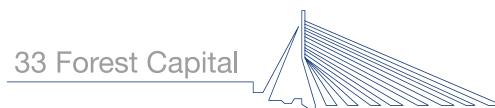


2010 MONITORING REPORT FOR CIKEL BRAZILIAN AMAZON REDD APD PROJECT

GHG EMISSION REDUCTIONS FROM AVOIDING PLANNED DEFORESTATION



Project Title	CIKEL BRAZILIAN AMAZON REDD APD PROJECT – AVOIDING PLANNED DEFORESTATION
Version	02
Date of Issue	18 May 2012
Project ID	
Monitoring Period	July 19 2007 to July 18 2010
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1. PROJECT DETAILS

1.1. Summary Description of Project

The objective of the project, referred to as the CIKEL Brazilian Amazon REDD APD Project, is avoid emissions from planned deforestation on a property in Para state, Brazil. The project proponent is CKBV Florestal Ltda (CKBV or “the company”), a Brazilian private and family company whose main business is the management and commercialization of native wood. CKBV is part of CIKEL group, which has been working in forest management in the Brazilian Amazon since 1977.

Due to difficulties in its commercial wood business in 2005 and 2006, which had a negative financial impact on the company, in 2006 CKBV decided to diversify its business beyond wood products. The diversification alternative chosen was livestock, and to pursue this new business activity CKBV had initiated plans to legally convert (suppress) 20% of its forest property in the Rio Capim Complex to pasture.

The main activity of the CIKEL Brazilian Amazon REDD APD Project is the cancelation of the planned deforestation activities and decision to instead conserve the forest area and continue limited forest management activities in the area under Forest Stewardship Council® Certification (FSC®) with Low Impact Logging (SFMLIL) practices. Also, the company is intensifying and improving its practices to support the sustainable social development, maintaining and improving the biodiversity monitoring at the RCC in the framework of FCS certification and REDD activities.

The financial incentives from the sale of VCU permit the project activity to be competitive with alternative business scenarios like livestock and allow CKBV to cancel its legal forest conversion plans and maintain its forest management activities.

The project is located at the Rio Capim Complex (RCC), Paragominas municipality, in Para State, in the Eastern Amazon. The RCC property includes five forest areas: Rio Capim, Poty, Cauaxi, Sumal and Caculé, totaling 209,130.54 ha. The project area is a subset of the RCC property and covers an area of 27,434.9 ha of native forest.

From the implementation of this REDD Project, it is estimated that 9,432,299 tonnes of carbon dioxide emissions will be avoided which would have been emitted into the atmosphere in a period of 10 years in the absence of the project, not including the project’s non-permanence risk buffer contribution.

1.2. 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 Planned Deforestation (APD)

1.3. Project Proponent

CKVB Florestal Ltda.

Owner and project proponent.

Responsible person: Aparecida Calixto Pereira Denadai

Role in the company: Shareholder and Social and Environmental Director

Role in this project: General Director

Telephone number: +55 91 4005 9955

e-mail: cida@cikel.com.br

Address: Estrada do 40 Horas, n 17, km 04. Bairro do Coqueiro. Ananindeua – Pará – Brazil. Zip Code. 67.120-000.

1.4. Other Entities Involved in the Project

Entity	33 Forest Capital
Role	Financial and Technical partner for the next 10-year
Responsible	Ivana Cepon
Address	Burgemeester van Karnebeeklaan 17 2585 BA The Hague, The Netherlands
Contact	Phone +31 70 3461734 icepon@33assetmngt.com

Entity	TerraCarbon LLC
Role	Technical lead on development of VCS PD
Responsible	David Shoch
Address	5901 N. Sheridan Road, Peoria, Illinois 61614 USA
Contact	david.shoch@terracarbon.com

1.5. Project Start Date

The project start date is July 19, 2007, which is the date of issuance of the Authorization of Forest Exploitation (AUTFE) in the project area.

1.6. Project Crediting Period

The project has a crediting period of 20 years. The start date of the crediting period is July 19 2007 and the end date of the crediting period is July 18 2027.

1.7. Project Location

The project is located in the Rio Capim Complex (RCC), Paragominas municipality, Pará State, Eastern Amazon, Brazil.

The geographical coordinates of the project area within the RCC are shown in the Figure 1.1 and Table 1.1 below:

Figure 1.1: Map of the polygons of the project area

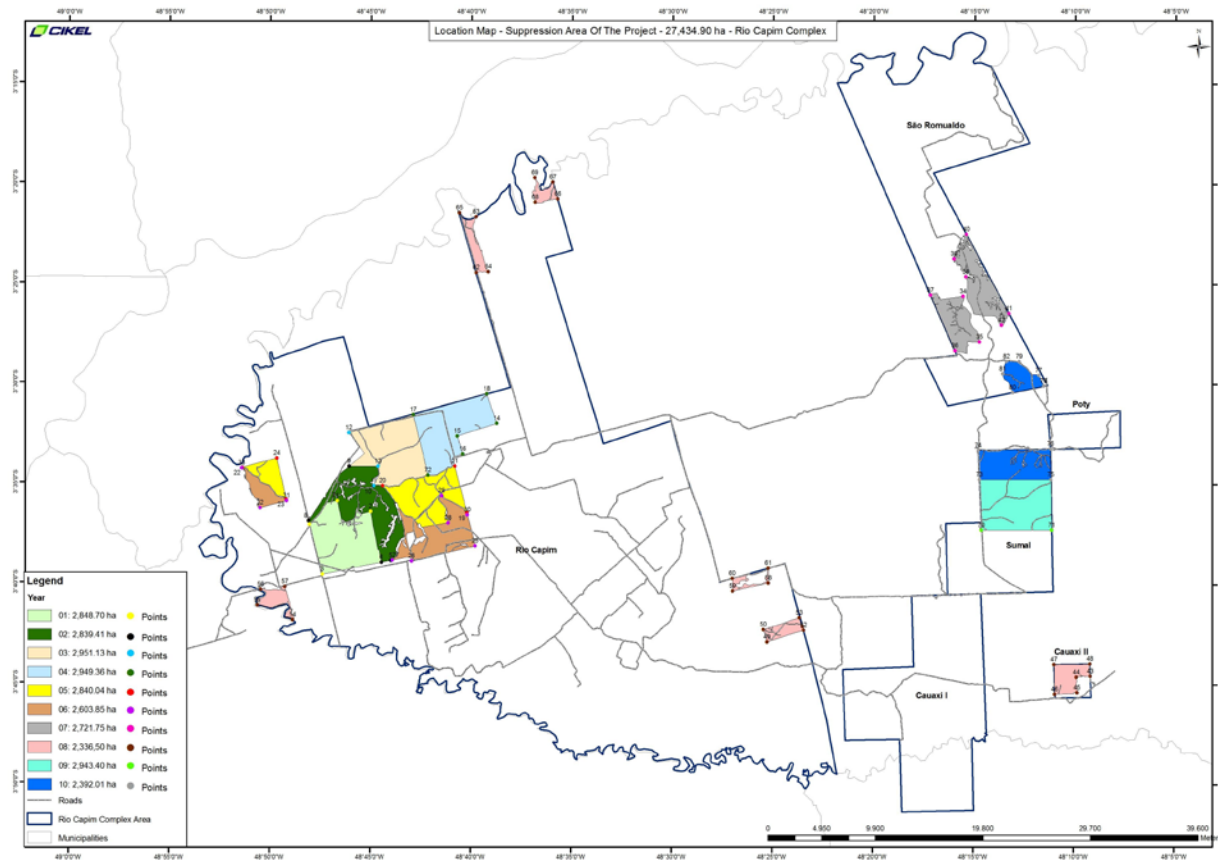


Table 1.1: The GPS coordinates of the polygons of the project area

Points	Areas	Year	Latitude	Longitude
1	Rio Capim	1	3° 35' 55,07" S	48° 46' 39,16" W
2	Rio Capim	1	3° 36' 26,81" S	48° 44' 59,92" W
3	Rio Capim	1	3° 39' 35,02" S	48° 47' 22,64" W
4	Rio Capim	1	3° 37' 5,27" S	48° 48' 2,13" W
5	Rio Capim	2	3° 38' 53,93" S	48° 43' 59,73" W
6	Rio Capim	2	3° 38' 59,43" S	48° 44' 26,89" W
7	Rio Capim	2	3° 35' 55,07" S	48° 46' 39,16" W
8	Rio Capim	2	3° 36' 55,69" S	48° 48' 4,78" W
9	Rio Capim	2	3° 34' 11,30" S	48° 46' 3,94" W
10	Rio Capim	2	3° 35' 10,98" S	48° 44' 51,32" W
11	Rio Capim	3	3° 35' 9,90" S	48° 44' 49,52" W
12	Rio Capim	3	3° 32' 31,19" S	48° 46' 5,08" W
13	Rio Capim	3	3° 34' 11,09" S	48° 44' 37,94" W
14	Rio Capim	4	3° 32' 2,28" S	48° 38' 43,78" W
15	Rio Capim	4	3° 32' 39,93" S	48° 40' 41,12" W
16	Rio Capim	4	3° 33' 33,94" S	48° 40' 25,10" W
17	Rio Capim	4	3° 31' 36,50" S	48° 42' 53,01" W
18	Rio Capim	4	3° 30' 33,59" S	48° 39' 13,78" W
72	Rio Capim	4	3° 34' 37,66" S	48° 42' 8,53" W
19	Rio Capim	5	3° 36' 30,49" S	48° 40' 12,27" W
20	Rio Capim	5	3° 35' 10,23" S	48° 44' 24,15" W
21	Rio Capim	5	3° 34' 10,22" S	48° 40' 48,33" W
22	Rio Capim	5	3° 34' 15,48" S	48° 51' 22,72" W
23	Rio Capim	5	3° 35' 50,50" S	48° 49' 11,38" W
24	Rio Capim	5	3° 33' 47,99" S	48° 49' 40,20" W
25	Rio Capim	6	3° 38' 9,88" S	48° 39' 47,58" W
26	Rio Capim	6	3° 38' 55,96" S	48° 42' 57,40" W
27	Rio Capim	6	3° 38' 52,99" S	48° 43' 55,10" W
28	Rio Capim	6	3° 37' 0,78" S	48° 41' 8,02" W
29	Rio Capim	6	3° 35' 38,85" S	48° 41' 28,32" W
30	Rio Capim	6	3° 36' 36,26" S	48° 40' 10,93" W
31	Rio Capim	6	3° 35' 55,53" S	48° 49' 10,44" W
32	Rio Capim	6	3° 36' 16,87" S	48° 50' 29,76" W
33	Rio Capim	6	3° 34' 16,91" S	48° 51' 24,12" W
34	São Romualdo/Caculé	7	3° 25' 37,99" S	48° 15' 33,64" W
35	São Romualdo/Caculé	7	3° 27' 53,91" S	48° 14' 44,08" W
36	São Romualdo/Caculé	7	3° 28' 20,77" S	48° 15' 57,53" W
37	São Romualdo/Caculé	7	3° 25' 33,99" S	48° 17' 10,75" W
38	São Romualdo/Caculé	7	3° 24' 39,40" S	48° 15' 25,80" W

