297)	(147,297)	(3,977,023)	27	32,347	32,347	873,356	(114,951)	(3,103,667)
28	(147,297)	(147,297)	(4,124,320)	28	32,347	32,347	905,702	(114,951)	(3,218,618)
29	(147,297)	(147,297)	(4,271,617)	29	32,347	32,347	938,049	(114,951)	(3,333,568)
30	(147,297)	(147,297)	(4,418,914)	30	32,347	32,347	970,395	(114,951)	(3,448,519)
31	(147,297)	(147,297)	(4,566,211)	31	32,347	32,347	1,002,742	(114,951)	(3,563,470)
32	(147,297)	(147,297)	(4,713,508)	32	32,347	32,347	1,035,088	(114,951)	(3,678,420)
33	(147,297)	(147,297)	(4,860,805)	33	32,347	32,347	1,067,435	(114,951)	(3,793,371)
34	(147,297)	(147,297)	(5,008,103)	34	32,347	32,347	1,099,781	(114,951)	(3,908,322)
35	(147,297)	(147,297)	(5,155,400)	35	32,347	32,347	1,132,128	(114,951)	(4,023,272)
36	(147,297)	(147,297)	(5,302,697)	36	32,347	32,347	1,164,474	(114,951)	(4,138,223)
37	(147,297)	(147,297)	(5,449,994)	37	32,347	32,347	1,196,821	(114,951)	(4,253,173)
38	(147,297)	(147,297)	(5,597,291)	38	32,347	32,347	1,229,167	(114,951)	(4,368,124)
39	(147,297)	(147,297)	(5,744,588)	39	32,347	32,347	1,261,514	(114,951)	(4,483,075)
40	(147,297)	(147,297)	(5,891,885)	40	32,347	32,347	1,293,860	(114,951)	(4,598,025)

Table 50: 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*	*2*	*△Cab BSLPA $_{icl,t}$*	*△Cab BSLPA $_{icl}$*	*ID iz >*	*1*	*△Cab BSLPA $_{z,t}$*	*△Cab BSLPA $_{z}$*	*△Cab BSLPA $_{t}$*	*△Cab BSLPA*
Name >	Dense Forest	Degraded Forest	annual	cumulative	Name >	Pasture	annual	cumulative	annual	cumulative
Project year *t*	tCO_2-e	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	0
1	(263,078)	(150,791)	(413,869)	(413,869)	1	-	-	-	(413,869)	(413,869)
2	(367,555)	(196,710)	(564,265)	(978,133)	2	4,203	4,203	4,203	(568,468)	(982,336)
3	(411,059)	(233,445)	(644,503)	(1,622,637)	3	6,976	6,976	11,179	(651,479)	(1,633,815)
4	(403,180)	(213,892)	(617,072)	(2,239,709)	4	9,624	9,624	20,803	(626,696)	(2,260,511)
5	(386,053)	(182,193)	(568,246)	(2,807,955)	5	12,053	12,053	32,856	(580,299)	(2,840,811)
6	(317,885)	(163,233)	(481,119)	(3,289,074)	6	14,116	14,116	46,971	(495,235)	(3,336,045)
7	(332,958)	(157,308)	(490,266)	(3,779,340)	7	16,212	16,212	63,183	(506,478)	(3,842,523)
8	(301,786)	(130,053)	(431,839)	(4,211,179)	8	18,052	18,052	81,235	(449,892)	(4,292,414)
9	(292,879)	(107,242)	(400,122)	(4,611,301)	9	19,750	19,750	100,985	(419,871)	(4,712,286)
10	(260,337)	(105,169)	(365,506)	(4,976,806)	10	21,305	21,305	122,289	(386,810)	(5,099,096)
11	(261,707)	(81,172)	(342,880)	(5,319,686)	11	22,752	22,752	145,042	(365,632)	(5,464,728)
12	(267,873)	(71,989)	(339,862)	(5,659,548)	12	19,978	19,978	165,020	(359,840)	(5,824,568)
13	(253,486)	(69,322)	(322,809)	(5,982,357)	13	18,564	18,564	183,584	(341,373)	(6,165,941)
14	(229,165)	(61,324)	(290,489)	(6,272,846)	14	17,138	17,138	200,722	(307,627)	(6,473,567)
15	(244,923)	(68,434)	(313,356)	(6,586,202)	15	16,028	16,028	216,749	(329,384)	(6,802,951)
16	(244,580)	(72,285)	(316,865)	(6,903,067)	16	15,301	15,301	232,050	(332,166)	(7,135,117)
17	(246,978)	(63,990)	(310,968)	(7,214,034)	17	14,512	14,512	246,562	(325,479)	(7,460,596)
18	(242,182)	(68,137)	(310,320)	(7,524,354)	18	13,978	13,978	260,540	(324,297)	(7,784,893)
19	(246,293)	(63,397)	(309,690)	(7,834,044)	19	13,582	13,582	274,121	(323,272)	(8,108,165)
20	(249,718)	(64,879)	(314,597)	(8,148,641)	20	13,349	13,349	287,470	(327,945)	(8,436,111)
21	(262,393)	(69,915)	(332,307)	(8,480,948)	21	13,298	13,298	300,768	(345,606)	(8,781,716)
22	(269,244)	(57,769)	(327,012)	(8,807,960)	22	13,237	13,237	314,005	(340,249)	(9,121,966)
23	(336,383)	(61,916)	(398,299)	(9,206,260)	23	13,540	13,540	327,545	(411,839)	(9,533,805)
24	(357,964)	(62,805)	(420,769)	(9,627,028)	24	14,071	14,071	341,616	(434,840)	(9,968,644)
25	(352,140)	(65,175)	(417,315)	(10,044,343)	25	14,492	14,492	356,108	(431,807)	(10,400,452)
26	(392,561)	(62,805)	(455,366)	(10,499,709)	26	15,050	15,050	371,158	(470,416)	(10,870,868)
27	(391,534)	(64,879)	(456,412)	(10,956,122)	27	15,643	15,643	386,801	(472,055)	(11,342,922)
28	(410,031)	(63,101)	(473,132)	(11,429,254)	28	16,302	16,302	403,103	(489,435)	(11,832,357)
29	(481,624)	(86,505)	(568,129)	(11,997,383)	29	17,369	17,369	420,472	(585,498)	(12,417,855)
30	(561,780)	(82,950)	(644,730)	(12,642,113)	30	18,725	18,725	439,197	(663,455)	(13,081,310)
31	(579,593)	(77,321)	(656,914)	(13,299,027)	31	20,051	20,051	459,248	(676,965)	(13,758,274)
32	(690,236)	(85,024)	(775,260)	(14,074,287)	32	21,893	21,893	481,141	(797,153)	(14,555,427)
33	(658,379)	(74,951)	(733,330)	(14,807,617)	33	23,265	23,265	504,406	(756,596)	(15,312,023)
34	(545,681)	(51,251)	(596,932)	(15,404,549)	34	23,975	23,975	528,381	(620,907)	(15,932,930)
35	(580,278)	(49,770)	(630,048)	(16,034,596)	35	24,831	24,831	553,212	(654,879)	(16,587,809)
36	(582,333)	(45,326)	(627,659)	(16,662,256)	36	25,522	25,522	578,734	(653,181)	(17,240,990)
37	(589,869)	(39,105)	(628,974)	(17,291,230)	37	26,208	26,208	604,942	(655,182)	(17,896,172)
38	(592,610)	(35,846)	(628,456)	(17,919,686)	38	26,823	26,823	631,765	(655,279)	(18,551,451)
39	(594,323)	(40,586)	(634,909)	(18,554,595)	39	27,065	27,065	658,830	(661,974)	(19,213,425)
40	(583,703)	(40,290)	(623,993)	(19,178,588)	40	26,954	26,954	685,784	(650,947)	(19,864,372)

Table 51: 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			Total carbon stock change in the below-	
ID icl >	1	2	△Cab BSLPA $_{icl,t}$	△Cab BSLPA $_{icl}$
Name >	Dense Forest	Degraded Forest	annual	cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
0	0	0	0	0
1	(5,895)	(3,386)	(9,282)	(9,282)
2	(14,132)	(7,803)	(21,936)	(31,217)
3	(23,344)	(13,046)	(36,389)	(67,607)
4	(32,379)	(17,849)	(50,228)	(117,834)
5	(41,030)	(21,940)	(62,970)	(180,805)
6	(48,154)	(25,606)	(73,759)	(254,564)
7	(55,615)	(29,138)	(84,753)	(339,317)
8	(62,378)	(32,059)	(94,437)	(433,754)
9	(68,941)	(34,467)	(103,408)	(537,162)
10	(74,776)	(36,828)	(111,604)	(648,766)
11	(74,745)	(35,265)	(110,010)	(758,776)
12	(72,511)	(32,464)	(104,975)	(863,752)
13	(68,980)	(28,779)	(97,759)	(961,510)
14	(65,080)	(25,353)	(90,433)	(1,051,943)
15	(61,918)	(22,798)	(84,716)	(1,136,659)
16	(60,275)	(20,756)	(81,031)	(1,217,690)
17	(58,348)	(18,660)	(77,008)	(1,294,698)
18	(57,012)	(17,270)	(74,282)	(1,368,981)
19	(55,968)	(16,285)	(72,254)	(1,441,234)
20	(55,730)	(15,381)	(71,111)	(1,512,346)
21	(55,746)	(15,128)	(70,874)	(1,583,219)
22	(55,777)	(14,809)	(70,585)	(1,653,804)
23	(57,634)	(14,642)	(72,276)	(1,726,081)
24	(60,521)	(14,675)	(75,196)	(1,801,277)
25	(62,923)	(14,602)	(77,526)	(1,878,802)
26	(66,239)	(14,389)	(80,629)	(1,959,431)
27	(69,479)	(14,409)	(83,888)	(2,043,319)
28	(73,240)	(14,296)	(87,537)	(2,130,856)
29	(78,514)	(14,815)	(93,329)	(2,224,185)
30	(85,507)	(15,221)	(100,728)	(2,324,913)
31	(92,615)	(15,387)	(108,003)	(2,432,916)
32	(102,050)	(15,999)	(118,049)	(2,550,965)
33	(109,265)	(16,292)	(125,557)	(2,676,522)
34	(113,472)	(16,033)	(129,505)	(2,806,027)
35	(118,585)	(15,687)	(134,271)	(2,940,298)
36	(122,837)	(15,294)	(138,131)	(3,078,429)
37	(127,282)	(14,715)	(141,997)	(3,220,427)
38	(131,373)	(14,103)	(145,477)	(3,365,903)
39	(133,899)	(13,072)	(146,971)	(3,512,875)
40	(134,390)	(12,114)	(146,504)	(3,659,379)

Carbon stock changes in the		Total carbon stock change in	
ID iz >	1	△Cab BSLPA $_{z,t}$	△Cab BSLPA $_{z}$
Name >	Pasture	annual	cumulative
Project year *t*	tCO_2-e	tCO_2-e	tCO_2-e
0	0	0	0
1	-	-	-
2	4,203	4,203	4,203
3	6,976	6,976	11,179
4	9,624	9,624	20,803
5	12,053	12,053	32,856
6	14,116	14,116	46,971
7	16,212	16,212	63,183
8	18,052	18,052	81,235
9	19,750	19,750	100,985
10	21,305	21,305	122,289
11	22,752	22,752	145,042
12	19,978	19,978	165,020
13	18,564	18,564	183,584
14	17,138	17,138	200,722
15	16,028	16,028	216,749
16	15,301	15,301	232,050
17	14,512	14,512	246,562
18	13,978	13,978	260,540
19	13,582	13,582	274,121
20	13,349	13,349	287,470
21	13,298	13,298	300,768
22	13,237	13,237	314,005
23	13,540	13,540	327,545
24	14,071	14,071	341,616
25	14,492	14,492	356,108
26	15,050	15,050	371,158
27	15,643	15,643	386,801
28	16,302	16,302	403,103
29	17,369	17,369	420,472
30	18,725	18,725	439,197
31	20,051	20,051	459,248
32	21,893	21,893	481,141
33	23,265	23,265	504,406
34	23,975	23,975	528,381
35	24,831	24,831	553,212
36	25,522	25,522	578,734
37	26,208	26,208	604,942
38	26,823	26,823	631,765
39	27,065	27,065	658,830
40	26,954	26,954	685,784

	Total net carbon stock change in	
	△Cab BSLPA $_{t}$	△Cab BSLPA
	annual	cumulative
Project year *t*	tCO_2-e	tCO_2-e
0	0	0
1	(9,282)	(9,282)
2	(17,732)	(27,014)
3	(29,414)	(56,428)
4	(40,604)	(97,032)
5	(50,917)	(147,949)
6	(59,644)	(207,593)
7	(68,542)	(276,135)
8	(76,384)	(352,519)
9	(83,659)	(436,177)
10	(90,299)	(526,477)
11	(87,258)	(613,735)
12	(84,997)	(698,732)
13	(79,194)	(777,926)
14	(73,295)	(851,222)
15	(68,688)	(919,910)
16	(65,730)	(985,640)
17	(62,497)	(1,048,136)
18	(60,305)	(1,108,441)
19	(58,672)	(1,167,113)
20	(57,762)	(1,224,876)
21	(57,575)	(1,282,451)
22	(57,348)	(1,339,799)
23	(58,737)	(1,398,536)
24	(61,125)	(1,459,661)
25	(63,033)	(1,522,694)
26	(65,579)	(1,588,273)
27	(68,246)	(1,656,518)
28	(71,234)	(1,727,753)
29	(75,960)	(1,803,713)
30	(82,003)	(1,885,716)
31	(87,952)	(1,973,668)
32	(96,156)	(2,069,824)
33	(102,292)	(2,172,116)
34	(105,530)	(2,277,646)
35	(109,440)	(2,387,086)
36	(112,610)	(2,499,695)
37	(115,790)	(2,615,485)
38	(118,654)	(2,734,139)
39	(119,906)	(2,854,045)
40	(119,551)	(2,973,595)

Table 52: 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			Total carbon stock change in litter of		Carbon stock changes in		Total carbon stock change in		Total net carbon stock change in	
ID icl >	1	2	$\triangle Cab\ BSLPA_{icl,t}$	$\triangle Cab\ BSLPA_{icl}$	ID iz >	1	$\triangle Cab\ BSLPA_{z,t}$	$\triangle Cab\ BSLPA_{z}$	$\triangle Cab\ BSLPA_{t}$	$\triangle Cab\ BSLPA$
Name >	Dense Forest	Degraded Forest	annual	cumulative	Name >	Pasture	annual	cumulative	annual	cumulative
Project year *t*	tCO_2-e	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	0
1	(4,877)	(3,133)	(8,011)	(8,011)	1	-	-	-	(8,011)	(8,011)
2	(6,814)	(4,088)	(10,902)	(18,912)	2	4,203	4,203	4,203	(6,698)	(14,709)
3	(7,620)	(4,851)	(12,471)	(31,383)	3	6,976	6,976	11,179	(5,496)	(20,205)
4	(7,474)	(4,445)	(11,919)	(43,303)	4	9,624	9,624	20,803	(2,295)	(22,500)
5	(7,157)	(3,786)	(10,943)	(54,245)	5	12,053	12,053	32,856	1,110	(21,390)
6	(5,893)	(3,392)	(9,285)	(63,531)	6	14,116	14,116	46,971	4,831	(16,559)
7	(6,173)	(3,269)	(9,441)	(72,972)	7	16,212	16,212	63,183	6,770	(9,789)
8	(5,595)	(2,702)	(8,297)	(81,269)	8	18,052	18,052	81,235	9,755	(34)
9	(5,430)	(2,228)	(7,658)	(88,927)	9	19,750	19,750	100,985	12,092	12,058
10	(4,826)	(2,185)	(7,012)	(95,939)	10	21,305	21,305	122,289	14,293	26,351
11	(4,852)	(1,687)	(6,538)	(102,477)	11	22,752	22,752	145,042	16,214	42,564
12	(4,966)	(1,496)	(6,462)	(108,939)	12	19,978	19,978	165,020	13,516	56,081
13	(4,699)	(1,441)	(6,140)	(115,079)	13	18,564	18,564	183,584	12,424	68,505
14	(4,248)	(1,274)	(5,523)	(120,602)	14	17,138	17,138	200,722	11,615	80,120
15	(4,541)	(1,422)	(5,963)	(126,564)	15	16,028	16,028	216,749	10,065	90,185
16	(4,534)	(1,502)	(6,036)	(132,601)	16	15,301	15,301	232,050	9,265	99,450
17	(4,579)	(1,330)	(5,908)	(138,509)	17	14,512	14,512	246,562	8,603	108,053
18	(4,490)	(1,416)	(5,906)	(144,415)	18	13,978	13,978	260,540	8,072	116,125
19	(4,566)	(1,317)	(5,883)	(150,298)	19	13,582	13,582	274,121	7,698	123,823
20	(4,629)	(1,348)	(5,978)	(156,275)	20	13,349	13,349	287,470	7,371	131,194
21	(4,864)	(1,453)	(6,317)	(162,593)	21	13,298	13,298	300,768	6,981	138,176
22	(4,991)	(1,200)	(6,192)	(168,784)	22	13,237	13,237	314,005	7,045	145,221
23	(6,236)	(1,287)	(7,523)	(176,307)	23	13,540	13,540	327,545	6,017	151,238
24	(6,636)	(1,305)	(7,941)	(184,248)	24	14,071	14,071	341,616	6,130	157,368
25	(6,528)	(1,354)	(7,883)	(192,131)	25	14,492	14,492	356,108	6,610	163,977
26	(7,278)	(1,305)	(8,583)	(200,714)	26	15,050	15,050	371,158	6,467	170,444
27	(7,259)	(1,348)	(8,607)	(209,320)	27	15,643	15,643	386,801	7,036	177,480
28	(7,601)	(1,311)	(8,913)	(218,233)	28	16,302	16,302	403,103	7,390	184,870
29	(8,929)	(1,798)	(10,726)	(228,959)	29	17,369	17,369	420,472	6,643	191,513
30	(10,415)	(1,724)	(12,138)	(241,097)	30	18,725	18,725	439,197	6,586	198,099
31	(10,745)	(1,607)	(12,352)	(253,449)	31	20,051	20,051	459,248	7,699	205,799
32	(12,796)	(1,767)	(14,563)	(268,012)	32	21,893	21,893	481,141	7,330	213,129
33	(12,205)	(1,557)	(13,763)	(281,775)	33	23,265	23,265	504,406	9,502	222,631
34	(10,116)	(1,065)	(11,181)	(292,956)	34	23,975	23,975	528,381	12,794	235,425
35	(10,758)	(1,034)	(11,792)	(304,748)	35	24,831	24,831	553,212	13,040	248,465
36	(10,796)	(942)	(11,738)	(316,485)	36	25,522	25,522	578,734	13,784	262,249
37	(10,935)	(813)	(11,748)	(328,233)	37	26,208	26,208	604,942	14,460	276,709
38	(10,986)	(745)	(11,731)	(339,964)	38	26,823	26,823	631,765	15,092	291,800
39	(11,018)	(843)	(11,861)	(351,826)	39	27,065	27,065	658,830	15,204	307,004
40	(10,821)	(837)	(11,658)	(363,484)	40	26,954	26,954	685,784	15,296	322,300

Table 53: 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 >	*1*	*2*	$\triangle Cab\ BSLLK_{icl,t}$	$\triangle Cab\ BSLLK_{icl}$	*ID iz >*	*1*	$\triangle Cab\ BSLLK_{z,t}$	$\triangle Cab\ BSLLK_{z}$	$\triangle Cab\ BSLLK_{t}$	$\triangle Cab\ BSLLK$
Name >	Dense Forest	Degraded Forest	annual	cumulative	Name >	Pasture	annual	cumulative	annual	cumulative
Project year *t*	tCO_2-e	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	0
1	(6,382,272)	-	(6,382,272)	(6,382,272)	1	-	-	-	(6,382,272)	(6,382,272)
2	(1,497,701)	-	(1,497,701)	(7,879,973)	2	26,275	26,275		(1,471,426)	(7,853,698)
3	-	-	-	(7,879,973)	3	30,881	30,881	30,881	30,881	(7,822,818)
4	(1,229,612)	-	(1,229,612)	(9,109,585)	4	34,981	34,981	65,862	(1,194,631)	(9,017,449)
5	(1,154,330)	-	(1,154,330)	(10,263,915)	5	38,830	38,830	104,692	(1,115,500)	(10,132,949)
6	(995,818)	-	(995,818)	(11,259,733)	6	42,150	42,150	146,842	(953,668)	(11,086,617)
7	(951,486)	-	(951,486)	(12,211,219)	7	45,323	45,323	192,165	(906,163)	(11,992,779)
8	(892,514)	-	(892,514)	(13,103,733)	8	48,299	48,299	240,464	(844,215)	(12,836,995)
9	(856,128)	-	(856,128)	(13,959,861)	9	51,153	51,153	291,617	(804,974)	(13,641,969)
10	(818,905)	-	(818,905)	(14,778,766)	10	53,884	53,884	345,501	(765,021)	(14,406,990)
11	(789,210)	-	(789,210)	(15,567,976)	11	56,516	56,516	402,017	(732,695)	(15,139,685)
12	(647,428)	-	(647,428)	(16,215,405)	12	32,400	32,400	434,416	(615,029)	(15,754,714)
13	(672,523)	-	(672,523)	(16,887,927)	13	30,036	30,036	464,452	(642,487)	(16,397,200)
14	(728,984)	-	(728,984)	(17,616,912)	14	28,367	28,367	492,819	(700,618)	(17,097,818)
15	(840,235)	-	(840,235)	(18,457,146)	15	27,319	27,319	520,138	(812,916)	(17,910,734)
16	(793,393)	-	(793,393)	(19,250,539)	16	26,644	26,644	546,782	(766,748)	(18,677,482)
17	(798,830)	-	(798,830)	(20,049,369)	17	26,135	26,135	572,917	(772,694)	(19,450,176)
18	(894,606)	-	(894,606)	(20,943,974)	18	26,142	26,142	599,060	(868,463)	(20,318,640)
19	(931,828)	-	(931,828)	(21,875,803)	19	26,395	26,395	625,454	(905,434)	(21,224,074)
20	(982,017)	-	(982,017)	(22,857,819)	20	26,939	26,939	652,393	(955,078)	(22,179,152)
21	(964,033)	-	(964,033)	(23,821,852)	21	27,521	27,521	679,914	(936,511)	(23,115,663)
22	(1,052,699)	-	(1,052,699)	(24,874,550)	22	28,873	28,873	708,787	(1,023,826)	(24,139,489)
23	(1,148,056)	-	(1,148,056)	(26,022,607)	23	30,458	30,458	739,245	(1,117,598)	(25,257,086)
24	(1,263,907)	-	(1,263,907)	(27,286,514)	24	32,242	32,242	771,487	(1,231,665)	(26,488,752)
25	(1,242,159)	-	(1,242,159)	(28,528,673)	25	33,582	33,582	805,070	(1,208,577)	(27,697,329)
26	(1,393,560)	-	(1,393,560)	(29,922,233)	26	35,583	35,583	840,653	(1,357,977)	(29,055,306)
27	(1,511,503)	-	(1,511,503)	(31,433,736)	27	37,960	37,960	878,613	(1,473,543)	(30,528,849)
28	(1,747,388)	-	(1,747,388)	(33,181,124)	28	40,803	40,803	919,416	(1,706,584)	(32,235,433)
29	(1,931,829)	-	(1,931,829)	(35,112,953)	29	44,138	44,138	963,553	(1,887,692)	(34,123,125)
30	(1,982,018)	-	(1,982,018)	(37,094,971)	30	47,472	47,472	1,011,025	(1,934,546)	(36,057,671)
31	(2,057,718)	-	(2,057,718)	(39,152,689)	31	51,119	51,119	1,062,144	(2,006,600)	(38,064,270)
32	(2,120,453)	-	(2,120,453)	(41,273,142)	32	54,679	54,679	1,116,823	(2,065,775)	(40,130,045)
33	(2,047,681)	-	(2,047,681)	(43,320,823)	33	57,679	57,679	1,174,501	(1,990,002)	(42,120,047)
34	(1,854,874)	-	(1,854,874)	(45,175,697)	34	59,649	59,649	1,234,150	(1,795,225)	(43,915,272)
35	(1,979,090)	-	(1,979,090)	(47,154,787)	35	62,106	62,106	1,296,257	(1,916,984)	(45,832,255)
36	(1,955,669)	-	(1,955,669)	(49,110,455)	36	63,981	63,981	1,360,237	(1,891,688)	(47,723,944)
37	(1,767,881)	-	(1,767,881)	(50,878,336)	37	64,835	64,835	1,425,073	(1,703,046)	(49,426,989)
38	(1,789,629)	-	(1,789,629)	(52,667,966)	38	64,976	64,976	1,490,049	(1,724,653)	(51,151,642)
39	(1,712,674)	-	(1,712,674)	(54,380,640)	39	64,246	64,246	1,554,294	(1,648,428)	(52,800,071)
40	(1,776,246)	-	(1,776,246)	(56,156,885)	40	63,559	63,559	1,617,854	(1,712,686)	(54,512,757)