39	São Romualdo/Caculé	7	3° 23' 45,34" S	48° 16' 0,99" W
40	São Romualdo/Caculé	7	3° 22' 31,98" S	48° 15' 24,13" W
41	São Romualdo/Caculé	7	3° 26' 28,39" S	48° 13' 16,97" W
42	São Romualdo/Caculé	7	3° 27' 4,07" S	48° 13' 38,31" W
43	Cauaxi	8	3° 44' 35,72" S	48° 9' 11,05" W
44	Cauaxi	8	3° 44' 38,99" S	48° 9' 52,27" W
45	Cauaxi	8	3° 45' 24,89" S	48° 9' 50,01" W
46	Cauaxi	8	3° 45' 30,20" S	48° 10' 56,72" W
47	Cauaxi	8	3° 44' 0,68" S	48° 10' 58,95" W
48	Cauaxi	8	3° 43' 58,36" S	48° 9' 12,26" W
49	Rio Capim	8	3° 42' 55,01" S	48° 25' 15,40" W
50	Rio Capim	8	3° 42' 17,86" S	48° 25' 26,58" W
51	Rio Capim	8	3° 42' 8,75" S	48° 23' 29,82" W
52	Rio Capim	8	3° 42' 19,94" S	48° 23' 26,81" W
53	Rio Capim	8	3° 41' 42,38" S	48° 23' 40,02" W
54	Rio Capim	8	3° 41' 52,61" S	48° 48' 51,08" W
55	Rio Capim	8	3° 41' 7,63" S	48° 50' 37,63" W
56	Rio Capim	8	3° 40' 21,65" S	48° 50' 26,99" W
57	Rio Capim	8	3° 40' 12,46" S	48° 49' 15,31" W
58	Rio Capim	8	3° 39' 58,41" S	48° 25' 12,76" W
59	Rio Capim	8	3° 40' 23,10" S	48° 26' 58,96" W
60	Rio Capim	8	3° 39' 45,25" S	48° 26' 59,55" W
61	Rio Capim	8	3° 39' 14,28" S	48° 25' 12,49" W
62	Rio Capim	8	3° 24' 30,04" S	48° 39' 45,56" W
63	Rio Capim	8	3° 21' 42,40" S	48° 39' 46,69" W
64	Rio Capim	8	3° 24' 27,25" S	48° 39' 10,00" W
65	Rio Capim	8	3° 21' 30,69" S	48° 40' 36,54" W
66	Rio Capim	8	3° 20' 49,29" S	48° 35' 43,51" W
67	Rio Capim	8	3° 19' 58,15" S	48° 35' 58,41" W
68	Rio Capim	8	3° 20' 58,45" S	48° 36' 50,54" W
69	Rio Capim	8	3° 19' 45,42" S	48° 36' 52,02" W
70	Sumal	9	3° 37' 18,85" S	48° 14' 36,88" W
71	Sumal	9	3° 37' 18,20" S	48° 11' 6,60" W
73	Sumal	10	3° 34' 47,20" S	48° 14' 42,85" W
74	Sumal	10	3° 33' 19,69" S	48° 14' 46,86" W
75	Sumal	10	3° 34' 46,55" S	48° 11' 9,75" W
76	Sumal	10	3° 33' 14,41" S	48° 11' 11,43" W
77	São Romualdo/Caculé	10	3° 29' 34,33" S	48° 11' 47,23" W
78	São Romualdo/Caculé	10	3° 30' 6,05" S	48° 11' 32,46" W
79	São Romualdo/Caculé	10	3° 28' 52,56" S	48° 12' 45,34" W
80	São Romualdo/Caculé	10	3° 30' 25,59" S	48° 13' 4,75" W

81	São Romualdo/Caculé	10	3° 29' 29,74" S	48° 13' 34,30" W
82	São Romualdo/Caculé	10	3° 28' 52,96" S	48° 13' 23,19" W

1.8. Title and Reference of Methodology

REDD Methodology framework:

VM0007 REDD Methodology Module, REDD Methodology Framework (REDD-MF), version 1.0

This project uses the following modules and tools:

REDD-MF REDD Methodology framework module

Carbon pool modules:

CP-AB "VMD0001 Estimation of carbon stocks in the above- and belowground biomass in live tree and non-tree pools", version 1.0

CP-W "VMD0005 Estimation of carbon stocks in the long-term wood products pool", version 1.0

Baseline module:

BL-PL "VMD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation", version 1.0

Leakage modules:

LK-ASP "VMD0009 Estimation of emissions from activity shifting for avoided planned deforestation", version 1.0

LK-ME "VMD0011 Estimation of emissions from market-effects", version 1.0. Mandatory where the process of deforestation involves timber harvesting for commercial markets

Monitoring module:

M-MON "VMD0015 Methods for monitoring of greenhouse gas emissions and removals", version 2, November 23, 2011

Other modules:

X -STR "VMD0016 Methods for stratification of the project area", version 1.0.

X-UNC "VMD0017 Estimation of uncertainty for REDD project activities", version 1.0.

Tools:

T-ADD "VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities", version 3.0.

"AFOLU Non-permanence Risk Tool", version 3.1

No deviations to the methodology were applied.

2. IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The project activity initiated on July 19 2007, with suspension of CKBV's plan to legally deforest the project area. On this date, a previously requested (June 29, 2007) amendment to its annual operating plan (AOP) by CKBV, suspending the planned forest "suppression" activity. The project area is currently protected through CKBV's patrimonial security. Limited sustainable, FSC-certified, forest management activities have been conducted, with low impact logging taking place on 1,122.3 ha in 2010. In 2000, the RCC Sustainable Forest Management Plan was approved by IBAMA and Low Impact Logging was instituted. On November 20, 2000, the first AUTFE was issued for the Rio Capim forest area, and thus the logging initiated on November 21st in that same year. Since then, the logging in RCC has been with Low Impact Logging. In that same year, September 2001, the farm Rio Capim forest area was certified by FSC®.

In 2010 low-impact logging, following the requirements of FSC certification was conducted in Caculé forest area. At this time, FSC certification was in process for this area, and in fact the harvest at Caculé APU was used as reference to audit the compliance of FSC criteria and validate the increased certification scope (to the entire RCC area, including the areas Poty, Cacule, Sumal and Cauaxi). The audit took place from November 29th to December 3rd of 2010; the validation report of the increased scope was received by CKBV in February, 07th of 2011. Note that the new areas (Poty, Cacule, Sumal and Cauaxi) were not issued independent FSC certificates, but instead the existing certificate (SW-FM/COC-005147, initiated and validated in 2001) for the Rio Capim forest area was extended to include all of the areas of the Rio Capim Complex.

At the time of the validation of the PD (2012) the entire project area has FSC® certification. All of the RCC property undergoes periodic certification which takes place every five years. In the following table are available the certification dates:

Period	Scope	Nº Certificate	Issue date	Expiration date	On-site visit date	Report date
2001	Rio Capim Forest Area	SCS-FM/COC-00031N	01/09/2001	31/08/2006	July 30 and 31 and August 1 of 2001	September, 2001
2001	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2001	31/08/2006	November 29, 30 and 31 of 2001	April, 2002
2002	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2001	31/08/2006	August 05 and 06 of 2002	October, 2002
2003	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2001	31/08/2006	August 04 to 06 of 2003	September, 2003
2004	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2001	31/08/2006	July 12 to 15 of 2004	August, 2004
2005	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2001	31/08/2006	October 17 to 20 of 2005	January, 2006
2006	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2006	01/09/2011	July 23 to 27 of 2006	August 30 of 2006
2007	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2006	01/09/2011		October, 2007
2008	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2006	01/09/2011		October, 2008
2009	Rio Capim (140.658 ha)	SCS-FM/COC-00031N	01/09/2006	01/09/2011		September, 2009
2010 (1 st)	Rio Capim (140.936,57 ha)	SW-FM/COC-005147	01/09/2006	31/08/2011	October 19 to 23 of 2010	February 07 of 2011
2010 (2 nd)	Rio Capim, Sumal, Poty, Caculé, Cauaxi (199.168,26 ha)	SW-FM/COC-005147	01/09/2006	31/08/2011	November 29 to December 03 of 2010	February 07 of 2011
2011	Rio Capim, Sumal, Poty, Caculé, Cauaxi (199.168,83 ha)	SW-FM/COC-005147	01/07/2009	30/06/2014	July 04 to 08 of 2011	February 2012

Minimizing risks

To prevent encroachment by outside actors, CKBV has maintained security personnel and infrastructure on the Rio Capim Complex (RCC) property, and also maintains good relationships with the surrounding neighbors, to prevent actions by external agents invading the area for illegal activities, like wood extraction and hunting.

In February 2012, CKBV a formal letter to SEMA where specify that the project area will be maintained under sustainable forest management, and forest cover conserved, through at least July 2107 (100 years from the project start date).

CKBV also continues to implement its fire management/prevention plan on the project area, involving an equipped fire brigade on-site that has conducted annual trainings, forest fire prevention signs visible along roads, and weekly safety meetings with employees and third parties and annual meeting with neighbors for covering fire risk and prevention. No forest fires occurred in the project area from the project start date through the end of the monitoring period (July 2010).

Minimizing leakage

In this avoiding planned deforestation project, the baseline agent of deforestation is the same as the project proponent. Generally, leakage mitigation activities are directed to the baseline agents to minimize risk of displacement of activities. Risk of displacement of CKBV's planned deforestation activities will be reduced through the realization of new revenues from the sale of carbon credits, which serve to replace the revenues foregone by cancelling the planned deforestation and new livestock activity, and CKBV, with the assistance of 33 Forest Capital and TerraCarbon, has been working to monetize carbon revenues generated by the project activity since December 2010. The commercial division of 33 Forest Capital created the Kobuyer strategy for selling these carbon credits (www.kobuyer.com).

2.2 Deviations from the Monitoring Plan

None applied.

2.3 Grouped Project Criteria

Not applicable.