Table 54: 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			Total carbon stock change in the below-		Carbon stock		Total carbon stock change in		Total net carbon stock change in the	
ID icl >	1	2	$\triangle Cab\ BSLLK_{icl,t}$	$\triangle Cab\ BSLLK_{icl}$	ID iz >	1	$\triangle Cab\ BSLLK_{z,t}$	$\triangle Cab\ BSLLK_{z}$	$\triangle Cab\ BSLLK_{t}$	$\triangle Cab\ BSLLK$
Name >	Dense Forest	Degraded Forest	annual	cumulative	Name >	Pasture	annual	cumulative	annual	cumulative
Project year *t*	tCO_2-e	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	0
1	(143,000)	-	(143,000)	(143,000)	1	-	-	-	(143,000)	(143,000)
2	(176,557)	-	(176,557)	(319,557)	2	26,275	26,275	26,275	(150,282)	(293,282)
3	(176,557)	-	(176,557)	(496,114)	3	30,881	30,881	57,156	(145,676)	(438,958)
4	(204,107)	-	(204,107)	(700,221)	4	34,981	34,981	92,137	(169,126)	(608,084)
5	(229,971)	-	(229,971)	(930,192)	5	38,830	38,830	130,966	(191,141)	(799,226)
6	(252,283)	-	(252,283)	(1,182,475)	6	42,150	42,150	173,117	(210,133)	(1,009,358)
7	(273,602)	-	(273,602)	(1,456,077)	7	45,323	45,323	218,440	(228,279)	(1,237,637)
8	(293,599)	-	(293,599)	(1,749,676)	8	48,299	48,299	266,738	(245,301)	(1,482,938)
9	(312,782)	-	(312,782)	(2,062,458)	9	51,153	51,153	317,892	(261,628)	(1,744,566)
10	(331,130)	-	(331,130)	(2,393,588)	10	53,884	53,884	371,776	(277,246)	(2,021,812)
11	(205,813)	-	(205,813)	(2,599,401)	11	56,516	56,516	428,291	(149,297)	(2,171,109)
12	(186,762)	-	(186,762)	(2,786,162)	12	32,400	32,400	460,691	(154,362)	(2,325,471)
13	(201,830)	-	(201,830)	(2,987,993)	13	30,036	30,036	490,727	(171,794)	(2,497,266)
14	(190,613)	-	(190,613)	(3,178,606)	14	28,367	28,367	519,093	(162,247)	(2,659,513)
15	(183,576)	-	(183,576)	(3,362,182)	15	27,319	27,319	546,413	(156,257)	(2,815,769)
16	(179,040)	-	(179,040)	(3,541,222)	16	26,644	26,644	573,057	(152,396)	(2,968,165)
17	(175,620)	-	(175,620)	(3,716,842)	17	26,135	26,135	599,192	(149,485)	(3,117,650)
18	(175,667)	-	(175,667)	(3,892,508)	18	26,142	26,142	625,334	(149,524)	(3,267,174)
19	(177,363)	-	(177,363)	(4,069,871)	19	26,395	26,395	651,729	(150,968)	(3,418,142)
20	(181,017)	-	(181,017)	(4,250,889)	20	26,939	26,939	678,668	(154,079)	(3,572,221)
21	(184,935)	-	(184,935)	(4,435,823)	21	27,521	27,521	706,189	(157,413)	(3,729,634)
22	(194,015)	-	(194,015)	(4,629,838)	22	28,873	28,873	735,062	(165,142)	(3,894,776)
23	(204,670)	-	(204,670)	(4,834,508)	23	30,458	30,458	765,520	(174,211)	(4,068,988)
24	(216,655)	-	(216,655)	(5,051,163)	24	32,242	32,242	797,762	(184,413)	(4,253,401)
25	(225,660)	-	(225,660)	(5,276,823)	25	33,582	33,582	831,344	(192,078)	(4,445,479)
26	(239,108)	-	(239,108)	(5,515,931)	26	35,583	35,583	866,928	(203,524)	(4,649,003)
27	(255,076)	-	(255,076)	(5,771,006)	27	37,960	37,960	904,887	(217,116)	(4,866,119)
28	(274,183)	-	(274,183)	(6,045,189)	28	40,803	40,803	945,690	(233,380)	(5,099,499)
29	(296,589)	-	(296,589)	(6,341,778)	29	44,138	44,138	989,828	(252,451)	(5,351,950)
30	(318,994)	-	(318,994)	(6,660,772)	30	47,472	47,472	1,037,300	(271,523)	(5,623,473)
31	(343,499)	-	(343,499)	(7,004,272)	31	51,119	51,119	1,088,418	(292,381)	(5,915,853)
32	(367,423)	-	(367,423)	(7,371,695)	32	54,679	54,679	1,143,097	(312,744)	(6,228,598)
33	(387,580)	-	(387,580)	(7,759,275)	33	57,679	57,679	1,200,776	(329,901)	(6,558,499)
34	(400,821)	-	(400,821)	(8,160,096)	34	59,649	59,649	1,260,425	(341,172)	(6,899,671)
35	(417,333)	-	(417,333)	(8,577,429)	35	62,106	62,106	1,322,531	(355,226)	(7,254,897)
36	(429,927)	-	(429,927)	(9,007,356)	36	63,981	63,981	1,386,512	(365,947)	(7,620,844)
37	(435,671)	-	(435,671)	(9,443,027)	37	64,835	64,835	1,451,347	(370,836)	(7,991,680)
38	(436,618)	-	(436,618)	(9,879,645)	38	64,976	64,976	1,516,324	(371,642)	(8,363,321)
39	(431,708)	-	(431,708)	(10,311,353)	39	64,246	64,246	1,580,569	(367,462)	(8,730,783)
40	(427,097)	-	(427,097)	(10,738,450)	40	63,559	63,559	1,644,128	(363,538)	(9,094,321)

Table 55: 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			Total carbon stock change in litter of the		Carbon stock		Total carbon stock change in		Total net carbon stock change in litter of	
ID icl >	1	2	$\triangle Cab\ BSLLK_{icl,t}$	$\triangle Cab\ BSLLK_{icl}$	ID iz >	1	$\triangle Cab\ BSLLK_{z,t}$	$\triangle Cab\ BSLLK_{z}$	$\triangle Cab\ BSLLK_{t}$	$\triangle Cab\ BSLLK$
Name >	Dense Forest	Degraded Forest	annual	cumulative	Name >	Pasture	annual	cumulative	annual	cumulative
Project year *t*	tCO_2-e	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	0
1	(117,673)	-	(117,673)	(117,673)	1	-	-	-	(117,673)	(117,673)
2	(27,614)	-	(27,614)	(145,287)	2	26,275	26,275	26,275	(1,339)	(119,012)
3	-	-	-	(145,287)	3	30,881	30,881	57,156	30,881	(88,131)
4	(22,671)	-	(22,671)	(167,958)	4	34,981	34,981	92,137	12,310	(75,821)
5	(21,283)	-	(21,283)	(189,241)	5	38,830	38,830	130,966	17,547	(58,274)
6	(18,360)	-	(18,360)	(207,601)	6	42,150	42,150	173,117	23,790	(34,484)
7	(17,543)	-	(17,543)	(225,144)	7	45,323	45,323	218,440	27,780	(6,704)
8	(16,456)	-	(16,456)	(241,600)	8	48,299	48,299	266,738	31,843	25,139
9	(15,785)	-	(15,785)	(257,384)	9	51,153	51,153	317,892	35,369	60,507
10	(15,099)	-	(15,099)	(272,483)	10	53,884	53,884	371,776	38,785	99,293
11	(14,551)	-	(14,551)	(287,034)	11	56,516	56,516	428,291	41,964	141,257
12	(11,937)	-	(11,937)	(298,971)	12	32,400	32,400	460,691	20,463	161,720
13	(12,400)	-	(12,400)	(311,371)	13	30,036	30,036	490,727	17,636	179,356
14	(13,441)	-	(13,441)	(324,811)	14	28,367	28,367	519,093	14,926	194,282
15	(15,492)	-	(15,492)	(340,303)	15	27,319	27,319	546,413	11,827	206,110
16	(14,628)	-	(14,628)	(354,931)	16	26,644	26,644	573,057	12,016	218,126
17	(14,728)	-	(14,728)	(369,660)	17	26,135	26,135	599,192	11,407	229,533
18	(16,494)	-	(16,494)	(386,154)	18	26,142	26,142	625,334	9,648	239,181
19	(17,181)	-	(17,181)	(403,334)	19	26,395	26,395	651,729	9,214	248,395
20	(18,106)	-	(18,106)	(421,440)	20	26,939	26,939	678,668	8,833	257,227
21	(17,774)	-	(17,774)	(439,215)	21	27,521	27,521	706,189	9,747	266,974
22	(19,409)	-	(19,409)	(458,624)	22	28,873	28,873	735,062	9,464	276,438
23	(21,167)	-	(21,167)	(479,791)	23	30,458	30,458	765,520	9,291	285,729
24	(23,303)	-	(23,303)	(503,094)	24	32,242	32,242	797,762	8,939	294,668
25	(22,902)	-	(22,902)	(525,996)	25	33,582	33,582	831,344	10,680	305,348
26	(25,694)	-	(25,694)	(551,690)	26	35,583	35,583	866,928	9,890	315,237
27	(27,868)	-	(27,868)	(579,558)	27	37,960	37,960	904,887	10,091	325,329
28	(32,217)	-	(32,217)	(611,776)	28	40,803	40,803	945,690	8,586	333,915
29	(35,618)	-	(35,618)	(647,394)	29	44,138	44,138	989,828	8,519	342,434
30	(36,543)	-	(36,543)	(683,937)	30	47,472	47,472	1,037,300	10,928	353,363
31	(37,939)	-	(37,939)	(721,876)	31	51,119	51,119	1,088,418	13,180	366,542
32	(39,096)	-	(39,096)	(760,972)	32	54,679	54,679	1,143,097	15,583	382,125
33	(37,754)	-	(37,754)	(798,726)	33	57,679	57,679	1,200,776	19,925	402,050
34	(34,199)	-	(34,199)	(832,925)	34	59,649	59,649	1,260,425	25,450	427,500
35	(36,489)	-	(36,489)	(869,415)	35	62,106	62,106	1,322,531	25,617	453,117
36	(36,058)	-	(36,058)	(905,472)	36	63,981	63,981	1,386,512	27,923	481,040
37	(32,595)	-	(32,595)	(938,067)	37	64,835	64,835	1,451,347	32,240	513,280
38	(32,996)	-	(32,996)	(971,064)	38	64,976	64,976	1,516,324	31,980	545,260
39	(31,577)	-	(31,577)	(1,002,641)	39	64,246	64,246	1,580,569	32,668	577,928
40	(32,749)	-	(32,749)	(1,035,391)	40	63,559	63,559	1,644,128	30,810	608,738

Non-CO2 emissions from fires area accounted because fire is the main technology used to clear the forest (slash and burn). Parameters (Table 56) and baseline non-CO2 emissions from forest fires in the project area (Table 57) are presented below:

Table 56: Parameters used to calculate non-CO2 emissions from forest fires (Refer to Table 23 – VM0015 methodology)

Initial Forest Class		Parameters																
		$Fburnt_{icl}$	Cab	Cdw	Cl	$Pburnt_{ab,icl}$	$Pburnt_{dw,icl}$	$Pburnt_{l,icl}$	$CE_{ab,icl}$	$CE_{dw,icl}$	$CE_{l,icl}$	$ECO2\text{-}ab$	$ECO2\text{-}dw$	$ECO2\text{-}l$	$EBBCO2\text{-}tot$	$EBBnN2O_{icl}$	$EBBCH4_{icl}$	$EBBtot_{icl}$
IDcl	Name	%	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	%	%	%	%	%	%	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
1	Dense Ombrofile Forest	96%	-422.9	0	-7.84	96%	0	100%	0.5	0	0.5	-202.99	0	-3.92	-199	0	-18	-18.2
2	Degraded Ombrofile Forest	96%	-365.74	0	-7.6	96%	0	100%	0.5	0	0.5	-175.56	1	-3.8	-172	1	-16	-14.8