3 MONITORING

3.1 Data and Parameters Available at Validation

Details on data and parameters available at validation are provided below for:

Emissions due to FSC-certified selective logging

Data Unit / Parameter:	<i>LDF</i>
Data unit:	t C m ⁻³
Description:	Logging damage factor for logging stratum <i>z</i> , in stratum <i>i</i>
Source of data:	VMD0015
Value applied:	0.67
Justification of choice of data or description of measurement methods and procedures applied:	Default value for broadleaf and mixed forests, VMD0015
Any comment:	

Data Unit / Parameter:	<i>CF</i>
Data unit:	t C t ⁻¹ d.m.
Description:	Carbon fraction of biomass
Source of data:	IPCC 2006GL
Value applied:	0.47
Justification of choice of data or description of measurement methods and procedures applied:	Global default
Any comment:	

Data Unit / Parameter:	<i>D_j</i>
Data unit:	t d.m.m ⁻³
Description:	Basic wood density of species <i>j</i>
Source of data:	Sourced from Forest Products Laboratory (LPF) of the Brazilian Forest Service database http://www.ibama.gov.br/lpf/madeira/pesquisa.ph

	p?idioma=portugues for species identified in annual harvest reports "RELATORIOS DE ATIVIDADES DO POA"
Value applied:	Varies by species
Justification of choice of data or description of measurement methods and procedures applied:	The Forest Products Laboratory (LPF) of the Brazilian Forest Service database is an acknowledged authoritative source for regional species-specific wood density data.
Any comment:	

Data Unit / Parameter:	WW_s
Data unit:	Dimension- less
Description:	Wood waste. The fraction immediately emitted through mill inefficiency by class of wood products
Source of data:	VMD0015
Value applied:	0.24
Justification of choice of data or description of measurement methods and procedures applied:	Default value from VMD0015
Any comment:	

Data Unit / Parameter:	SLF_s
Data unit:	Dimensionless
Description:	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood products
Source of data:	VMD0015
Value applied:	0.2
Justification of choice of data or description of measurement methods and procedures applied:	Default value from VMD0015
Any comment:	

Data Unit / Parameter:	Of_s
Data unit:	Dimensionless
Description:	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood products
Source of data:	VMD0015
Value applied:	0.84
Justification of choice of data or description of measurement methods and procedures applied:	Default value from VMD0015
Any comment:	

Activity shifting leakage

Data Unit / Parameter:	$NewR_{i,t}$
Data unit:	Há
Description:	New calculated forest clearance in stratum i at time t by the baseline agent of the planned deforestation where no leakage is occurring
Source of data:	derived in Section 3 of PD
Value applied:	0
Justification of choice of data or description of measurement methods and procedures applied:	Fixed for the first baseline period, derived and justified in Section 3 of PD
Any comment:	

Market leakage

Data Unit / Parameter:	$FG_{BSL,t}$
Data unit:	$m^3 \text{ yr}^{-1}$
Description:	Average projected annual volume of fuelwood to be gathered in the project area in the baseline scenario in stratum i at time t
Source of data:	Derived in Section 3 of PD in which baseline is set
Value applied:	Set at start of baseline period
Justification of choice of data or description of measurement methods and procedures applied:	Derived and justified in Section 3 of PD in which baseline is set

applied:	
Any comment:	

Data Unit / Parameter:	D_{mn}
Data unit:	t d.m.m ⁻³
Description:	Mean wood density of commercially harvested species
Source of data:	average basic wood density of the Forest Products Laboratory (LPF) of the Brazilian Forest Service database http://www.ibama.gov.br/lpf/madeira/pesquisa.php?idioma=portugues
Value applied:	0.65
Justification of choice of data or description of measurement methods and procedures applied:	Parameter Dmn is set as 0.65 metric tons per cubic meter, which represents the average basic wood density of the Forest Products Laboratory (LPF) of the Brazilian Forest Service database http://www.ibama.gov.br/lpf/madeira/pesquisa.php?idioma=portugues This is conservative, because the majority of tree species exploited for fuelwood/charcoal are successional/non-commercial species with relatively low wood densities.
Any comment:	

Data Unit / Parameter:	CF
Data unit:	t C t ⁻¹ d.m.
Description:	Carbon fraction of biomass for commercially harvested species
Source of data:	IPCC 2006GL
Value applied:	0.47
Justification of choice of data or description of measurement methods and procedures applied:	Global default
Any comment:	
Data Unit / Parameter:	LF_{ME}
Data unit:	Dimensionless

Description:	Leakage factor for market effects calculations
Source of data:	VM0007
Value applied:	0.4
Justification of choice of data or description of measurement methods and procedures applied:	Default for fuelwood/charcoal in all circumstances; VM0007
Any comment:	

3.2 Data and Parameters Monitored

Details on data and parameters monitored are provided below. Note that:

- “value applied” is left blank because all parameters in this section are monitored
- “monitoring equipment” is left blank to provide flexibility in measurement and monitoring approach, essential for any long term MRV plan
- Where a parameter is calculated from a methodology equation (i.e. not raw data), the methodology module and equation number is specified and “Description of measurement methods and procedures to be applied” and “QA/QC procedures to be applied” are appropriately left blank
- To avoid repetition and maintain an economical use of space in the summary tables, “Description of measurement methods and procedures to be applied” and “QA/QC procedures to be applied” for monitored (not calculated) parameters reference detailed accounts of procedures provided in the monitoring plan description below.

Emissions due to deforestation and natural disturbance

Data Unit / Parameter:	$\Delta C_{P,Def,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock change as a result of deforestation in the project case in the project area in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	

QA/QC procedures to be applied:	
Calculation method:	Equation 3, VMD0015
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DistPA,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 20, VMD0015
Any comment:	

Data Unit / Parameter:	$A_{DefPA,u,i,t}$
Data unit:	ha
Description:	Area of recorded deforestation in the project area stratum <i>i</i> converted to land use <i>u</i> at time <i>t</i>
Source of data:	Monitored at each monitoring/verification event through analysis of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description. Minimum Mapping Unit (MMU) of 0.81 ha, corresponding to 3 pixels by 3 pixels Landsat resolution (90m by 90m), providing closest conformance possible to 1 ha Brazil DNA forest definition with Landsat.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under

	monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$A_{DistPA,q,i,t}$
Data unit:	Há
Description:	Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i , at time t
Source of data:	Monitored at each monitoring/verification event through analysis of classified satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description. Minimum Mapping Unit (MMU) of 0.81 ha, corresponding to 3 pixels by 3 pixels Landsat resolution (90m by 90m), providing closest conformance possible to 1 ha Brazil DNA forest definition with Landsat.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{BSL,i}$
Data unit:	t CO _{2-e} ha ⁻¹
Description:	Carbon stock in all pools in the baseline case in stratum i
Source of data:	Estimated from forest carbon inventory
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description
Frequency of monitoring/recording:	Every ≤ 10 years. First re-measurement in 2015.
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description

Calculation method:	
Any comment:	

Emissions due to illegal degradation

Data Unit / Parameter:	$A_{DegW,i,t}$
Data unit:	Há
Description:	Area potentially impacted by degradation processes in stratum i
Source of data:	Delineated based on survey results indicating general area of project potentially accessed and typical depth of penetration of illegal harvest activities from points of access
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Repeated each time the PRA indicates a potential for degradation. PRA conducted every ≤ 2 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{DegW,i,t}$
Data unit:	t CO _{2-e}
Description:	Biomass carbon of trees cut and removed through degradation process from plots measured in stratum i at time t
Source of data:	Estimated from diameter measurements of cut stumps in sample plots
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	

Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	AP_i
Data unit:	Há
Description:	Total area of degradation sample plots in stratum i
Source of data:	Calculated as 3% of $A_{DegW,i,t}$
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\Delta C_{P,DegW,i,t}$
Data unit:	t CO ₂ -e
Description:	Net carbon stock changes as a result of degradation in stratum i in the project area at time t
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area
Value applied:	
Monitoring equipment:	

QA/QC procedures to be applied:	
Calculation method:	Equation 8, VMD0015
Any comment:	

Emissions due to FSC-certified selective logging

Data Unit / Parameter:	$C_{LG,i,t}$
Data unit:	t CO _{2-e}
Description:	Actual net project emissions arising in the logging gap , in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 10, VMD0015
Any comment:	

Data Unit / Parameter:	$V_{EXT,z,i,t}$
Data unit:	m ³
Description:	Volume extracted from logging stratum <i>z</i> , in stratum <i>i</i> at time <i>t</i>
Source of data:	Annual harvest reports "RELATORIOS DE ATIVIDADES DO POA"
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	

Any comment:	
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Data Unit / Parameter:	$C_{EXT, z, i, t}$
Data unit:	t CO _{2-e}
Description:	Biomass carbon stock of timber extracted within the project boundary for logging stratum <i>z</i> , in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated from $V_{EXT, z, i, t}$
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 11, VMD0015
Any comment:	

Data Unit / Parameter:	$C_{LR, i, t}$
Data unit:	t CO _{2-e}
Description:	Actual net project emissions arising from logging infrastructure in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 12, VMD0015
Any comment:	

Data Unit / Parameter:	$\Delta C_{SKID,i,t}$
Data unit:	t CO _{2-e}
Description:	Change in carbon stock resulting from skid trail creation in stratum <i>i</i> at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 13, VMD0015
Any comment:	

Data Unit / Parameter:	L_{SKID}
Data unit:	Meters
Description:	Length of skid trails
Source of data:	Annual harvest reports "RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)"
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	SK
Data unit:	tCO ₂ /m
Description:	Skid trail emission factor
Source of data:	Calculated from W_{SKID} and $C_{dest,i}$;

	soil carbon ($\Delta C_{SOC_sk,i}$) change is not included as it is not included in the project boundary, nor will it result in emissions - IPCC stock change factors for sustainably managed forests (IPCC 2006GL, Chapter 5 Cropland, Table 5.10, p. 5.37) are 1, so effectively no emission from this pool from skid trails where the applicability conditions are met
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 14, VMD0015
Any comment:	

Data Unit / Parameter:	W_{SKID}
Data unit:	Meters
Description:	Mean width of skid trails
Source of data:	Annual harvest reports "RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)"
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{dest, i}$
Data unit:	$t CO_{2-e} ha^{-1}$
Description:	Mean live carbon stock of trees and non-tree biomass assumed to be killed per unit area in

	creation of skid trail in stratum i
Source of data:	Sourced from strata-level mean forest carbon stock estimates from forest carbon inventory of project area; conservatively assume that all stocks are emitted from within skid trails
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Re-measured every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\Delta C_{ROAD,i,t}$
Data unit:	t CO _{2-e}
Description:	Change in carbon stock resulting from logging road creation in stratum i at time t
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 17, VMD0015
Any comment:	

Data Unit / Parameter:	A_{ROAD}
Data unit:	ha
Description:	Area of roads in stratum i at time t
Source of data:	Annual harvest reports "RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)"

Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{BSL,i}$
Data unit:	$t CO_{2-e} ha^{-1}$
Description:	Carbon stock in all pools in the baseline case in stratum i
Source of data:	Sourced from strata-level mean forest carbon stock estimates from forest carbon inventory of project area; equivalent to $C_{dest, i}$
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Re-measured every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$\Delta C_{DECKS,i,t}$
Data unit:	$t CO_{2-e}$
Description:	Change in carbon stock resulting from logging deck creation in stratum i at time t
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	

Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 18, VMD0015
Any comment:	

Data Unit / Parameter:	A_{DECKS}
Data unit:	ha
Description:	Area of logging decks in stratum i at time t
Source of data:	Annual harvest reports "RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)"
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{WP\ i,t}$
Data unit:	t CO _{2-e}
Description:	Carbon stock in wood products pool from stratum i , at time t
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 2, VMD0005

Any comment:	
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Data Unit / Parameter:	$V_{EXT,s,i,t}$
Data unit:	m ³
Description:	Volume wood product class “s” (sawnwood) extracted from stratum <i>i</i> at time <i>t</i>
Source of data:	Annual harvest reports "RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)"; estimation of carbon stocks retained in long-lived wood products is limited to volumes of sawlogs (not residues, that will be converted to charcoal and emitted).
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Activity shifting leakage

Data Unit / Parameter:	$\Delta C_{LK-AS,planned}$
Data unit:	t CO _{2-e}
Description:	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	

Calculation method:	Equation 1, VMD0009
Any comment:	

Data Unit / Parameter:	$A_{defLK,i,t}$
Data unit:	ha
Description:	The total area of deforestation by the baseline agent of the planned deforestation in stratum i at time, t
Source of data:	Monitored through assessment of aerial/satellite imagery
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$LKA_{planned,i,t}$
Data unit:	ha
Description:	The area of activity shifting leakage in stratum i at time t
Source of data:	Calculated as $NewR_{i,t} - A_{defLK,i,t}$
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every < 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 5, VMD0009
Any comment:	