Table 57: 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: $ID_{icl} = 1$ $ABSLPA_{icl,t}$ ha	$ID_{icl} = 1$ $EBBBSLtot_{icl}$ tCO_2-e ha^{-1}	$ID_{icl} = 2$ $ABSLPA_{icl,t}$ ha	$ID_{icl} = 2$ $EBBBSLtot_{icl}$ tCO_2-e ha^{-1}	Total baseline non-CO2 emissions from forest fires in the project area: annual $EBBBSLPA_t$ tCO_2-e	cumulative $EBBBSLPA$ tCO_2-e
1	622	(18)	412	(15)	(17,416)	(17,416)
2	869	(18)	538	(15)	(23,768)	(41,184)
3	972	(18)	638	(15)	(27,125)	(68,310)
4	953	(18)	585	(15)	(25,996)	(94,305)
5	913	(18)	498	(15)	(23,978)	(118,283)
6	752	(18)	446	(15)	(20,278)	(138,561)
7	787	(18)	430	(15)	(20,687)	(159,248)
8	714	(18)	356	(15)	(18,244)	(177,493)
9	693	(18)	293	(15)	(16,939)	(194,432)
10	616	(18)	288	(15)	(15,455)	(209,887)
11	619	(18)	222	(15)	(14,544)	(224,431)
12	633	(18)	197	(15)	(14,438)	(238,869)
13	599	(18)	190	(15)	(13,711)	(252,581)
14	542	(18)	168	(15)	(12,341)	(264,922)
15	579	(18)	187	(15)	(13,307)	(278,229)
16	578	(18)	198	(15)	(13,448)	(291,677)
17	584	(18)	175	(15)	(13,216)	(304,893)
18	573	(18)	186	(15)	(13,177)	(318,070)
19	582	(18)	173	(15)	(13,162)	(331,232)
20	590	(18)	177	(15)	(13,370)	(344,602)
21	620	(18)	191	(15)	(14,119)	(358,721)
22	637	(18)	158	(15)	(13,923)	(372,643)
23	795	(18)	169	(15)	(16,980)	(389,624)
24	846	(18)	172	(15)	(17,945)	(407,568)
25	833	(18)	178	(15)	(17,790)	(425,359)
26	928	(18)	172	(15)	(19,434)	(444,793)
27	926	(18)	177	(15)	(19,474)	(464,266)
28	970	(18)	173	(15)	(20,198)	(484,464)
29	1,139	(18)	237	(15)	(24,225)	(508,689)
30	1,328	(18)	227	(15)	(27,532)	(536,221)
31	1,371	(18)	211	(15)	(28,071)	(564,292)
32	1,632	(18)	232	(15)	(33,144)	(597,436)
33	1,557	(18)	205	(15)	(31,366)	(628,802)
34	1,290	(18)	140	(15)	(25,558)	(654,360)
35	1,372	(18)	136	(15)	(26,987)	(681,347)
36	1,377	(18)	124	(15)	(26,896)	(708,243)
37	1,395	(18)	107	(15)	(26,969)	(735,212)
38	1,401	(18)	98	(15)	(26,955)	(762,167)
39	1,405	(18)	111	(15)	(27,220)	(789,387)
40	1,380	(18)	110	(15)	(26,751)	(816,139)

3.2.1.1 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 2008 by undertaking on-site patrolling and reporting (refer to Annex 7_Monitoring Reports 2005 to 2011). 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 2008 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 58):

Table 58: 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	(21,558)	(21,558)	(21,558)	(21,558)
2	0	0	0	0	(29,855)	(51,413)	(29,855)	(29,855)
3	0	0	0	0	(34,668)	(86,081)	(34,668)	(34,668)
4	0	0	0	0	(33,961)	(120,042)	(33,961)	(33,961)
5	0	0	0	0	(32,108)	(152,150)	(32,108)	(32,108)
6	0	0	0	0	(28,208)	(180,358)	(28,208)	(28,208)
7	0	0	0	0	(29,223)	(209,581)	(29,223)	(29,223)
8	0	0	0	0	(26,729)	(236,310)	(26,729)	(26,729)
9	0	0	0	0	(25,559)	(261,870)	(25,559)	(25,559)
10	0	0	0	0	(24,206)	(286,076)	(24,206)	(24,206)
11	0	0	0	0	(22,971)	(309,047)	(22,971)	(22,971)
12	0	0	0	0	(22,565)	(331,612)	(22,565)	(22,565)
13	0	0	0	0	(21,335)	(352,947)	(21,335)	(21,335)
14	0	0	0	0	(19,322)	(372,270)	(19,322)	(19,322)
15	0	0	0	0	(20,202)	(392,471)	(20,202)	(20,202)
16	0	0	0	0	(20,197)	(412,668)	(20,197)	(20,197)
17	0	0	0	0	(19,694)	(432,362)	(19,694)	(19,694)
18	0	0	0	0	(19,525)	(451,887)	(19,525)	(19,525)
19	0	0	0	0	(19,391)	(471,279)	(19,391)	(19,391)
20	0	0	0	0	(19,584)	(490,863)	(19,584)	(19,584)
21	0	0	0	0	(20,475)	(511,338)	(20,475)	(20,475)
22	0	0	0	0	(20,189)	(531,527)	(20,189)	(20,189)
23	0	0	0	0	(23,905)	(555,432)	(23,905)	(23,905)
24	0	0	0	0	(25,195)	(580,628)	(25,195)	(25,195)
25	0	0	0	0	(25,136)	(605,764)	(25,136)	(25,136)
26	0	0	0	0	(27,229)	(632,993)	(27,229)	(27,229)
27	0	0	0	0	(27,445)	(660,438)	(27,445)	(27,445)
28	0	0	0	0	(28,479)	(688,917)	(28,479)	(28,479)
29	0	0	0	0	(33,609)	(722,526)	(33,609)	(33,609)
30	0	0	0	0	(37,880)	(760,406)	(37,880)	(37,880)
31	0	0	0	0	(38,863)	(799,270)	(38,863)	(38,863)
32	0	0	0	0	(45,394)	(844,663)	(45,394)	(45,394)
33	0	0	0	0	(43,633)	(888,296)	(43,633)	(43,633)
34	0	0	0	0	(36,881)	(925,177)	(36,881)	(36,881)
35	0	0	0	0	(38,806)	(963,982)	(38,806)	(38,806)
36	0	0	0	0	(38,876)	(1,002,859)	(38,876)	(38,876)
37	0	0	0	0	(39,136)	(1,041,995)	(39,136)	(39,136)
38	0	0	0	0	(39,283)	(1,081,278)	(39,283)	(39,283)
39	0	0	0	0	(39,687)	(1,120,965)	(39,687)	(39,687)
40	0	0	0	0	(39,108)	(1,160,073)	(39,108)	(39,108)

3.3 Leakage

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[43]. 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 2.3.1.

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[44].

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.

3.3.1 Total ex ante estimated actual net carbon stock changes and emissions of non-CO2 gasses in the project area

Total ex ante estimated actual net carbon stock changes and emissions of non-CO2 gasses in the project area are presented below (Table 59)

[43] Taken from the definition of "leakage belt" in the vm0015 methodology page 10.

[44] 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 cero.

Table 59: Total ex ante estimated actual emissions of non-CO2 gasses due to forest fires in the project area (Refer to Table 28 – VM0015 methodology)

Project year t	Total *ex ante* estimated actual non-CO2 emissions from forest fires in the Project area	
	$EBBPSPA_t$ annual tCO_2-e	$EBBPSPA$ cumulative tCO_2-e
0	0	0
1	(871)	(871)
2	(1,188)	(2,059)
3	(1,356)	(3,415)
4	(1,300)	(4,715)
5	(1,199)	(5,914)
6	(1,014)	(6,928)
7	(1,034)	(7,962)
8	(912)	(8,875)
9	(847)	(9,722)
10	(773)	(10,494)
11	(727)	(11,222)
12	(722)	(11,943)
13	(686)	(12,629)
14	(617)	(13,246)
15	(665)	(13,911)
16	(672)	(14,584)
17	(661)	(15,245)
18	(659)	(15,903)
19	(658)	(16,562)
20	(668)	(17,230)
21	(706)	(17,936)
22	(696)	(18,632)
23	(849)	(19,481)
24	(897)	(20,378)
25	(890)	(21,268)
26	(972)	(22,240)
27	(974)	(23,213)
28	(1,010)	(24,223)
29	(1,211)	(25,434)
30	(1,377)	(26,811)
31	(1,404)	(28,215)
32	(1,657)	(29,872)
33	(1,568)	(31,440)
34	(1,278)	(32,718)
35	(1,349)	(34,067)
36	(1,345)	(35,412)
37	(1,348)	(36,761)
38	(1,348)	(38,108)
39	(1,361)	(39,469)
40	(1,338)	(40,807)

Table 60: Total ex ante estimated actual net carbon stock changes and emissions of non-CO2 gasses in the project area (Refer to Table 29 – VM0015 methodology)

Project year t	Total *ex ante* carbon stock decrease due to planned activities		Total *ex ante* carbon stock increase due to planned activities		Total *ex ante* carbon stock decrease due to unavoided unplanned deforestation		Total *ex ante* carbon stock change		Total ex ante estimated actual non-CO_2 emissions from forest fires in the project area	
	annual $\Delta CPAdPA_t$ tCO_2-e	cumulative $\Delta CPAdPA$ tCO_2-e	annual $\Delta CPAiPA_t$ tCO_2-e	cumulative $\Delta CPAiPA$ tCO_2-e	annual $\Delta CUDdPA_t$ tCO_2-e	cumulative $\Delta CUDdPA$ tCO_2-e	annual $\Delta CPSPA_t$ tCO_2-e	cumulative $\Delta CPSPA$ tCO_2-e	annual $EBBPSPA_t$ tCO_2-e	cumulative $EBBPSPA$ tCO_2-e
0	0	0	0	0	0	0	0	0	0	0
1	0	0	0	0	(21,558)	(21,558)	(21,558)	(21,558)	(871)	(871)
2	0	0	0	0	(29,855)	(51,413)	(29,855)	(51,413)	(1,188)	(2,059)
3	0	0	0	0	(34,668)	(86,081)	(34,668)	(86,081)	(1,356)	(3,415)
4	0	0	0	0	(33,961)	(120,042)	(33,961)	(120,042)	(1,300)	(4,715)
5	0	0	0	0	(32,108)	(152,150)	(32,108)	(152,150)	(1,199)	(5,914)
6	0	0	0	0	(28,208)	(180,358)	(28,208)	(180,358)	(1,014)	(6,928)
7	0	0	0	0	(29,223)	(209,581)	(29,223)	(209,581)	(1,034)	(7,962)
8	0	0	0	0	(26,729)	(236,310)	(26,729)	(236,310)	(912)	(8,875)
9	0	0	0	0	(25,559)	(261,870)	(25,559)	(261,870)	(847)	(9,722)
10	0	0	0	0	(24,206)	(286,076)	(24,206)	(286,076)	(773)	(10,494)
11	0	0	0	0	(22,971)	(309,047)	(22,971)	(309,047)	(727)	(11,222)
12	0	0	0	0	(22,565)	(331,612)	(22,565)	(331,612)	(722)	(11,943)
13	0	0	0	0	(21,335)	(352,947)	(21,335)	(352,947)	(686)	(12,629)
14	0	0	0	0	(19,322)	(372,270)	(19,322)	(372,270)	(617)	(13,246)
15	0	0	0	0	(20,202)	(392,471)	(20,202)	(392,471)	(665)	(13,911)
16	0	0	0	0	(20,197)	(412,668)	(20,197)	(412,668)	(672)	(14,584)
17	0	0	0	0	(19,694)	(432,362)	(19,694)	(432,362)	(661)	(15,245)
18	0	0	0	0	(19,525)	(451,887)	(19,525)	(451,887)	(659)	(15,903)
19	0	0	0	0	(19,391)	(471,279)	(19,391)	(471,279)	(658)	(16,562)
20	0	0	0	0	(19,584)	(490,863)	(19,584)	(490,863)	(668)	(17,230)
21	0	0	0	0	(20,475)	(511,338)	(20,475)	(511,338)	(706)	(17,936)
22	0	0	0	0	(20,189)	(531,527)	(20,189)	(531,527)	(696)	(18,632)
23	0	0	0	0	(23,905)	(555,432)	(23,905)	(555,432)	(849)	(19,481)
24	0	0	0	0	(25,195)	(580,628)	(25,195)	(580,628)	(897)	(20,378)
25	0	0	0	0	(25,136)	(605,764)	(25,136)	(605,764)	(890)	(21,268)
26	0	0	0	0	(27,229)	(632,993)	(27,229)	(632,993)	(972)	(22,240)
27	0	0	0	0	(27,445)	(660,438)	(27,445)	(660,438)	(974)	(23,213)
28	0	0	0	0	(28,479)	(688,917)	(28,479)	(688,917)	(1,010)	(24,223)
29	0	0	0	0	(33,609)	(722,526)	(33,609)	(722,526)	(1,211)	(25,434)
30	0	0	0	0	(37,880)	(760,406)	(37,880)	(760,406)	(1,377)	(26,811)
31	0	0	0	0	(38,863)	(799,270)	(38,863)	(799,270)	(1,404)	(28,215)
32	0	0	0	0	(45,394)	(844,663)	(45,394)	(844,663)	(1,657)	(29,872)
33	0	0	0	0	(43,633)	(888,296)	(43,633)	(888,296)	(1,568)	(31,440)
34	0	0	0	0	(36,881)	(925,177)	(36,881)	(925,177)	(1,278)	(32,718)
35	0	0	0	0	(38,806)	(963,982)	(38,806)	(963,982)	(1,349)	(34,067)
36	0	0	0	0	(38,876)	(1,002,859)	(38,876)	(1,002,859)	(1,345)	(35,412)
37	0	0	0	0	(39,136)	(1,041,995)	(39,136)	(1,041,995)	(1,348)	(36,761)
38	0	0	0	0	(39,283)	(1,081,278)	(39,283)	(1,081,278)	(1,348)	(38,108)
39	0	0	0	0	(39,687)	(1,120,965)	(39,687)	(1,120,965)	(1,361)	(39,469)
40	0	0	0	0	(39,108)	(1,160,073)	(39,108)	(1,160,073)	(1,338)	(40,807)

3.4 Summary of GHG Emission Reductions and Removals

Long-lived wood products (those that last more than 100 years according to the vm0015 methodology) are made from the commercial wood extracted by logging activities in the area. Logging activities selectively extract all the valuable (and in some cases also not so valuable) species that can be found per unit of area. As explained through this PD once logging activities deplete an area from valuable species, deforestation agents come into play. These deforestation agents either pioneer (squatters) or final land users (ranchers) clear the remaining trees by applying slash and burn. Although these agents may use wood to make fences these won't last more long given the harsh environment of the area, the lack of maintenance and the informality in the area. So, such products do not qualify as long-lived (more than a 100 years according to the definition in the vm0015 methodology).

The other deforestation agents, riberinhos, extract timber as construction materials (subsistence level). According to the PRA riberinhos extract this timber from areas they consider to be under control of the village, which happen to be the area accounted as non-forest or LMA. The LMA, although considered as non-forest, still has forested areas that are not included in the Project Area because either LULC for these areas changed within the past twelve years before the Project start date or because such forested areas do not qualify as forest by the Brazilian definition. Also in the case of wood products made by riberinhos, environmental factors and lack of maintenance create the necessity of often replacing the wood in constructions. In conclusion, long-lived wood products will be estimated only for the volumes extracted by selective logging operations.

Wood Products Calculations

Long-lived Wood Products

According to literature, selective logging operations in Brazil and the state of Para have a low logging intensity close to 10 m3/ha:

- According to Oliveira, L., 2005 who conducted a research in Para, logging intensity in low populated areas such as those of the projects ranges between 10-20 m3/ha.

- According to Verissimo, A., et al. 1992 who conducted a research in Para, logging yields vary greatly ranging from 20 to 50 m3/ha

- According to Silva, A., et al., 2004 (page 1) who conducted a research in Mato Grosso the logging intensity of a explored forest was 10 m3/ha whereas the logging intensity of a heavily explored and burned forest was 25 m3/ha. The type of forest of this study is the same as the one in the project area (ombrofila), the same soil type (latossolo-vermelho) and texture (mostly clay) and similar annual precipitation (around 2,000 mm) (page 2).

- According to Asner, g., et al. 2010 (page 7) the Brazilian industrial logging extraction activity removes around 10 to 40 m3/ha of timber from the Amazon forest.

Based on the aforementioned arguments significance of wood products was tested using logging intensities of 10 and 20 m3/ha for each forest class[45]:

As a result from the analysis, carbon stored in long-live wood products is not accounted for because this pool did not pass the 5% significance test in any case tested (Table 61):

Table 61: Significance test for long-lived wood products

	Value	Unit
Net emission factor per Ha	462.74	tCO2e/Ha
Logging Intensity	10	m3/ha
Coefficient of Volumetric Efficiency	39%	
Wood Density	0.7153	t/m3
Carbon Density	0.5	
Conversion factor for CO2e	3.67	Dimensionless
Permanence factor of CO2e by the use of wood in durable products	5.15	tCO2e/Ha
Calculation of significance level	**1.1%**	

	Value	Unit
Net emission factor per Ha	462.74	tCO2e/Ha
Logging Intensity	20	m3/ha
Coefficient of Volumetric Efficiency	39%	
Wood Density	0.7153	t/m3
Carbon Density	0.5	
Conversion factor for CO2e	3.67	Dimensionless
Permanence factor of CO2e by the use of wood in durable products	10.30	tCO2e/Ha
Calculation of significance level	**2.2%**	

Data for the significance analysis came from:

- Logging intensity for illegal selective logging ranges between 10-20 m3/ha: Verissimo, A., et al. 1992; Silva, A., et al., 2004; Asner, g., et al. 2009; Oliveira, L., 2005.
- Coefficient of volumetric efficiency: (Pereira, Santos et al. 2010)
- Wood density: Weighted average of wood density of valuable timber species as per Table 63[46].
- Conversion factor: IPCC 2003

[45] Net emission factors are those to be used after updating Table 15b of the PDDs and MRs using the correct Overmann's equation

[46] Weighted average was calculated taking into account the number of individuals per tree species and their respective wood density

Medium-lived wood products

Literature indicates that the deforestation process (slash and burn) occurs once valuable timber species have been selectively removed. Timber extraction can be conducted by loggers or other agents acting as loggers (squatters or ranchers) (Margulis 2004). Once valuable timber resources are extracted, pastures for cattle are implemented (May, Millikan et al. 2011).

Regarding short lived and medium lived wood products the vm0015 methodology states in page 153 "If data on the proportion of carbon stocks in each fraction of the wood product carbon pool are unavailable, it is conservative to assume that 100% of the carbon is stored in the long-term fraction in the baseline case (in which case no carbon is released into the atmosphere in the baseline case), and that 100% of the carbon is stored in short-term fraction in the project case (in which case all carbon is emitted immediately in the project case)."

Based on the data from the social assessment and according to local literature (Pinto, Santos et al. 2007), the following are the most common timber species used by local habitants:

Table 62: Commonly used tree species timber by local habitants

Common name	Scientific name
Louro preto	ocotea sp.
Tachi preto	Tachigalia paniculata
Jacareuba	Calophyllum brasilense
Maçaranduba	Manilkara huberi
Cedro vermelho	Cedrela odorata L
Paricarana	Parkia
Acapu	Vouacapoua americana
Cupiuba	Goupia glabra
Itauba	Mezilaurus
Piquia	Caryocar villosum

	Specie with high economic value
	Specie with medium economic value

As showed in Table 62 many of the trees used by local habitants have significant economic value (Pereira, Santos et al. 2010). Despite such trees could be assumed to be extracted as part of the volume considered in the calculations for long-lived wood products, to be conservative we also count such trees in the calculations for medium-lived wood products.

Detailed calculations of the significance of each tree can be found in Annex 9 and the results are presented below (Table 63):

Table 63: Significance level for medium-lived wood products

#	Common name	Scientific name	# of individuals in the sampling area	Wood Density (t.d.m/m3)	Volume (m3/ha)	Significance level (%)
1	Louro preto	ocotea sp.	13	0.51	0.10	0.004752%
2	Tachi preto	Tachigalia paniculata	358	0.56	8.54	0.433085%
3	Jacareuba	Calophyllum brasilense	5	0.65	0.08	0.004515%
4	Maçaranduba	Manilkara huberi	311	0.89	12.19	0.982119%
5	Cedro vermelho	Cedrela odorata L	1	0.43	0.07	0.002867%
6	Paricarana	Parkia	100	0.39	3.46	0.122254%
7	Acapu	Vouacapoua americana	552	0.79	15.25	1.090913%
8	Cupiuba	Goupia glabra	143	0.695	7.78	0.489645%
9	Itauba	Mezilaurus	61	0.68	1.68	0.103672%
10	Piquia	Caryocar villosum	14	0.7	2.70	0.170893%
				TOTAL	**51.85**	**3.40%**

We assume that the total volume of timber (m3/ha) extracted for building materials (i.e house building and posts for wire fences) should be equal to the volume extracted by selective logging operations. This assumption is conservative in the sense that selective logging operations use specialized equipment and heavy machinery to remove the timber whereas local habitants do all the work with hand-equipment.

Finally, the added significance of medium-lived and long-lived wood products is (Table 64):

Table 64: Total significance of medium-lived and long-lived wood products

Maximum Volume of valuable species (m3/ha) in the Project Area (*Tab Medium-lived Wood*)	**23.99**	**Significance**	
Maximum logging intensity according to literature(m3/ha)	20	4.9%	Not significant
Average logging intensity according to literature(m3/ha)	10	3.8%	Not significant

Our calculations are conservative in assuming that all timber extracted by local stakeholders (riberinhos and ranchers) is going to end as long-lived wood products, so no further calculations are required.

The Project will generate a Net GHG emission reduction of 22,130,927 tCO2e by the end of its lifetime. The total amount of GHG emissions reductions for the first fixed baseline period is 7,690,722 tCO2e. The average amount of GHG emissions reductions per year is 1,020,294 tCO2e (Table 65)

Table 65: Ex ante estimated net anthropogenic GHG emission reductions (DREDDt) and Voluntary Carbon Units (VCUt) (Refer to Table 36 – VM0015 methodology)

Project year *t*	Baseline carbon stock changes		Baseline GHG emissions		*Ex ante* project carbon stock changes		*Ex ante* project GHG emissions		*Ex ante* leakage carbon stock changes		*Ex ante* leakage GHG emissions		*Ex ante* net athropogenic GHG emission reductions		*Ex ante* VCUs tradable		*Ex ante* buffer credits	
	annual $\Delta CBSLPA_t$	cumulative $\Delta CBSLPA$	annual $EBBBSLPA_t$	cumulative $EBBBSLPA$	annual $\Delta CPSPA_t$	cumulative $\Delta CPSPA$	annual $EBBPSPA_t$	cumulative $EBBPSPA$	annual ΔCLK_t	cumulative ΔCLK	annual ELK_t	cumulative ELK	annual $\Delta REDD_t$	cumulative $\Delta REDD$	annual VCU_t	cumulative VCU	annual VBC_t	cumulative VBC
	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	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	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1	(431,161)	(431,161)	(17,416)	(17,416.09)	(21,558)	(21,558)	(871)	(871)	-	-	-	-	426,148	426,148	**369,828**	**369,828**	56,320	56,320
2	(592,899)	(1,024,059)	(23,768)	(41,184.42)	(29,855)	(51,413)	(1,188)	(2,059)	-	-	-	-	585,624	1,011,771	**508,205**	**878,033**	77,418	133,739
3	(686,389)	(1,710,448)	(27,125)	(68,309.52)	(34,668)	(86,081)	(1,356)	(3,415)	-	-	-	-	677,489	1,689,261	**587,878**	**1,465,910**	89,612	223,350
4	(669,595)	(2,380,043)	(25,996)	(94,305.48)	(33,961)	(120,042)	(1,300)	(4,715)	-	-	-	-	660,330	2,349,591	**572,931**	**2,038,841**	87,400	310,750
5	(630,106)	(3,010,149)	(23,978)	(118,283.43)	(32,108)	(152,150)	(1,199)	(5,914)	-	-	-	-	620,777	2,970,368	**538,552**	**2,577,393**	82,225	392,975
6	(550,048)	(3,560,197)	(20,278)	(138,561.28)	(28,208)	(180,358)	(1,014)	(6,928)	-	-	-	-	541,104	3,511,472	**469,351**	**3,046,744**	71,753	464,728
7	(568,249)	(4,128,446)	(20,687)	(159,248.45)	(29,223)	(209,581)	(1,034)	(7,962)	-	-	-	-	558,679	4,070,151	**484,563**	**3,531,307**	74,116	538,844
8	(516,521)	(4,644,967)	(18,244)	(177,492.67)	(26,729)	(236,310)	(912)	(8,875)	-	-	-	-	507,124	4,577,275	**439,778**	**3,971,085**	67,346	606,190
9	(491,438)	(5,136,405)	(16,939)	(194,431.84)	(25,559)	(261,870)	(847)	(9,722)	-	-	-	-	481,971	5,059,246	**417,913**	**4,388,997**	64,058	670,249
10	(462,817)	(5,599,222)	(15,455)	(209,886.57)	(24,206)	(286,076)	(773)	(10,494)	-	-	-	-	453,293	5,512,539	**392,984**	**4,781,981**	60,309	730,558
11	(436,676)	(6,035,898)	(14,544)	(224,430.68)	(22,971)	(309,047)	(727)	(11,222)	-	-	-	-	427,522	5,940,060	**370,637**	**5,152,618**	56,884	787,442
12	(431,321)	(6,467,219)	(14,438)	(238,869.10)	(22,565)	(331,612)	(722)	(11,943)	-	-	-	-	422,472	6,362,533	**366,268**	**5,518,887**	56,204	843,646
13	(408,143)	(6,875,362)	(13,711)	(252,580.55)	(21,335)	(352,947)	(686)	(12,629)	-	-	-	-	399,833	6,762,366	**346,647**	**5,865,534**	53,186	896,832
14	(369,307)	(7,244,669)	(12,341)	(264,921.99)	(19,322)	(372,270)	(617)	(13,246)	-	-	-	-	361,709	7,124,075	**313,586**	**6,179,120**	48,123	944,955
15	(388,007)	(7,632,676)	(13,307)	(278,228.94)	(20,202)	(392,471)	(665)	(13,911)	-	-	-	-	380,447	7,504,522	**329,874**	**6,508,994**	50,573	995,528
16	(388,631)	(8,021,307)	(13,448)	(291,676.75)	(20,197)	(412,668)	(672)	(14,584)	-	-	-	-	381,210	7,885,732	**330,550**	**6,839,544**	50,660	1,046,188
17	(379,373)	(8,400,680)	(13,216)	(304,892.61)	(19,694)	(432,362)	(661)	(15,245)	-	-	-	-	372,234	8,257,965	**322,778**	**7,162,322**	49,456	1,095,644
18	(376,530)	(8,777,209)	(13,177)	(318,069.63)	(19,525)	(451,887)	(659)	(15,903)	-	-	-	-	369,523	8,627,488	**320,435**	**7,482,756**	49,088	1,144,732
19	(374,246)	(9,151,455)	(13,162)	(331,232.06)	(19,391)	(471,279)	(658)	(16,562)	-	-	-	-	367,359	8,994,847	**318,566**	**7,801,323**	48,792	1,193,524
20	(378,337)	(9,529,792)	(13,370)	(344,601.77)	(19,584)	(490,863)	(668)	(17,230)	-	-	-	-	371,454	9,366,301	**322,125**	**8,123,448**	49,328	1,242,853
21	(396,200)	(9,925,992)	(14,119)	(358,720.50)	(20,475)	(511,338)	(706)	(17,936)	-	-	-	-	389,138	9,755,438	**337,476**	**8,460,923**	51,662	1,294,515
22	(390,552)	(10,316,544)	(13,923)	(372,643.33)	(20,189)	(531,527)	(696)	(18,632)	-	-	-	-	383,589	10,139,028	**332,664**	**8,793,588**	50,925	1,345,440
23	(464,559)	(10,781,103)	(16,980)	(389,623.53)	(23,905)	(555,432)	(849)	(19,481)	-	-	-	-	456,785	10,595,812	**396,195**	**9,189,783**	60,590	1,406,030
24	(489,835)	(11,270,937)	(17,945)	(407,568.49)	(25,195)	(580,628)	(897)	(20,378)	-	-	-	-	481,687	11,077,500	**417,799**	**9,607,582**	63,888	1,469,918
25	(488,231)	(11,759,168)	(17,790)	(425,358.58)	(25,136)	(605,764)	(890)	(21,268)	-	-	-	-	479,996	11,557,495	**416,320**	**10,023,902**	63,676	1,533,593
26	(529,527)	(12,288,696)	(19,434)	(444,792.67)	(27,229)	(632,993)	(972)	(22,240)	-	-	-	-	520,761	12,078,256	**451,695**	**10,475,597**	69,066	1,602,659
27	(533,264)	(12,821,960)	(19,474)	(464,266.33)	(27,445)	(660,438)	(974)	(23,213)	-	-	-	-	524,319	12,602,575	**454,769**	**10,930,366**	69,550	1,672,209
28	(553,279)	(13,375,239)	(20,198)	(484,464.32)	(28,479)	(688,917)	(1,010)	(24,223)	-	-	-	-	543,988	13,146,563	**471,828**	**11,402,194**	72,160	1,744,369
29	(654,815)	(14,030,054)	(24,225)	(508,689.43)	(33,609)	(722,526)	(1,211)	(25,434)	-	-	-	-	644,220	13,790,783	**558,804**	**11,960,998**	85,416	1,829,785
30	(738,872)	(14,768,926)	(27,532)	(536,220.94)	(37,880)	(760,406)	(1,377)	(26,811)	-	-	-	-	727,147	14,517,930	**630,761**	**12,591,759**	96,386	1,926,172
31	(757,217)	(15,526,144)	(28,071)	(564,291.69)	(38,863)	(799,270)	(1,404)	(28,215)	-	-	-	-	745,021	15,262,951	**646,248**	**13,238,006**	98,774	2,024,945
32	(885,979)	(16,412,122)	(33,144)	(597,435.92)	(45,394)	(844,663)	(1,657)	(29,872)	-	-	-	-	872,072	16,135,023	**756,492**	**13,994,498**	115,580	2,140,526
33	(849,385)	(17,261,508)	(31,366)	(628,801.99)	(43,633)	(888,296)	(1,568)	(31,440)	-	-	-	-	835,551	16,970,574	**724,760**	**14,719,257**	110,791	2,251,317
34	(713,642)	(17,975,150)	(25,558)	(654,359.73)	(36,881)	(925,177)	(1,278)	(32,718)	-	-	-	-	701,041	17,671,615	**607,987**	**15,327,244**	93,055	2,344,371
35	(751,280)	(18,726,430)	(26,987)	(681,346.74)	(38,806)	(963,982)	(1,349)	(34,067)	-	-	-	-	738,112	18,409,727	**640,147**	**15,967,391**	97,965	2,442,337
36	(752,007)	(19,478,437)	(26,896)	(708,242.67)	(38,876)	(1,002,859)	(1,345)	(35,412)	-	-	-	-	738,681	19,148,409	**640,626**	**16,608,017**	98,055	2,540,392
37	(756,512)	(20,234,948)	(26,969)	(735,211.58)	(39,136)	(1,041,995)	(1,348)	(36,761)	-	-	-	-	742,996	19,891,405	**644,357**	**17,252,374**	98,639	2,639,031
38	(758,841)	(20,993,789)	(26,955)	(762,166.77)	(39,283)	(1,081,278)	(1,348)	(38,108)	-	-	-	-	745,165	20,636,570	**646,226**	**17,898,600**	98,939	2,737,970
39	(766,676)	(21,760,465)	(27,220)	(789,387.20)	(39,687)	(1,120,965)	(1,361)	(39,469)	-	-	-	-	752,848	21,389,418	**652,887**	**18,551,487**	99,961	2,837,931
40	(755,202)	(22,515,667)	(26,751)	(816,138.61)	(39,108)	(1,160,073)	(1,338)	(40,807)	-	-	-	-	741,508	22,130,927	**643,045**	**19,194,532**	98,463	2,936,394