Data Unit / Parameter:	$\Delta C_{BSL,i}$
Data unit:	t CO _{2-e} ha ⁻¹
Description:	Net carbon stock changes in all pools in baseline stratum <i>i</i>
Source of data:	Sourced from mean forest carbon stock estimates from forest carbon inventory of project area for equivalent strata in area of activity shifting leakage
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Stock estimates updated every ≤ 10 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Market leakage

Data Unit / Parameter:	$FG_{LP,t}$
Data unit:	m ³ yr ⁻¹
Description:	Volume of fuelwood gathered in the project area
Source of data:	Annual harvest reports "RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)"
Description of measurement methods and procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	Detailed procedures provided below under monitoring plan description.
Calculation method:	
Any comment:	

Data Unit / Parameter:	$C_{BSL, XBFWC, t}$
Data unit:	t CO ₂
Description:	Carbon emission due to displaced fuelwood/charcoal harvests in stratum <i>i</i> in the baseline scenario at time <i>t</i>
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 7, VMD0011
Any comment:	

Data Unit / Parameter:	$AL_{FW/C, i}$
Data unit:	t CO ₂ -e
Description:	Summed emissions from fuelwood/charcoal harvests in stratum <i>i</i> in the baseline case potentially displaced through implementation of carbon
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 6, VMD0011
Any comment:	

Data Unit / Parameter:	$LK_{MarketEffects,FWC}$
Data unit:	t CO ₂
Description:	Total GHG emissions due to market leakage through decreased harvest of fuelwood and charcoal sold into regional and/or national markets
Source of data:	Calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Every ≤ 5 years
Value applied:	
Monitoring equipment:	
QA/QC procedures to be applied:	
Calculation method:	Equation 5, VMD0011
Any comment:	

3.3 Description of the Monitoring Plan

Revision of the baseline

The baseline as outlined here in the Project Description is valid for 10 years, through July 2017. The baseline will be revised every 10 years from the project start date. Because the entire project area is deforested in the first 10-year baseline period, deforestation rate and emissions in the baseline for all subsequent baseline periods will be equal to zero.

Monitoring of actual carbon stock changes and greenhouse gas emissions

The project area is made up of a combination of mature forest and secondary forest, the latter having initiated since 1992, the year of acquisition of the property by CKBV. Although the secondary forests are accumulating biomass over the project crediting period, for accounting purposes the project conservatively assumes stable stocks and no biomass monitoring is conducted in areas undergoing carbon stock enhancement, as permitted in the methodology monitoring module VMD0015, hence $\Delta C_{P,Enh,i,t}$ is set to 0.

Monitoring of actual emissions in the project area focuses on:

- Emissions due to deforestation and natural disturbance
- Emissions due to illegal degradation
- Emissions due to FSC-certified selective logging

Procedures and responsibilities for monitoring each of the above sources of emissions are detailed below.

Emissions due to deforestation and natural disturbance

Forest cover change due to deforestation and natural disturbance is monitored through periodic assessment of classified satellite imagery covering the project area. Emissions ($\Delta C_{P,Def,i,t}$ and $\Delta C_{P,DistPA,i,t}$ for deforestation and natural disturbance, respectively) are estimated by multiplying area of forest loss detected ($A_{DefPA,u,i,t}$ and $A_{DistPA,q,i,t}$ for deforestation and natural disturbance, respectively) by average forest carbon stock per unit area (conservatively assuming $\Delta C_{P,Dist,q,i,t}$ and $\Delta C_{pools,Def,u,i,t} = C_{BSL,i}$). Stock estimates from the initial field inventory completed in 2011 (using measurements from 2005 to 2011), are valid for 10 years (per VM0007), minimally through 2015. Post 2015, forest carbon stock estimates will be updated for any strata where deforestation or natural disturbance is detected.

Monitoring changes in forest cover

The project boundary, as set in the PD, will serve as the initial “forest cover benchmark map” against which changes in forest cover will be assessed over the interval of the first monitoring period; the entire project area has been demonstrated to meet the forest definition at the beginning of the crediting period. For subsequent monitoring periods, change in forest cover will be assessed against the preceding classified forest cover map marking the beginning of the monitoring interval.

Data collection and analysis to determine forest cover change at each monitoring event will follow the procedures detailed below. The resulting classified image is compared with the preceding classified image (forest cover benchmark map marking the start of the monitoring interval) to detect forest cover change over the monitoring interval, and subsequently becomes the updated forest cover benchmark map for the next monitoring interval. Thus, the forest benchmark map is updated at each monitoring event. All changes in forest cover detected for the monitoring interval will be annualized (to produce estimates of ha for each year) by dividing the area by the number of years in the period.

For each monitoring/verification date, Landsat imagery or equivalent for that year will be acquired and interpreted to produce a classified forest cover map in which forest and non forest are distinguished. Consistent with the original 2007 imagery from which the eligible project area was set, a Minimum Mapping Unit (MMU) of 0.81 ha, corresponding to 3 pixels by 3 pixels Landsat resolution (90m by 90m) will be used throughout the duration of the project crediting period.

1. Data acquisition

Landsat imagery covering the entire project area will be acquired for the monitoring/verification date. Landsat scenes covering the RCC area include Path/ row 223/62 and 223/63.

To allow flexibility in selection of cloud-free scenes, Landsat images spanning various months within the year of the monitoring/verification date may be mosaiced to produce a composite image. The composite image shall be at least 90% cloud free.

2. Pre-processing

The images were subjected to digital processing to perform the mapping and quantification of the land cover classes studied.

2.1. Registration and Georeferencing

The reference Landsat images were georeferenced based on GeoCover 2000 image from NASA (National Aeronautics and Space Administration) (NASA, 2000). After georeferencing, others images from temporal series were registered based on the georeferenced image. Georeferencing and registration are important to detect changes in the forest over time.

In both methods were used the method resampling for nearest neighborhood, available in the software Environment for Visualizing Images - ENVI 4.6. It will be collected at least 40 points in the control of each image and the Root-Mean-Squared-Error – RMSE maximum acceptable will be of 0,5 pixel.

3. Interpretation and classification

3.1. Landsat Images Classification

3.1.1. Masks of water, cloud and shadow of cloud

Amazon has intense cloud cover during most of the year and is surrounded by a highly branched watershed. In this methodology the cloud and water of rivers need to be masked, as they may be misleading by the classifier, which works by detecting changes.

The masking of water will be performed in xWaterMask module from software ImgTools 0.8 Beta, developed by Souza Júnior¹ (personal information), using the fraction images resulting from MMS of every year of the temporal serie, resulting in a water mask for each year of the serie of this study. The xWaterMask uses the bands of vegetation (GV) and bared soil (Soil) and calculates the shade (shade) to perform the masking of the water.

The masking of cloud and shadow will be performed in xCloudMask module, present in ImgTools 0.8 Beta. To generate the masks of cloud were used the fraction images and the masks of water of each year of the temporal serie. xCloudMask uses in its process the Cloud band and Shade band to map the voer of cloud em each scene.

The results of the masking of clouds were ternary images with values 0, 1 e 2, where pixels from the mask of cloud are represented by value 2. The masks of cloud and shadow were subjected to a manual edition (editing) in ENVI 4.7 to eliminate noises of shadow of relief and in some burnt area.

3.1.2. Normalized Difference Fraction Index - (NDFI)

From the images obtained by SMM, it will be generated the NDFI for all images to highlight the signals of forest degradation caused by woody exploration and fire (Souza Jr. et al. 2005). Based on NDFI images, it is possible map trails of forest exploration, characterized by the presence of log storage decks, connected to the roads (skid trails), beyond the fire.

¹ SOUZA JÚNIOR, C. Instituto do Homem e Meio Ambiente da Amazônia, 2011.

3.1.3 Classification

The classification of NDFI images is performed in two steps: obtaining a map of the base year (Baseline) and obtaining of the maps of increment of deforestation and degradation (MIDD) through the method of change detection (Change Detection).

The baseline will be obtained through xNDFISlicer module presents in the software ImgTools 0.8 Beta, where the NDFI image, referent to the first year of the analysis was classified. In this classification were obtained five thematic classes: forest, non-forest, water, cloud (cloud and shade of cloud) and degradation.

MIDD's were obtained in the xChangeDetection module, available in the software ImgTools 0.8 beta, for this will be necessary the baseline and NDFI images of all years of the temporal serie. In this classification were obtained six thematic classes: forest, non-forest, water, cloud (cloud and shade of cloud), degradation and deforestation.

4. Change detection

4.1. Correction of fog and smoke

Then, all images were subjected to a process of correction of fog and smoke, using the method proposed by Carlotto (1999) and implemented in IDL (Interactive Data Language – program language coupled with ENVI) by Souza Júnior² (personal information). This method uses infrared band close and medium (4, 5 and 7), which are free from interference of this effect, to correct the spectral band of the visible region (1, 2 and 3), more affected by fog and smoke.

4.2. Atmospheric correction

The raw images that have the pixel values in DN (Digital Numbers), were radiometrically corrected, using the calibration values (gains and offsets) from sensors TM and ETM+ (Chander et. al., 2009). The purpose of this correction is to convert DN's to values of physical parameters, in this case, radiance in $W/(m^2 \text{ sr } \mu m)$. Subsequently, the images in radiance were converted to absolute reflectance, using the tool FLAASH (Fast Line-of-sight Atmospheric Analysis of Spectral Hypercubes), available in the software ENVI 4.6. The reflectance is the eletromagnetic energy captured.

In FLAASH, parameters as initial visibility (km) and aerosol retrieval were adjusted for each image, by trail and error, to obtain the best spectral curves of the target analysed, in this case, the vegetation.

4.3. Spectral Mixture Model (SMM)

The next step will be to estimate the abundance of the pure components (vegetation pure pixels – GV, bared soil and innative photosynthetically vegetation – NPV) in each pixel, applying the spectral mixture model in the images in reflectance (Adams; Smith; Gillespie, 1993).

The pure components of GV, NPV and bared soil used to generate the SMM were obtained from Souza Jr. *et al.* (2005) (generic pure components), selected from images in reflectance. Tool *Pixel Purity Index* (PPI) from ENVI 4.2 will be used to identify the candidates to pure pixels. The final pure components were selected based on yours spectral curves and location in the image. The mixture model algorithms were implemented in IDL by Souza Júnior³ (personal information). As a result, fraction images of GV, NPV and bared soil were obtained.

² SOUZA JÚNIOR, C. Instituto do Homem e Meio Ambiente da Amazônia, 2006.

³ SOUZA JÚNIOR, C. Instituto do Homem e Meio Ambiente da Amazônia, 2005.

Quality Assurance/Quality Control

To ensure consistency and quality results, spatial analysts carrying out the imagery processing, interpretation, and change detection procedures will strictly adhere to the steps detailed above. All data sources and analytical procedures will be documented and archived (detailed under data archiving below).

Accuracy of the classification will be assessed by comparing the classification with ground truth points or samples of high resolution imagery (e.g. SPOT or Rapidere imagery). Any data collected from ground-truth points will be recorded (including GPS coordinates, identified land-use class, and supporting photographic evidence) and archived. Any sample points of high resolution imagery used to assess classification accuracy will also be archived. Samples used to assess classification accuracy should be well-distributed throughout the project area (as far as is possible considering availability of high resolution imagery and/or logistics of acquiring ground truth data), with a minimum sampling intensity of 100 points each for the forest and non forest classes.

Results of the accuracy assessment will be presented and analyzed in a matrix in the format elaborated in the example below.