4 MONITORING

4.1 Data and Parameters Available at Validation

Data Unit / Parameter	**RRD Forest / Non-forest Cover Benchmark Map**
Data Unit	ha
Description	Map showing LULC class forest and non-forest at Project start date
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**Project Area Forest Cover Benchmark Map**
Data Unit	ha
Description	Map that shows the stratification an location of LULC class forest in the Project Area at the Project start date (100% forest cover)
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**Leakage Belt Forest Cover Benchmark Map**
Data Unit	ha
Description	Map that shows the stratification an location of LULC class forest in the Leakage Belt at the Project start date (100% forest cover)
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**$ABSLRR_t$**
Data Unit	ha
Description	Annual area of baseline deforestation in the reference region at year t
Source of data	Calculated based on the results from future deforestation model using peer-reviewed software IDRISI Selva.
Justification of choice of data or description of measurement methods and procedures applied	Variables and procedures to calculate baseline deforestation are thoroughly explained in Annex 3.
Measurement Frequency	Each renewal of fixed baseline period
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**ABSLPA**$_t$
Data Unit	ha
Description	Annual area of baseline deforestation in the project area at year t
Source of data	Calculated based on the results from future deforestation model using peer-reviewed software IDRISI Selva.
Justification of choice of data or description of measurement methods and procedures applied	Variables and procedures to calculate baseline deforestation are thoroughly explained in Annex 3.
Measurement Frequency	Each renewal of fixed baseline period
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**ABSLLK**$_t$
Data Unit	ha
Description	Annual area of baseline deforestation in the leakage belt at year t
Source of data	Calculated based on the results from future deforestation model using peer-reviewed software IDRISI Selva.
Justification of choice of data or description of measurement methods and procedures applied	Variables and procedures to calculate baseline deforestation are thoroughly explained in Annex 3.
Measurement Frequency	Each renewal of fixed baseline period
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**Ctot**$_{icl}$
Data Unit	t CO_2-e ha^{-1}
Description	Average carbon stock of all accounted carbon pools in forest class icl
Source of data	Determined by using data from the carbon inventory developed by SETA Ambiental and supervised by Ecosystem Services LLC (November 2011 through January 2012).
Value Applied	Dense Forest: 468.01 Degraded Forest: 413.35
Justification of choice of data or description of measurement methods and procedures applied	The inventory was carried out in 79 plots of forest comprising two classes namely dense forest and degraded forest, within an area that encompasses the Project Area and Leakage Belt. A detailed report can be found in Annex 5 but as a summary the following are the highlights of the report: - Sampling plots were randomly located in forest stratum - DBH (Diameter at Breast Height) was measured for all the trees in a plot - Trees biomass was determined using Overman et.al. 1994 equation, which was successfully tested nearby the Project Area by a different study
Measurement Frequency	Only once at project start
QA/QC procedures to be applied	Sampling protocol can be found in Annex 5 and calculations in Annex 6..
Any Comment	na

Data Unit / Parameter	**Ctot**$_{fcl}$
Data Unit	t CO_2-e ha^{-1}
Description	Average carbon stock of all accounted carbon pools in post-deforestation class fcl
Source of data	IPCC 2003 Good Practice Guidance for Land Use – Table 3.3.8
Value Applied	51.65
Justification of choice of data or description of measurement methods and procedures applied	Data is a default value for land converted to grassland in Tropical-Moist & Wet Climate Zones.
Measurement Frequency	Only once at project start
QA/QC procedures to be applied	The highest value of the error range was utilized (original value reduced in 75%)
Any Comment	na

Data Unit / Parameter	**CF**
Data Unit	tCt-1d.m
Description	Carbon fraction of dry matter.
Source of data	IPCC 2003 Good Practice Guidance for Land Use, Chapter 3.2 Forest Land, page 3.25
Value Applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	The value chosen is an IPCC default value as recommended by the vm0015 methodology.
Measurement Frequency	n/a
QA/QC procedures to be applied	n/a
Any Comment	n/a

Data Unit / Parameter	***CFj***
Data Unit	tCt-1d.m
Description	Carbon fraction for tree specie j.
Source of data	IPCC 2003 Good Practice Guidance for Land Use, Chapter 3.2 Forest Land, page 3.25
Value Applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	The value chosen is an IPCC default value as recommended by the vm0015 methodology.
Measurement Frequency	At Project start
QA/QC procedures to be applied	n/a
Any Comment	n/a

Data Unit / Parameter	$\mathbf{f}_j\boldsymbol{(DBH)}_{ab}$
Data Unit	t d.m. tree-1
Description	Allometric equation for species j linking DBH to aboveground biomass of living trees, expressed as t d.m. tree-1
Source of data	Overman's 1994 equation Overman, Witte et al. 1994) corrected for biomass moisture content (Araujo, Higuchi et al. 1999)
Justification of choice of data or description of measurement methods and procedures applied	Above-ground biomass for a DBH ≥ 10cm was calculated using Overman's equation (Overman, Witte et al. 1994) corrected for biomass moisture content (Araujo, Higuchi et al. 1999). Araujo tested Overman's equation in a location 250Km from Belem in Para (close to the Project Area under the same forest type), obtaining predicted results within ±0.6% of the weight determined in the field through destructive sampling.
Measurement Frequency	At project start.
QA/QC procedures to be applied	Overman 1994 equation has an R2 of 0.9 and was tested in the same region of the Project Area, in the same forest type with an error of ±0.6%
Any Comment	na

Data Unit / Parameter	**LULC-change**
Data Unit	%
Description	Percentage of forest that change to non-forest final classes during the historical reference period.
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site. SEMA (2010) Economic-ecologic Zonning information for the northen area of Para.
Justification of choice of data or description of measurement methods and procedures applied	Landsat imagery is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3. SEMA's data is available to the public and is the most up to date and scale adequate official data for the Project Area.
Measurement Frequency	At project start.
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**Fburnt**$_{icl}$
Data Unit	%
Description	Proportion of forest area burned during the historical reference period in the forest class icl
Source of data	Percentage of biomass that is left to burn after timber for wood products is extracted.
Value Applied	96%
Justification of choice of data or description of measurement methods and procedures applied	Data is derived from the assessment of durable wood products
Measurement Frequency	only once at project start
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**ERCH4**
Data Unit	dimensionless
Description	Emission ratio for CH_4 (IPCC default value = 0.012)
Source of data	vm0015 methodology
Justification of choice of data or description of measurement methods and procedures applied	Default value indicated by the vm0015 methodology
Measurement Frequency	each renewal of fixed baseline period
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**Pburnt**$_{p,icl}$
Data Unit	%
Description	Average proportion of mass burnt in the carbon pool p in the forest class icl;
Source of data	Percentage of biomass that is left to burn after timber for wood products is extracted.
Value Applied	96%
Justification of choice of data or description of measurement methods and procedures applied	Data is derived from the assessment of durable wood products
Measurement Frequency	only once at project start
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**$Cp_{,icl,t}$**
Data Unit	t CO_2-e ha^{-1}
Description	Average carbon stock per hectare in the carbon pool *p* burnt at year *t* in the forest class *icl*;
Source of data	Determined by using data from the carbon inventory developed by SETA Ambiental and supervised by Ecosystem Services LLC (November 2011 through January 2012) Data from IPCC Good Practice Guidance for Land Use – Table 3.3.8
Justification of choice of data or description of measurement methods and procedures applied	The inventory was carried out in 79 plots of forest comprising two classes namely dense forest and degraded forest, within an area that encompasses the Project Area and Leakage Belt. A detailed report can be found in Annex 5 but as a summary the following are the highlights of the report: - Sampling plots were randomly located in forest stratum - DBH (Diameter at Breast Height) was measured for all the trees in a plot - Trees biomass was determined using Overman et.al. 1994 equation, which was successfully tested nearby the Project Area by a different study. Data is a default value for land converted to grassland in Tropical-Moist & Wet Climate Zones.
Measurement Frequency	only once at project start
QA/QC procedures to be applied	Sampling protocol can be found in Annex 5 and calculations in Annex 6. The highest value of the error range was utilized (original value reduced in 75%).
Any Comment	na
Used in Equations	na

Data Unit / Parameter	**CE**$_{p,icl}$
Data Unit	dimensionless
Description	Average combustion efficiency of the carbon pool p in the forest class
Source of data	vm0015 methodology
Value Applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	Presented by the vm0015 methodology
Measurement Frequency	only once at project start
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**GWP**$_{CH4}$
Data Unit	dimensionless
Description	Global Warming Potential for CH_4 (IPCC default value = 21 for the first commitment period)
Source of data	vm0015 methodology
Justification of choice of data or description of measurement methods and procedures applied	Presented by the vm0015 methodology
Measurement Frequency	each renewal of fixed baseline period
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	***DLF***
Data Unit	%
Description	Displacement Leakage Factor
Source of data	vm0015 methodology.
Value Applied	0
Justification of choice of data or description of measurement methods and procedures applied	Presented in the vm0015 methodology. The value is an ex-ante estimation.
Measurement Frequency	each renewal of fixed baseline period
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	***%LKB***
Data Unit	%
Description	Percentage of the overlapping leakage belts area to be assigned to project, A, B…..N
Source of data	Map of Distance to sellective logging from tertiary roads Map of distance to rivers Project Area Forest Cover Benchmark Map
Justification of choice of data or description of measurement methods and procedures applied	The data was generated using Landsat imagery that is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3. Relevance of the variable is recognized in the literature.
Measurement Frequency	At project start and at each verification
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	RF_t
Data Unit	%
Description	Risk factor used to calculate VCS buffer credits
Source of data	AFOLU Non-Permanence Risk Tool v3.1
Justification of choice of data or description of measurement methods and procedures applied	The value was calculated as a result of applying the guidelines in the aforementioned Tool
Measurement Frequency	each renewal of fixed baseline period
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	R_j
Data Unit	dimensionless
Description	Root-shoot ratio appropriate for species, group of species or forest type j
Source of data	IPCC 2003 Good Practice Guidance for Land Use – Table 3.3.8
Value Applied	0.22
Justification of choice of data or description of measurement methods and procedures applied	Is the lowest value presented in the document for Tropical Wet Forests in the IPCC's table.
Measurement Frequency	Only once at project start
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	***Cwp***
Data Unit	t CO_2-e
Description	Average carbon stock per hectare in the harvested wood products carbon pool
Source of data	Logging Intensity Coefficient of Volumetric Efficiency Carbon Stock Change Factor Carbon Fraction for Tree Specie j Basic Wood Density in specie j
Justification of choice of data or description of measurement methods and procedures applied	Logging Intensity was used as a default for Para as presented by Putz et. al. 2008 Coefficient of Volumetric Efficiency is an official default from CONAMA Wood Density is a default value from IPCC 2003 Carbon Stock Change Factor was caculated using the lowest boundary of the 90% CI
Measurement Frequency	only once at project start and when mandatory
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	***$\Delta Ctot_{ct,t}$***
Data Unit	$t\ CO_2\text{-e}\ ha^{-1}$
Description	Carbon stock change factor (also called emission factor) for all accounted carbon pools in category *ct* at time *t*
Source of data	Calculated
Value Applied	798.02
Justification of choice of data or description of measurement methods and procedures applied	Value calculated based on the corrected values of carbon density for each pool at the lowest boundary of the 90% CI
Measurement Frequency	only once at project start and when mandatory
QA/QC procedures to be applied	Lowest boundary of the 90% CI for carbon values in all pools
Any Comment	na

Data Unit / Parameter	**Map of Distance to sellective logging from tertiary roads**
Data Unit	Km
Description	Average distance from tertiary roads to areas presenting sellective logging
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3. Relevance of the variable is recognized in the literature.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	Random sampling of several points in different areas
Any Comment	na

Data Unit / Parameter	**Map of distance to rivers**
Data Unit	Km
Description	Raster map of distances from navigable rivers in the RRD.
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	
Any Comment	na

Data Unit / Parameter	**Map of distance to roads**
Data Unit	Km
Description	Raster map of distances from all roads in the RRD.
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**Map of distance to non-forest**
Data Unit	Km
Description	Raster map of distances from non-forest areas in the RRD.
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**Logging Intensity**
Data Unit	m3/ha
Description	Volume of commercial timber extracted per hectare in Para
Source of data	Putz et. al. 2008
Value Applied	30
Justification of choice of data or description of measurement methods and procedures applied	Data comes from a peer reviewed publication
Measurement Frequency	At project start
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**Coefficient of Volumentric Efficiency**
Data Unit	NA
Description	Proportion of wood that actually makes it all the way to durable wood products
Source of data	CONAMA 2009
Value Applies	0.45
Justification of choice of data or description of measurement methods and procedures applied	Data comes from an official sources.
Measurement Frequency	At project start
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**EI**
Data Unit	%
Description	Ex ante estimated Effectiveness Index
Source of data	calculated
Justification of choice of data or description of measurement methods and procedures applied	Based on results from ongoing on-site monitoring activities since 2008
Measurement Frequency	At project start and annually
QA/QC procedures to be applied	Based on accuracy assessment in Annex 3
Any Comment	na

4.2 Data and Parameters Monitored

Data Unit / Parameter	**RRD Forest / Non-forest Cover Benchmark Map**
Data Unit	ha
Description	Map showing LULC class forest and non-forest at Project start date
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**Project Area Forest Cover Benchmark Map**
Data Unit	ha
Description	Map that shows the stratification an location of LULC class forest in the Project Area at the Project start date (100% forest cover)
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**Leakage Belt Forest Cover Benchmark Map**
Data Unit	ha
Description	Map that shows the stratification an location of LULC class forest in the Leakage Belt at the Project start date (100% forest cover)
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**$ABSLRR_t$**
Data Unit	ha
Description	Annual area of baseline deforestation in the reference region at year t
Source of data	Calculated based on the results from future deforestation model using peer-reviewed software IDRISI Selva.
Justification of choice of data or description of measurement methods and procedures applied	Variables and procedures to calculate baseline deforestation are thoroughly explained in Annex 3.
Measurement Frequency	Each renewal of fixed baseline period
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**$ABSLPA_t$**
Data Unit	ha
Description	Annual area of baseline deforestation in the project area at year t
Source of data	Calculated based on the results from future deforestation model using peer-reviewed software IDRISI Selva.
Justification of choice of data or description of measurement methods and procedures applied	Variables and procedures to calculate baseline deforestation are thoroughly explained in Annex 3.
Measurement Frequency	Each renewal of fixed baseline period
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**$ABSLLK_t$**
Data Unit	ha
Description	Annual area of baseline deforestation in the leakage belt at year t
Source of data	Calculated based on the results from future deforestation model using peer-reviewed software IDRISI Selva.
Justification of choice of data or description of measurement methods and procedures applied	Variables and procedures to calculate baseline deforestation are thoroughly explained in Annex 3.
Measurement Frequency	Each renewal of fixed baseline period
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	**LULC-change**
Data Unit	%
Description	Percentage of forest that change to non-forest final classes during the historical reference period.
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site. SEMA (2010) Economic-ecologic Zonning information for the northen area of Para.
Justification of choice of data or description of measurement methods and procedures applied	Landsat imagery is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3. SEMA's data is available to the public and is the most up to date and scale adequate official data for the Project Area.
Measurement Frequency	At project start.
QA/QC procedures to be applied	Through accuracy assessment in Annex 3
Any Comment	na

Data Unit / Parameter	***DLF***
Data Unit	%
Description	Displacement Leakage Factor
Source of data	vm0015 methodology.
Value Applied	0
Justification of choice of data or description of measurement methods and procedures applied	Presented in the vm0015 methodology. The value is an ex-ante estimation.
Measurement Frequency	each renewal of fixed baseline period
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	***%LKB***
Data Unit	%
Description	Percentage of the overlapping leakage belts area to be assigned to project, A, B…..N
Source of data	Map of Distance to sellective logging from tertiary roads Map of distance to rivers Project Area Forest Cover Benchmark Map
Justification of choice of data or description of measurement methods and procedures applied	The data was generated using Landsat imagery that is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3. Relevance of the variable is recognized in the literature.
Measurement Frequency	At project start and at each verification
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	RF_t
Data Unit	%
Description	Risk factor used to calculate VCS buffer credits
Source of data	AFOLU Non-Permanence Risk Tool v3.1
Justification of choice of data or description of measurement methods and procedures applied	The value was calculated as a result of applying the guidelines in the aforementioned Tool
Measurement Frequency	each renewal of fixed baseline period
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**Map of Distance to sellective logging from tertiary roads**
Data Unit	Km
Description	Average distance from tertiary roads to areas presenting sellective logging
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3. Relevance of the variable is recognized in the literature.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	Random sampling of several points in different areas
Any Comment	na

Data Unit / Parameter	**Map of distance to rivers**
Data Unit	Km
Description	Raster map of distances from navigable rivers in the RRD.
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	
Any Comment	na

Data Unit / Parameter	**Map of distance to roads**
Data Unit	Km
Description	Raster map of distances from all roads in the RRD.
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**Map of distance to non-forest**
Data Unit	Km
Description	Raster map of distances from non-forest areas in the RRD.
Source of data	Landsat Imagery from 1996, 2004 and 2008 obtained from INPES web site.
Justification of choice of data or description of measurement methods and procedures applied	The data is available to the public free of charge. Details about data pre and post-processing can be found in Annex 3.
Measurement Frequency	At the start of every fixed baseline period.
QA/QC procedures to be applied	na
Any Comment	na

Data Unit / Parameter	**EI**
Data Unit	%
Description	Ex ante estimated Effectiveness Index
Source of data	calculated
Justification of choice of data or description of measurement methods and procedures applied	Based on results from ongoing on-site monitoring activities since 2008
Measurement Frequency	At project start and annually
QA/QC procedures to be applied	Based on accuracy assessment in Annex 3
Any Comment	na

4.3 Description of the Monitoring Plan

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;

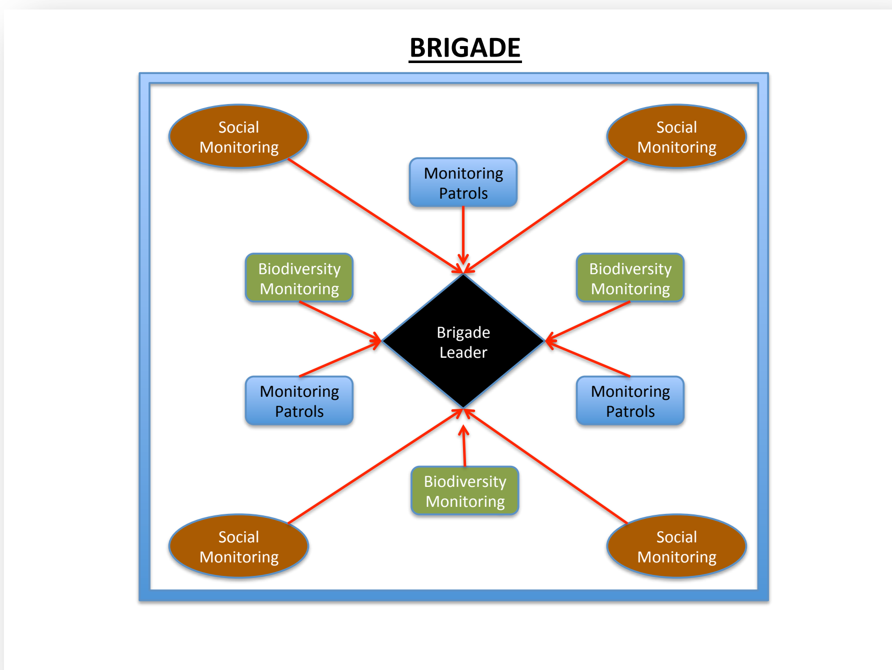
1.4 Monitoring the impacts of natural disturbances and other catastrophic events.