Land-use class as determined from ground-truth points	Classification		Total	Accuracy (%) <i>User's accuracy (# correct/ row total)</i>	Error of Commission (%)
	Forest	Non-forest			
Forest (100)	95	5	100	95.0	5.0
Non-forest (100)	9	91	100	91.0	9.0
Total	104	96	200		
Accuracy (%) <i>Producer's accuracy (# correct/ column total)</i>	91.3	94.8			
Error of Omission (%)	8.7	5.2			

The classification will only be used in the forest cover change detection step if the overall classification accuracy, calculated as the total number of correct samples/ the total number of samples, is equal to or exceeds 90%.

Data Archiving

All data sources and processing, classification and change detection procedures will be documented and stored in a dedicated long-term electronic archive maintained by CKBV at its main office in Ananindeua.

Information related to monitoring deforestation maintained in the archive will include:

- Base (raw) imagery used (specifying type, source, resolution, imagery date, acquisition date)
- Any cartographic data used to geo-reference the image (source, base data)
- Data used for training classification
- Definition of land cover classes assessed
- Documentation of software type and procedures applied (including all pre-processing steps and corrections, spectral bands used in final classifications, and classification methodologies and algorithms applied)
- Classified images
- Data used in accuracy assessment - ground-truth points (including GPS coordinates, identified land-use class, and supporting photographic evidence) and/or sample points of high resolution imagery
- Accuracy assessment matrix with minimally the following errors presented: overall classification accuracy, error of omission of each land-use category (forest and non-forest), and error of commission of each land-use category (forest and non-forest)

Data archived will be maintained through at least two years beyond the end of the project crediting period, through July 2029. Given the extended time frame and the pace of production of updated versions of software and new hardware for storing data, electronic files will be updated periodically or converted to a format accessible to future software applications, as needed.

Updating forest carbon stock estimates

Forest carbon stock estimates used to calculate emissions from deforestation and natural disturbance will use estimates derived from field measurements less than or equal to 10 years old. In the event that any deforestation is discovered in the project area, forest carbon stock estimates older than 10 years will be updated for any strata where deforestation is detected.

Where necessary (per above), forest carbon stocks will be re-estimated from new field measurements. Fifteen (15) sample plots will be randomly located in areas within the Rio Capim Complex representative of the stratum(a) where deforestation was detected, and measured following field procedures outlined in Silva et al (2005⁴) and maintaining conformance with field procedures used in the collection of data for the “Forest Biomass Inventory Results for the Rio Capim” document (2011; Annex 4 of the PDD). Biomass will be estimated applying the allometric equations of Higuchi et al (1998⁵) and otherwise maintain consistency with analytical procedures applied in the original inventory (“Forest Biomass Inventory Results for the Rio Capim”, 2011).

For each stratum, where the re-measured estimate of forest biomass carbon (live above- and belowground biomass) is within the 90% confidence interval of the 2011 estimate, the 2011 stock estimate will be used. If the re-measured estimate is outside (i.e., greater than or less than) the 90% confidence interval of the 2011 estimate, then the new stock estimate from the supplemental 15 sample plots will be used.

⁴ SILVA, J. N. M.; LOPES, J. do C. A. L.; OLIVEIRA, L. C. de; SILVA, S. M. A. da; CARVALHO, J. O. P. de; COSTA, D. H. M.; MELO, M. S.; TAVARES, M. J. M. 2005. Diretrizes para a instalação e medição de parcelas permanentes em florestas naturais da Amazônia Brasileira. Belém, PA: Embrapa Amazônia Oriental, p. 68.

⁵ HIGUCHI, N., SANTOS, J., RIBEIRO, R.J., MINETTE L. & BIOT, Y. 1998. Biomassa da parte aérea da vegetação da floresta tropical úmida de terra-firme da Amazônia brasileira. Acta Amazonica 28(2):153-166.

Quality Assurance /Quality Control and Data Archiving Procedures

The following steps will be taken to control for errors in field sampling and data analysis:

1. Professional field crews with extensive prior training in forest inventory will carry out all field data collection and adhere to field measurement protocols outlined in Silva et al (2005). Field crews will have attended periodic update training courses at IFT (Tropical Forest Institute) and/or Embrapa. Pilot sample plots shall be measured before the initiation of formal measurements to appraise field crews and identify and correct any errors in field measurements. Field crew leaders will be responsible for ensuring that field protocols are followed to ensure accurate and consistent measurement. To ensure accurate measurements, the height of diameter at breast height (1.3 m) will be periodically re-assessed by personnel during the course of the inventory; note that in re-measurements, diameter at breast height will be carried out in places marked previously in old measurements. Field crews will have fine scale forest strata maps for use in the field to precisely interpret strata/forest boundaries and identify potential areas of plot overlap.
2. An opportunistic sample of plots will be re-measured to identify and correct any field measurement issues which arise during implementation of the monitoring plan and to assess measurement errors. Re-measurement for this purpose will be done by a different field crew. Measurement error will be assessed as 1/2 of the mean (absolute) percent difference between re-measured plot level biomass estimates (a valid assumption where teams are equally experienced and there are no systematic errors in measurement, which will also be appraised from the re-measurement results). Target measurement error is < 3-5%.
3. Field measurement data will be recorded on standard field data sheets "FICHA DE CAMPO PARA PARCELA PERMANENTE – ARVORE" and entered to the forest inventory software MFT – Monitoramento de Florestas Tropicais for data management and quality control; MFT identifies and reports potential errors in data entry (anomalous values) which are then verified or corrected consulting the original data sheets or personnel involved in measurement. Original data sheets will be permanently archived at the CKBV office on-site at Rio Capim, and the electronic MFT database of all field measurements will be exported to Excel spreadsheets and will be stored in the dedicated long-term electronic archive maintained by CKBV at its main office in Ananindeua. Software MFT will be used as a tool for the accurate transcription of the data in the typing process. The electronic database will also archive GIS coverages detailing forest and strata boundaries and plot locations. Note that the 152 original data sheets that are part of this project are distinguished by a label from the others, indicating the plot identification to standardize the nomenclature with maps, spreadsheets and any information regarding the inventory for the carbon stock. Furthermore, in addition to the sheets information it is included the geographical coordinates of the plots.
4. Moreover, in order to update the intern control of the procedures for the implementation and archiving of the permanent plots data, the IOWSE (Instruction of Operational Work of Security and Environment) regarding this process is being reviewed to be in accordance with procedures implemented for quality control and will be presented during the validation process.

Emissions due to illegal degradation

Emissions due to illegal logging will be tracked by conducting surveys in the surrounding areas. Locations surveyed will include:

- Ararandeuá Community: located in the municipality of Goianésia do Pará, in the neighboring area of RCC on the bank of the Ararandeuá river, an area still known as an Indigenous Land. It is composed of six families who arrived to this land in 2001.
- Barreirinha: Indigenous community of Amanayé ethnic group, located near RCC and has an area of 2,374 hectares on the banks of the Capim river, area known as Indigenous Land. The community is composed of 20 households, of which six are located in a more isolated area that is difficult to be accessed. Therefore, during the collection of data, 14 households will be interviewed.
- Vila Betânia: A traditional community area of 20 hectares located on the left bank of the Capim river, with eight households. They are seeking for the regularization of the area, and there are doubts if it is located in Paragominas or Ipixuna do Pará.
- Families residing along the neighbouring access between RCC and PA150, composed of different centers of dwellings located in the access route to RCC.
- Nearby farms and rural properties, including 77 households in the surroundings of RCC.

Surveys will produce information on wood consumers (fuel wood and wood for construction and charcoal production) in the surroundings areas, as well as general indications on the areas where wood is sourced from and maximum depth of penetration of harvest activities from access points. Detailed survey forms are provided in Annex 5 of the Project Document.

In the event that any potential of illegal logging occurring in the project area is detected from the surveys (i.e. $\geq 10\%$ of those interviewed/surveyed believe that degradation may be occurring within the project boundary), temporary sample plots will be allocated and measured in the area of the project indicated by the surveys as a potential source area for illegally-harvested wood. The potential degradation area within the project area ($A_{DegW,i}$) will be delineated based on survey results, incorporating general area information and maximum depth of penetration. Rectangular plots 10 meters by 1 kilometer (1 ha area) will be randomly or systematically allocated in the area, sufficient to produce a 1% sample of the area, and any recently-cut stumps or other indications of illegal harvest will be noted and recorded. Diameter at breast height, or diameter at height of cut, whichever is lower, of cut stumps will be measured.

In the event that the sample plot assessment indicated that illegal logging is occurring in the area, supplemental plots will be allocated to achieve a 3% sample of the area. Biomass will be estimated from measured diameters (conservatively assuming that diameters of stumps cut below breast height are equivalent to diameter at breast height) applying the allometric equations of Higuchi et al (1998) and otherwise maintain consistency with analytical procedures applied in the original inventory ("Forest Biomass Inventory Results for the Rio Capim", 2011). Emissions due to illegal logging ($\Delta C_{P,DegW,i,t}$) are estimated by multiplying area ($A_{DegW,i}$) by average biomass carbon of trees cut and removed per unit area ($C_{DegW,i,t} / AP_i$).

The more intensive 3% sample will be carried out once every 5 years where surveys and limited sampling continue to indicate possibility of illegal logging in the project area to produce an estimate of emissions resulting from illegal logging ($\Delta C_{P,DegW,i}$). Estimates of emissions will be annualized (to produce estimates in t CO₂-e per year) by dividing the emission for the monitoring interval by the number of years in the interval.

The same quality assurance/quality control and archiving procedures as detailed above for updating estimates of forest carbon stocks will be adhered to in the field surveys of potential degradation areas.

Emissions due to FSC-certified selective logging

Project emissions due to FSC-certified selective logging ($\Delta C_{P, SelLog,i,t}$) will be estimated applying module M-MON (VMD0015), version 7 as revised and approved December 2011, of methodology VM0007, covering emissions from the following sources/sinks:

- Emissions from the felling gap ($C_{LG,i,t}$)
- Emissions from construction of infrastructure, including roads, skid trails and logging decks ($C_{LR,i,t}$)
- Removals from storage in long term wood products generated ($C_{WP,i,t}$)

All monitored parameters will be sourced from annual post harvest assessment reports “RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)” prepared for SEMA and for FSC certification. Monitoring objectives and procedures for preparing the annual harvest reports are detailed in the “Plano de Manejo Florestal Sustentável de Uso Múltiplo Empresarial-v2 (CIKEL BRASIL VERDE MADEIRAS LTDA-COMPLEXO RIO CAPIM Feb 2011) and in CKBV IOWSE.

Sampling/field measurement procedures are detailed below:

- Area of logging decks (A_{DECKS}) created for harvest
- Area of roads created for harvest (A_{ROAD})
- Length (L_{SKID}) and width (W_{SKID}) of skid trails created for harvest
- Volume wood removed, by product class (logs and residues) and species

Area of logging decks (A_{DECKS}) created for harvest

According ITOSMA 23 (IOWSE 23) all logging decks shall be measured at widest points; and the measurements shall include open areas by machine when driving or deposit logs beyond the planned area (usually this occur after the roads)

Area of roads created for harvest (A_{ROAD})

According ITOSMA 23 (IOWSE 23):

Access roads: measure all access road at each 2.5 km

Main roads: measure all main roads at each 1 km.

Secondary and Tertiary roads: measure at each 250 meters.