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

1.1.1 Monitor the implementation of the project.

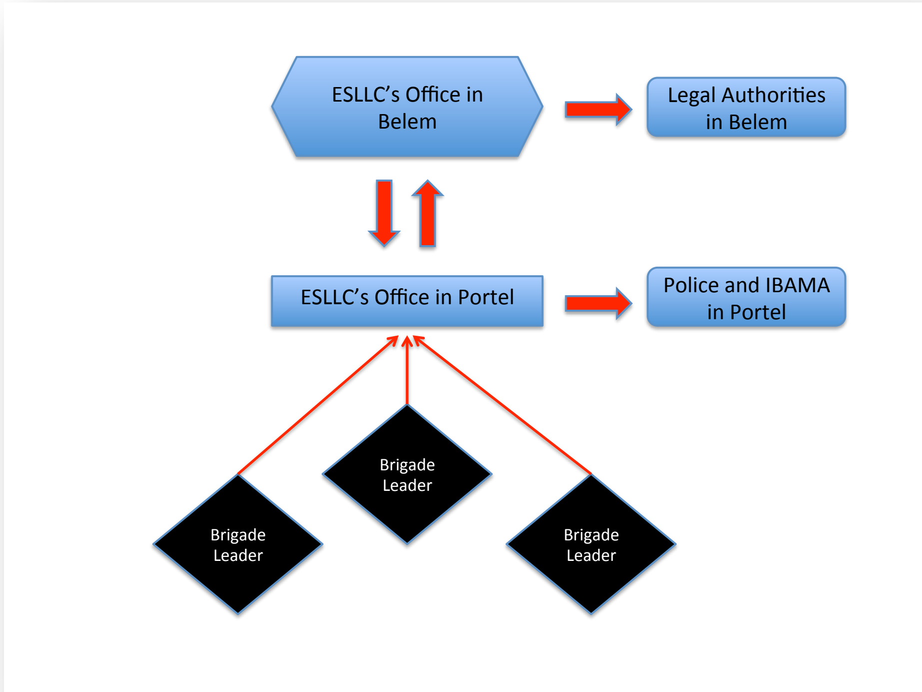
This task will be the responsibility of Ecosystem Services LLC. To assure the most effective monitoring of the activities of the Project, areas will be divided in brigades to better manage the extent of the Project Area and LMA. Brigade leaders will oversee the activities and compile and analyze the results from monitoring patrols[47] (Figure 17). Brigade leaders will report to ESLLC's office in Portel, which in turn will report to the office in Belem. 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 18).

Figure 17: Activities management in the Project



[47] Could be one leader overseen all the patrols or one for each type of patrol. This will be decided after validation based on the results from the census.

Figure 18: 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 responsible 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[48] 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 ESLLC's office in Portel. 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.

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[48] Georeferenced information should be available as shapefile.

2. Biodiversity monitoring: will be undertaken by biodiversity monitoring squads. These patrols should follow approved monitoring protocols[49] (by ESLLC) 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 Ecosystem Services LLC. 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.

[49] Protocols and monitoring plan will be developed within six months before validation.

Table 66: 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 will be deforested in the baseline case.	Does not apply because the Project will not claim carbon credits from carbon stock increase.

To assess LULC-change from forest land to non-forest land, the Project will use LANDSAT 8 imagery and/or radar imagery[50] to generate annual deforestation data throughout the Reference Region using the protocol described in detail in Annex 3. 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[51] 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; Ecosystem Services LLC will hire technicians from Portel or Breves.

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

[50] Depending on clouds cover.

[51] We define as brigades the subdivisions of the Project Area.

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 Portel and to IBAMA in Portel 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 67). So, the Project is not required to set sampling plots to measure carbon stocks in either the Project Area or Leakage Belt.

Table 67: 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 significatn 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.
		Within the Project Area	
Optional monitoring of carbon stocks	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 deforestation 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.

Ecosystem Services LLC 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.

Ecosystem Services LLC 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 following10-year period in the Reference Region (2018-2028).

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.

According to Section 1.1.3 of this monitoring plan, it will not be necessary to adjust the carbon component of the baseline.

5 ENVIRONMENTAL IMPACT

5.1 Impacts on Communities

Net positive impacts will be estimated based on the indicators developed for each activity. The results from the social assessment and PRA will be used as initial data to build a baseline against which changes in the indicators will be compared. During the census, workshops will be held to discuss the activities of the Project with villagers and to identify potential conflicts or negative impacts. Nevertheless, it should be highlighted that all the activities of the Project aim at generating improvements in local livelihoods and negative impacts are not expected.

The following are the expected positive community impacts:

- Secured land tenure
- Diversification of food through agroforestry practices thus an improvement in local nutrition
- More efficient technologies to produce farinha therefore less time is consume in 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.

Awareness-rising for participating and neighboring communities will be addressed through discussions and trainings, billboards, boundary demarcation, and meetings, with encouragement for surrounding migrant communities to emulate sustainable forest management practices under future REDD expansion.

The Project will also facilitate a natural resource management planning process with project neighboring communities that would involve local migrant families. This process would result in the formulation of land- use plans that will lead to more sustainable development in the areas outside the immediate project.

Agroforestry training will help boost farm output, encourage farmers to put energy into increased production, rather than further forest clearing.

The Project will include neighboring communities outside the Project's Boundaries in its socio-economic monitoring activities[52]. This should allow feedback from non-project communities in the area concerning the negative and positive ways in which the project impacts them. The implementing organization team would also respond to queries and problems related to the project that may arise in neighboring non-project communities.

5.2 Impacts on Biodiversity

The Project zone is recognized as an extreme priority site for biodiversity, especially for birds and invertebrates' conservation (MMA 2002). It holds preserved biodiversity and a very low demographic density, counting with a research station (Scientific Station Ferreira Penna), which allows research and monitoring of flora and fauna.

Within the project zone there is a significant concentration of igarapés draining two main rivers: Xingu and Tocantins. Due to this, flooded forests (Igapós and Várzeas) are abundant and provide invertebrates and fish with feeding, breeding and protection areas (Montag et al. 2008), enhancing therefore High Conservation Values already identified in the area.

The Project will avoid ecosystems fragmentation and loss due to deforestation. Consequently, the "with project" scenario will benefit the area in numerous ways. Firstly, the implementation of the project will guarantee the conservation of the area as whole. It can be inferred that the vegetation cover will remain intact and will continue to host important species of great biodiversity and socio-economic value.

Another positive net impact of the project is the biodiversity monitoring itself. Currently, the monitoring in the Amazon forest is still incipient and fragmented (Marengo 2007) and the Project will add up another area of monitoring to the Amazon as a whole, and, consequently gather accurate information about the local biodiversity and ecological processes.

The Project won't generate negative offsite impacts to biodiversity. On the contrary, the Project is expected to generate positive leakage on biodiversity by avoiding ecosystem fragmentation through voluntary engagement of neighbor communities in the Project's activities.

[52] Depending on the number of people available to work as monitoring staff. This will be defined once the census information becomes available.

6 STAKEHOLDER COMMENTS

6.1 Villagers participation

Ecosystem Services LLC developed a Participatory Rural Appraisal (PRA) with villages located in the project areas and within a 15 Km buffer from the project areas. The PRA has designed and implemented by a team of experienced anthropologists and lead by a senior specialist on PRA for REDD projects.

The PRA was developed through a series of field visits, observations, surveys, workshops and interviews to local leaders and experts. To complement field information, the team used secondary information from IBGE's 2010 Census.

Through our PRA, plenty of information about the needs and expectations of local villagers in terms of how they envision their communities in the future was gathered.

The Project´s activities were based on that information. It is recommended to arrive to the villages with a clear and open mind to be able to understand local needs and then shape our activities based on the results from our PRA.

For this reason, the Project's activities were conceived right after the social assessment was carried out and not the other way around. Therefore, local villagers not only were involved in the Project design, they actually provided the inputs for the ESLLC's team to design the Project.

In addition to the participation of community people in the community forest committees, and in decision making regarding the development and implementation of the project management plan, several other programs will be implemented that require community participation, including:

• **Paid monitoring jobs:** villagers will have the opportunity to work in paid monitoring positions in a rotational basis in order to give an opportunity to all the members of the community that wish to participate.

• **Biodiversity and Natural Resource Use Monitoring Program:** This program will train community members to participate and collaborate in natural resource monitoring activities.

This program will generate information about the status of biodiversity, its uses and threats. The duties of these monitors are as follows:

- Census monitor – performs a weekly collection of information about natural resource use.

- Fishing monitor – collects data about the production, marketing and selling of fish at the major docks in the municipality.

- Boat monitors – collects data on the transit of boats at strategic points in the protected area.

- Fauna monitor – monitors the presence and quantity of animals in the forest

- Road Monitor – monitors the road traffic and types of goods transported

• **Forest Management:** It is crucial for project success that good practices in Forest Management are developed with the community. Some material will be distributed, and workshops will be planned in order to provide sufficient knowledge so that the community people can continue their forestry activities, without damaging the natural resources.

6.2 Plan to receive and solve conflicts and complaints

The Project will receive and deal with all complaints and conflicts in a timely and effective manner though a comprehensive process presented in Figure 19 and Table 68:

Figure 19: Flowchart of the claim-solving process

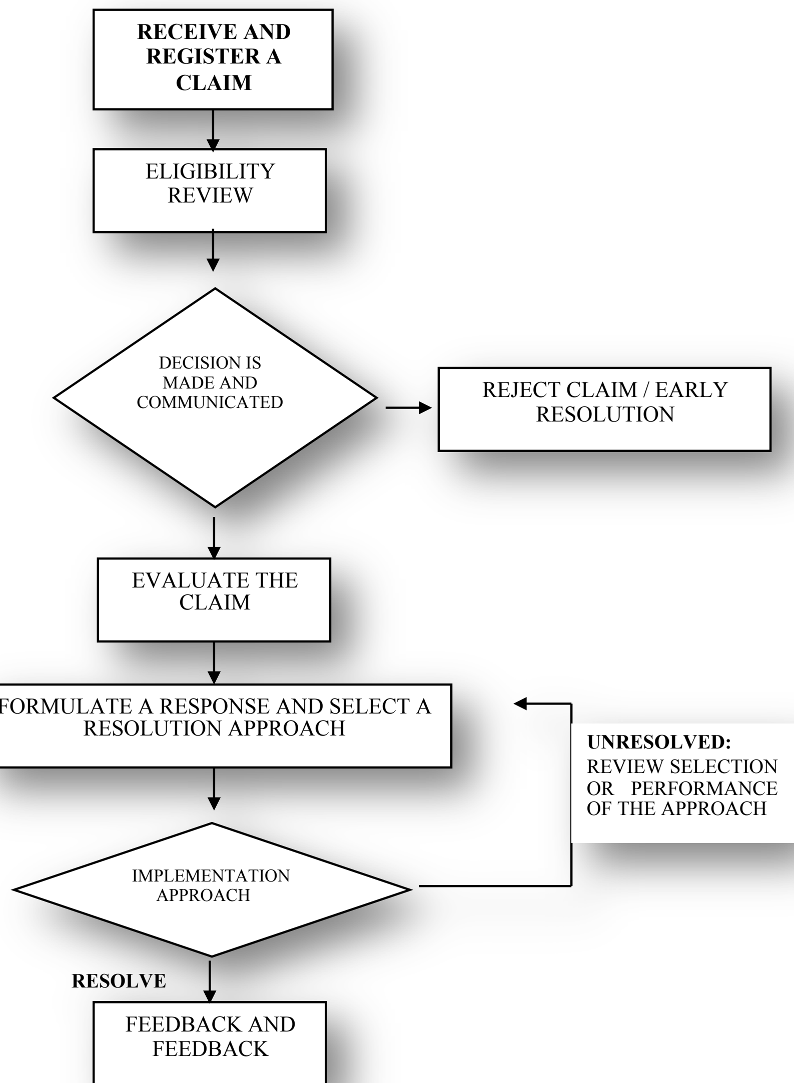

Table 68: Complaints management mechanism

STEPS	COMPONENT	DESCRIPTION
1	**Receive and register a claim**	**Multiple channels for receiving complaints:** Community liaison, project operator, community organization. **Presenting a claim:** Letter, use of official form, orally (face-to-face, telephone or radio), confidential (suggestion box). **Registration:** It is registered locally by the community liaison and is transmitted to the Claims Service Office for registration in the central file.
2	**Examine and determine eligibility of the claim**	**Examine the claim:** The Claims Service Office examines the complaint and determines whether it is meritorious according to eligibility criteria: • The complaint is related to the project. • Issues mentioned in the complaint fall within the themes that the grievance mechanism is allowed to attend. • The claimant is positioned to present it. **Notice of Decision:** In case of an ineligible claim, it must be established a dialogue with the claimant for more details of the complaint and ensure that no implications or connections with the project or if there is any other means to resolve the complaint.
3	**Decide, communicate decisions, solve early**	**Reject claim:** In case of failure to find support elements of the claim and ensure there is no connection with the project, claimant must be informed of the decision, clearly explaining the decision and the reasons for the rejection of his claim. **Indicate as appropriate** If eligible the claim, the claimant is notified and informed about the process for solving it. **Early resolution of the claim:** If the case is not complex and it is possible, resolve the matter of the complaint locally and satisfactory to the complainant using the direct and clear dialogue. When the claim is solved the agreed solution is recorded and filed.
4	**Evaluation of the claim**	Determine who will conduct the evaluation, collect information about the case, identify stakeholders, classify a complaint according to its severity (high, medium or low). The claimant must be involved throughout the evaluation process and influence the conflict resolution process.
5	**Formulating a response**	Determine who communicates and how. Special attention should be paid to the standpoint of the claimant in the process of evaluation and possible solution of the claim.

		Formulate a specific solution or approach to resolve the claim.
6	**Approaches to resolving complaints**	1. The company proposes a solution. 2. The claimant and the company discuss the proposed solution. 3. The company and the claimant have require a third party to decide. 4. The company and the community use traditional practices.
7	**Monitoring, documentation and feedback**	Claims must be tracked and monitored, recording the whole process, settlement mechanism and results of each stage.

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