Length (L_{SKID}) and width (W_{SKID}) of skid trails created for harvest

According ITOSMA 23 (IOWSE 23), the following procedures should be taken:

Measure after and before the night skid; measure after and before the residues harvest.

Measure all skid trails of two maps of 6.25 ha for each Unit of Work, being the first measure at the entrance of the skid trail, the second in the middle and the third in the end.

In the same skid trail, note the presence of exposed soil caused by the blade of the skidder, and measure in cross in the wider parts.

In the same skid trail, re-measure 10 clearing that were measure for the logging report, in cross in the wider parts, randomly at the same map.

In the office, measure the length of all skid trails using specific tool as ARC GIS.

Present final data to the Forest Engineer responsible by the project to data analysis

Volume wood removed, by product class (logs and residues) and species

The procedures are described below:

The volume of wood removed is measured when the logs arrive in the CKBV sawmills. Workers use tape measures perform the length and diameter measurement to calculate the volume of the logs discounting bark, rotten and hollows (if necessary). Measurements and information about logs entry and output are recorded.

The top of the logs measured will be painted and information regarding number of the tree and species code is added in the log. Monthly a log inventory is performed, and if any distinction from the initial volume inventoried is found an investigation is conducted.

Regarding residues, these shall be stacked on carts that are already sized for determined amount (steres) or be measured in the moment of its discharge, according described in ITOSMA 22.

Monitored parameters will be entered into the table format below to complete calculations of with-project emissions from FSC-certified selective logging ($\Delta C_{P, SelLog,i,t}$).

Calculation format for with-project emissions from FSC-certified selective logging.

		m^3	tCO_2/ha	tCO_2	tCO_2	M	tCO_2	ha	tCO_2	ha	tCO_2	tCO_2	tCO_2	tCO_2
Year	Harvest Area (ha)	V_{EXT}	C_{BSL}	C_{EXT}	C_{LG}	L_{SKID}	ΔC_{SKID}	A_{ROAD}	ΔC_{ROAD}	A_{DECKES}	ΔC_{DECKES}	C_{LR}	C_{WP}	$\Delta C_{P, SelLog}$
2008														
2009														
2010														
Etc...														

Monitoring of leakage carbon stock changes and greenhouse gas emissions

Two sources of leakage will be monitored: activity shifting leakage and market leakage.

Activity-shifting leakage

Activity-shifting leakage will be monitored by tracking forest cover change across all lands outside of the project area owned or under the management of CKBV ($A_{defLK,i,t}$). This will be accomplished using

remotely sensed imagery that covers the properties at the needed monitoring intervals. Imagery that is freely available and accessible using Google Earth will be used preferentially when it is available. When it is unavailable, other remotely sensed imagery will be acquired for analysis. CKBV property boundaries will be overlaid on remotely sensed imagery to assess if forest cover changes have occurred. In the event that deforestation is noted, further confirmation will be made that the deforestation resulted from authorized deforestation activities by CKBV. If annual forest cover change data is unavailable, all changes in forest cover (due to planned deforestation) detected for the monitoring interval will be annualized (to produce estimates of ha for each year) by dividing the area by the number of years in the period.

The CKBV administers the Rio Capim Complex performing the Sustainable Forest Management all over the forest area. Part of the Rio Capim Complex is CKVB property and another part is administered and managed in accordance with a lease agreement of forest land held with the owners of other forest areas: Madeira Matinha S.A. and Rondon Imóveis Ltda

The owners of companies Madeira Matinha S.A. and Rondon Imóveis Ltda are members of the Pereira Dias's family, including CKBV Floresta Ltda. (current name of the company Cikel Brazil Verde Madeiras Ltda.), the project proponent.

Thus, the CKBV has the Sustainable Forest Management Plan, as well as all environmental permits to develop forestry activities within the Rio Capim Complex.

Rondon Imóveis Ltda also owns the forest áreas Deus é Bom I and Deus é Bom II, in Maranhão state, since April 4 2011. Before April 4, 2011 these areas were owned by the Copal Compensados Paraensis Ltda, which acquired the property on September 13, 1990 being a company of Pereira Dias's family for many years. These forests have no forestry activities being developed.

The CKBV also manages and develops the Sustainable Forest Management for many years, in other forests owned by companies that do not belong to Pereira Dias's family members and are located in the Portel municipality, Pará state. These forests are:

1. Jutaituba forest area owned by Martins Agropecuaria S/A: CKVB began the administration of the forest and forest management through the Lease Agreement entered into force on June 18, 2002. The contractual relationship has been renewed over the years and currently in force Lending Agreement and Operating Agreement for Sustainable Forestry, are both dated December 30, 2008.
2. ABC forest area owned by ABC Agropecuária Brasil Norte S/A – Produção e Exportação: CKVB started the administration of the forest and forest management by the Lease Agreement concluded in 1997. The contractual relationship has been renewed over the years and currently in force Lease Agreement is dated January 1, 2009 and has of 35 years term

In summary:

Forest Area	Land Owner	Status
Rio Capim Complex	CKBV and other family companies (see section Proof of Title)	CKBV Forest Management
Deus é Bom I	Rondon Imóveis (family company)	No Forestry Activity

Deus é Bom II	Rondon Imóveis (family company)	No Forestry Activity
Jutaitúba	Martins Agropecuária	Leasing to CKBV for Forest Management, since 18 June 2002
ABC	ABC Agropecuária	Leasing to CKBV for Forest Management, since 1997

Option 1.2 from methodology module LK-ASP will be used to calculate activity shifting deforestation.

Monitored parameters will be entered into the table format below to complete calculations of area subject to activity shifting leakage ($LKA_{planned,i,t}$).

Calculation format for area subject to activity shifting leakage.

Year	$NewR_{i,t}$ (ha)	$A_{defLK,i,t}$ (ha)	$LKA_{planned,i,t}$ (ha)
2008	0		
2009	0		
2010	0		
Etc...	0		

Market leakage

Leakage due to market effects is restricted to reductions in harvest of wood for charcoal production destined for domestic markets (all sawn wood harvested in the baseline is exported and thus not included in accounting of market leakage).

For estimation of market leakage, the main parameter monitored is annual volume of fuelwood harvested from the project area, which will be derived from annual harvest reports "RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)" with harvested volumes estimated as per procedures above.

Monitored parameters will be entered into the table format below to complete calculations of market leakage ($LK_{MarketEffects,FW/C}$).

Calculation format for market leakage.

	m ³	m ³	t CO ₂	t CO ₂
Year	<i>FG_{BSL,t}</i>	<i>FG_{LP,t}</i>	<i>C_{BSL,XBFWC,t}</i>	<i>LK_{MarketEffects,FW/C}</i>
2008	790,469			
2009	788,391			
2010	819,588			
2011	819,095			
2012	788,737			
2013	723,142			
2014	755,885			
2015	648,754			
2016	817,442			
2017	667,722			

Estimation of ex-post net carbon stock changes and greenhouse gas emissions.

Estimates of GHG credits eligible for issuance as VCU's will be calculated entering data into the table format below, where

Estimated GHG emission reduction credits =

Baseline emissions, fixed for 10 years at validation *minus*

Project emissions *minus*

Leakage *minus*

Non-permanence Risk Buffer withholding (calculated as a percent of net change in carbon stocks prior to deduction of leakage), fixed at validation

Years	Estimated baseline emissions or removals (tCO _{2e})*	Estimated project emissions or removals (tCO _{2e})	Estimated leakage emissions (tCO _{2e})	Risk buffer (%)	Deductions for AFOLU pooled buffer account (tCO _{2e})	GHG credits eligible for issuance as VCUs (tCO _{2e})
2008	1,815,232			15.5%		
2009	1,700,492			15.5%		
2010	1,707,561			15.5%		
2011	1,716,590			15.5%		
2012	900,252			15.5%		
2013	821,758			15.5%		
2014	1,537,097			15.5%		
2015	814,410			15.5%		
2016	1,613,270			15.5%		
2017	1,236,940			15.5%		

Organization and Responsibilities

For all aspects of project monitoring, CKBV will ensure that data collection, processing, analysis, management and archiving are conducted in accordance with the monitoring plan.

The table below shows the type of monitoring and responsible for monitoring actual emissions in the project area.

Type of monitoring and responsables for monitoring actual emissions in the project area

	Variables to be monitored	Responsible	Frequency	Record (form and time of archiving)
	Emissions due to deforestation and natural disturbance			
1	Natural Disturbance	CKBV - Forest Management	When a natural event occurs	When there is a natural event, the research team from CKBV will make the registration of the geographical coordinates of the place affected and also register with pictures the disturbances caused by the event. The data field collected are analyzed by the georeferencing team, who elaborates the maps and evaluate the damages in the satellite image; this to register the natural disturbance in the competent environmental agency where the responsible protocols a letter stating the event. All registers will be archived in digital format till 2029 and original forms for at least 5 years from the date of the event.
2	Legal Deforestation in RCC	IMAZON or another external institution qualified for the monitoring.	Annual	IMAZON or another external institution qualified for the monitoring by satellite images for the deforestation analysis will annually evaluate the project area following the procedure described in the methodology and perform the Accuracy Assessment Report. All shapes and analysis generated will be archived in CKBV, in digital format till 2029.
3	Deforestation in others forest areas from CKBV property or areas where the company works with Forest Management.	IMAZON or another external institution qualified for the monitoring.	Annual	IMAZON or another external institution qualified for the monitoring by satellite images for the deforestation analysis will annually evaluate the project area following the procedure described in the methodology and perform the Accuracy Assessment Report. All shapes and analysis generated will be archived in CKBV, in digital format till 2029.
4	Changes in the vegetation cover in RCC	IMAZON or another external institution qualified for the monitoring. CKBV- Forest Management	Annual	IMAZON or another external institution qualified for the monitoring by satellite images for the deforestation analysis will annually evaluate the project area following the procedure described in the methodology and perform the Accuracy Assessment Report. If necessary, validation of the data collected in the satellite images will be carried out. All shapes and analysis generated will be archived in CKBV, in digital format till 2029.
5	Re measurement of the Permanent Plots	IMAZON or another external institution qualified for the	1 st year: re-measurement of all 71 permanent plots; 2 nd	The re-measurement of the Permanent Plots will be performed in 71 permanent plots of this project REDD (the measurement will start one year later after the registration of the project), data will be recorded in the document "Ficha de Campo para Parcela

	Variables to be monitored	Responsible	Frequency	Record (form and time of archiving)
		monitoring. CKBV- Forest Management	re-measurement after 2 years of the 1 st re-measurement; 3 rd re-measurement after 3 years of the 2 nd re-measurement; and then from each 5 years.	Permanente", additional data such as geographical coordinates shall be registered in GPS and also in the field sheets. In the office, data will be transferred to the software of Tropical Forest Monitoring (MFT) that analysis and generate specific data for the depuration, correction and manipulation of the information for the quality control of the data typed. Data will be exported to Excel spreadsheets and stored in the CKBV servidor. The original data sheets will be archived in RCC office, and the original data sheets that are part of this REDD project are distinguished by the others with a label. All register will be archived in digital format till 2029 and original sheets at least for 5 years from the event date. This re-measurement is not a requirement of the methodology, it is a voluntary decision by CKVB under this REDD project.
6	Installation of new permanent plots in case of deforestation or natural disturbances.	CKVB - Forest Management	When any event occurs that could modify the carbon stock before 10 years of validation of the inventory.	If there is a need of new permanent plots the research team from CKBV will make the installation of new plots following the procedures indicated in this REDD project. Data will be recorded in the document "Ficha de Campo para Parcela Permanente", additional data such as geographical coordinates shall be registered in GPS and also in the field sheets. In the office, data will be transferred to the software of Tropical Forest Monitoring (MFT) that analysis and generate specific data for the depuration, correction and manipulation of the information for the quality control of the data typed. Data will be exported to Excel spreadsheets and stored in the CKBV servidor. The original data sheets will be archived in RCC office, and the original data sheets that are part of this REDD project are distinguished by the others with a label. All register will be archived in digital format till 2029 and original sheets at least for 5 years from the installation date.
Emissions due to illegal degradation				
7	Illegal Degradation in RCC	CKVB - Social Responsibility CKBV- Forest Management IMAZON or another external institution qualified for the monitoring.	Every two years	The Social Responsibility team will carry out fields' research among the property from neighbor areas of RCC for possible identification of illegal logging. The questionnaires answered and the reports of data analysis will be archived electronically and physically in CKBV till 2029. Further, an analysis of the area will be carried out through satellite images by a competent entity.

Emissions due to FSC-certified selective logging				
8	Volume of wood removed	CKVB - Forest Management	Annual	<p>CKVB, through the Forest Management team prepares annually the monitoring report of POA, that generate data to the monitoring of the Forest Management Plan, and also, for the requirements of the Principles and Criteria of FSC Certification. All registers will be archived in digital format till 2029 and original reports at least for 5 years.</p>
9	Length (L_{SKID}) and width (W_{SKID}) of skid trails created for harvest	CKVB - Forest Management	Annual	
10	Area of logging decks (A_{DECKS}) created for harvest	CKVB - Forest Management	Annual	
11	Area of roads created for harvest (A_{ROAD})	CKVB - Forest Management	Annual	
12	Volume of residues removed from the project area	CKVB - Forest Management	Annual	
13	Maintenance of FSC Certification	CKBV - Forest Management, Environment, Work Security and Social Responsibility (RSA)	Annual	<p>CKBV will monitor the compliance to the Certification FSC principles and criteria to ensure the maintenance of the certification. In addition to the internal control carried out by internal audit process, FSC Certification is independently audited annually.</p> <p>Reports of internal and independent audit will be archived till 2029, in digital and physical format.</p>

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions were calculated applying module BL-PL. Area in hectares deforested per year ($D\%_{planned,i,t} * A_{planned,i}$) follows the approved suppression plan below.

Area in hectares deforested per year in the project area in the baseline.

Year	$D\%_{planned,i,t} * A_{planned,i}$ Há
2008	2846.3
2009	2838.8
2010	2951.1

Note: this monitoring report adopts the convention that year refers to the year at the end of the annual interval, hence 2008 represents the year between July 19 2007 to July 18 2008.

As per BL-PL section 1.4

“For all other planned deforestation areas (i.e. areas not both under government control and zoned for deforestation), $L-D_i$ shall be equal to 100%”,

likelihood of deforestation ($L-D_i$) is set at 1.

Estimation of forest biomass stocks was made from direct inventory of the Rio Capim property area, including the project area, and is detailed in Annex 4 of the Project Document “Forest Biomass Inventory Results for the Rio Capim property, CIKEL, REDD project areas, Paragominas, Para, Brazil.” Results are summarized by forest type/strata in the table below.

By forest type above- and belowground biomass carbon in live trees ≥ 5 cm dbh (t C/ha). (FOD = floresta ombrofila densa, FS = floresta secundaria, APP = Riparian forest)

Forest type	ha (deforested 2007 – 2010)	Mean ABGB t C/ha	95% C.I.	95% C.I. as % of mean
FOD	7973.5	175.5	9.9	6%
FS	662.7	100.1	56.4	56%
APP	0.0	119.2	56.5	47%

Post deforestation carbon stocks in pasture in included pools (aboveground and belowground live aboveground trees = $C_{AB_tree,i}$ and $C_{BB_tree,i}$) is zero ($C_{BSL,post,i} = 0$), as the suppression plan involves clearcut timber harvest and no trees are retained on-site following conversion to pasture.

GHG emissions ($GHG_{BSL,E}$) in the baseline are conservatively assumed to be zero. No nitrogen fertilizer application takes place in the project area in the baseline. Biomass burning is conservatively excluded from accounting in the baseline. While some fossil fuel emissions occur from vehicle and machinery use in the forest conversion process, they are conservatively excluded from the baseline.

Carbon sequestered in long-lived wood products is calculated using module CP-W Option 1, Direct Volume Extraction Estimation, because an approved harvest plan for the project is available. One wood product class (sawnwood, “s”) is extracted in the baseline. All other wood extracted would be in the form of residues for fuelwood/charcoal production use, and thus involve no long-term sequestration in wood products and are not treated here. All parameters employed in calculations are summarized in the table below. Parameters A and $V_{ex,ty,j}$ follow the suppression plan for planned extraction of sawnwood (“toras”). Wood density applied, D_j , represents a volume-weighted wood density across all species for the project area, referencing species-specific wood densities from the Forest Products Laboratory (LPF) of the Brazilian Forest Service database (accessed at <http://www.ibama.gov.br/lpf/madeira/pesquisa.php?idioma=portugues>)⁶ and permitted species-specific volumes of sawnwood/toras from the suppression plan. Calculations are detailed “CIKEL APD analysis.xls” worksheet “wood products.” This represents the volume-weighted average density for commercial species to be extracted as toras in the baseline in the project area. A default carbon fraction of biomass of 0.47 is applied for parameter CF (IPCC 2006GL).

⁶ Where species were unidentified or no species-specific wood density data was available, 0.65 metric tons per cubic meter was applied, which represents the average basic wood density of the Forest Products Laboratory (LPF) of the Brazilian Forest Service database

Assumptions used in calculations of the wood products pool.

Parameter	Value	Units
<i>A</i>	8,636	ha
$V_{ex,ty,j}$	439,065	m ³
D_j	0.6740	t/ m ³
CF_j	0.47	None
<i>Ty</i>	(s) sawnwood	None
WW_s	0.24	None
SLF_s	0.2	None
Ofs	0.84	None

The t CO₂/ha sequestered in gross volume of sawnwood extracted, $C_{XB,s}$, is calculated as 59.0 t CO₂/ha using equation 1 of CP-W. The proportion retained in long-lived wood products after 100 years (C_{WP}), applying the emission factors for sawnwood for wood waste and fractions emitted through 100 years post harvest, WW_s , SLF_s and OF_s , is 5.7 t CO₂/ha.

Full baseline calculations, following module BL-PL, are detailed in the table below.

Calculations of project baseline, applying module BL-PL of methodology VM0007.

		tC/ha	tC/ha	tC/ha								
		175.5	100.1	119.2			forest C stocks	pasture stocks	wood prod			
year	D%planned, i, t * Aplanned, i, t ha	FOD (ha)	FS (ha)	APP (ha)	weighted average stock tC/ha	L-D _i	C _{BSL, I} tCO ₂ e/ha	C _{BSL, post, I} tCO ₂ e/ha	C _{BSL, WP, I} tCO ₂ e/ha	ΔC _{BSL, I} tCO ₂ e/ha	GHG _{BSL-E, i, t} tCO ₂ e	ΔC _{BSL, planned} tCO ₂ e
2008	2846.3	2846.3	0.0	0.0	175.5	1	643.5	0	5.7	637.8	0	1,815,232
2009	2838.8	2564.0	274.8	0.0	168.2	1	616.7	0	5.7	611.0	0	1,734,495
2010	2951.1	2563.2	387.9	0.0	165.6	1	607.2	0	5.7	601.4	0	1,774,855
total												5,324,581

Uncertainty

Total uncertainty in carbon stocks (parameter $Uncertainty_{BSL,SS}$) is equal to combined uncertainty of forest carbon stock estimates across strata/forest types, calculated using propagation of errors (equation 3 of VM0007 module X-UNC). Parameter $Uncertainty_{BSL,SS}$ is thus calculated to be 6.3% at the 95% confidence level. Total uncertainty in the baseline scenario ($Uncertainty_{BSL}$) is then 6.3%, applying equation 4 of VM0007 module X-UNC, because uncertainty in the baseline rate ($Uncertainty_{BSL,RATE}$) is assumed to be zero where the planned deforestation rate is based on actual plans.

Compensation/reforestation

The legal permit to conduct the suppression activity requires that CKBV compensate for the loss of forest by replanting an existing un-forested area. Although technically the reforestation activity would be outside the accounting boundary of the project in the baseline, because non-forest areas are not eligible project areas, for completeness in project accounting, sequestration resulting from this activity is included in the project baseline, as the planned deforestation could not have legally occurred without it.

Sequestration occurring in the baseline due to the obligatory reforestation activities was estimated using the growth rates above (area-weighted average growth rate among the three species is 4.2 m³/ha/yr) and employing the following:

- tons biomass converted from m³ volumes applying Biomass Conversion and Expansion Factor, where t biomass = 4.0 * m³ volume, for humid tropical natural forests (Table 4.5 in IPCC 2006 GL Chapter 4 Forests)
- Carbon fraction of biomass of 0.47
- Root biomass estimated applying Cairns et al 1997 equation, where Root Biomass Density (t/ha) = EXP (-1.085 + 0.9256 LN(aboveground biomass density))

Results of calculations are presented in the table below.

Estimates of sequestration resulting from compensatory reforestation activities in the baseline, outside of the project area.

	tCO ₂		
planting year	2008	2009	2010
1		34,003	67,294
2			34,003

cumulative total tCO ₂	0	34,003	101,297
incremental total CO ₂ /yr		34,003	67,294

Calculated sequestration is subtracted from baseline emissions calculations above to produce an estimate of net baseline emissions.

Years	Estimated baseline emissions or removals (tCO _{2e})	Sequestered tCO ₂ in reforested plantations in the baseline	Estimated net baseline emissions or removals (tCO _{2e})
2008	1,815,232		1,815,232
2009	1,734,495	34003.0	1,700,492
2010	1,774,855	67294.2	1,707,561
Total			5,223,284

4.2 Project Emissions

4.2.1 Emissions due to deforestation and natural disturbance

Forest cover change due to deforestation and natural disturbance was monitored through assessment of classified satellite imagery covering the project area. No deforestation was detected in the project area.

Data and Parameters Monitored

Parameter	Description	Monitored Value (2007-2010)
$\Delta C_{P,Def,i,t}$	Net carbon stock change as a result of deforestation in the project case in the project area in stratum <i>i</i> at time <i>t</i>	0 t CO ₂ -e
$\Delta C_{P,DistPA,i,t}$	Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum <i>i</i> at time <i>t</i>	0 t CO ₂ -e
$A_{DefPA,u,i,t}$	Area of recorded deforestation in the project area stratum <i>i</i>	0 ha

	converted to land use u at time t	
$A_{DistPA,q,i,t}$	Area impacted by natural disturbance in post-natural disturbance stratum q in stratum i , at time t	0 ha

4.2.2 Emissions due to illegal degradation

Potential for emissions due to illegal logging was monitored by conducting surveys in the surrounding areas of CIKEL in November and December 2011. Locations surveyed included:

- Ararandeuá Community
- Barreirinha (14 households interviewed)
- Vila Betânia
- Families residing along the neighbouring access between RCC and PA150
- Nearby farms and rural properties, including 77 households in the surroundings of RCC.

No indications were encountered that emissions resulting from degradation due to illegal logging (parameter $\Delta C_{P, DegW}$) are occurring in the project area, based on negative results of surveys surrounding the project area carried out in December 2011, as well as lack of evidence of illegal logging encountered in the project area during extensive inventory field work conducted August to October 2011.

Data and Parameters Monitored

<i>Parameter</i>	<i>Description</i>	<i>Monitored Value (2007-2010)</i>
$A_{DegW,i,t}$	Area potentially impacted by degradation processes in the project area	0 ha
$\Delta C_{P, DegW}$	Net carbon stock changes as a result of degradation in the project area	0 t CO ₂ -e

4.2.3 Emissions due to FSC-certified selective logging

Project emissions due to FSC-certified selective logging were monitored and estimated applying module M-MON (VMD0015), version 7 as revised and approved December 2011, of methodology VM0007.

No harvests occurred in the project area from 2007 to 2010.

Year	Harvest Area (ha)	Volume of timber	Volume of residues	Total volume extracted
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		extracted (m ³) <i>V_{EXT} sawnwood</i>	extracted (m ³)	(m ³) <i>V_{EXT}</i>
2008	0	0	0	0.0
2009	0	0	0	0.0
2010	0	0	0	0.0

With-project emissions are calculated in the table below.

Calculations of actual project emissions applying module M-MON of methodology VM0007.

		m ³	t CO ₂ /ha	tCO ₂	tCO ₂	M	tCO ₂	Ha	tCO ₂	ha	tCO ₂	tCO ₂	tCO ₂	tCO ₂	tCO ₂
Year	Harvest Area (ha)	<i>V_{EXT}</i>	<i>C_{BSL}</i>	<i>C_{EXT}</i>	<i>C_{LG}</i>	<i>L_{SKID}</i>	ΔC_{SKID}	<i>A_{ROAD}</i>	ΔC_{ROAD}	<i>A_{DECKS}</i>	ΔC_{DECKS}	<i>C_{LR}</i>	<i>C_{WP}</i>	$\Delta C_{P,SelLog}$	$\Delta C_{P,Deg}$
2008	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2010	0.0	0.0	0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
														total	0

4.3 Leakage

Two sources of leakage were monitored: activity shifting and market leakage.

Activity-shifting leakage was monitored by tracking forest cover change across all lands outside of the project area owned or under the management of CKBV ($A_{defLK,i,t}$), identified in the monitoring plan above, using classified Landsat imagery. All changes in forest cover detected for the monitoring interval were annualized (to produce estimates of ha for each year) by dividing the area by the number of years in the period.

Data and Parameters Monitored

Parameter	Description	Monitored Value (2007-2010)
$A_{defLK,i,t}$	The total area of deforestation by the baseline agent of the planned deforestation in stratum i at time, t	ha
$\Delta C_{BSL,i}$	Net carbon stock changes in all pools in baseline stratum i ; sourced from mean forest carbon stock estimates from forest carbon inventory of project area for equivalent strata in area of activity shifting leakage	t CO ₂ -e ha ⁻¹

From 2007 to 2009, CKBV deforested with authorization 84.2 ha in the RCC (Figure 4.1 below), outside the project area, for the implementation of the necessary infrastructure to the development of the carbonization activity, according to the partnership signed with steel companies, for the use of the forest residues generated in the sustainable forest management activities in RCC and according approval of the competent environmental body. At the time of clearing, all of the areas cleared were on mature floresta ombrofila densa (FOD stratum) forests. The areas converted were not burned in the clearing process, and hence no non-CO₂ emissions from biomass burning resulted from these activities. These areas were not suppressed in the REDD Planned Project areas and had no impacts in FSC certification, however, are included in assessment of activity shifting leakage.

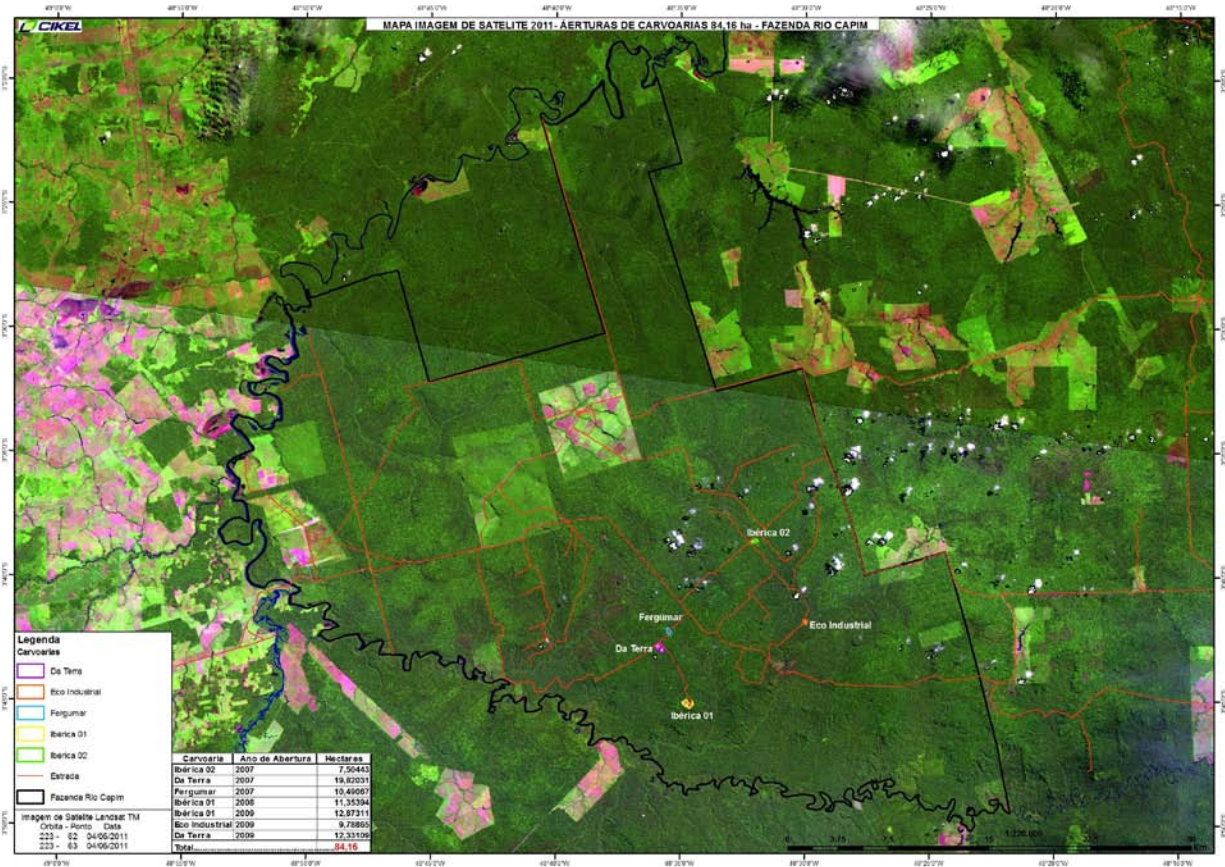


Figure 4.1 Identified areas of activity shifting leakage on the RCC, through 2010.

No evident areas of planned deforestation/activity shifting leakage were observed over the monitoring period on the other CKBV properties, including Deus é Bom I, Deus é Bom II, Jutaituba and ABC (Figures 4.2 and 4.3 below).

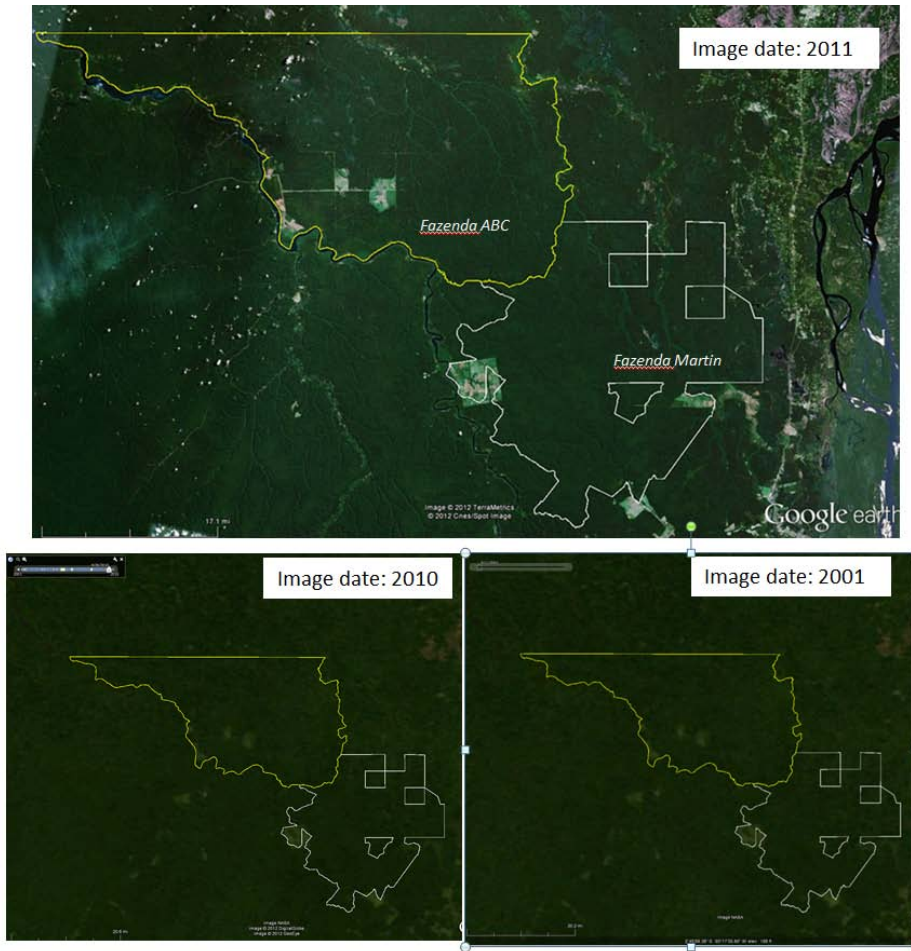


Figure 4.2. Map showing the properties Fazenda ABC & Fazenda Martin . Hi-resolution imagery is from 2011 where all forest clearing is clearly visible. The images below show how the same cleared areas appear are evident in medium spatial resolution Landsat imagery from 2010 and in the 2001 imagery, indicating that this land clearing occurred prior to 2001 (i.e. not cleared during the project monitoring period and predated the project).



Figure 4.3. Map showing the properties Dues E Bom I & II . Hi-resolution imagery is from 2010 and shows no land clearing in the properties. The slight misalignment is due to projection distortions. The same areas is shown below in 2005, and hence there is no evident deforestation during the project monitoring period.

Monitored parameters were entered into the table format below to complete calculations of activity shifting leakage. As stated above, the areas converted were not burned in the clearing process, and hence no non-CO₂ emissions from biomass burning resulted from these activities, nor does CKBV practice fertilizer application on any of the lands under its management. Total activity shifting leakage estimated for the monitoring period is 54,157 t CO₂.

Calculation format for area subject to activity shifting leakage.

Year	$NewR_{i,t}$ (ha)	$A_{defLK,i,t}$ (ha)	$LKA_{planned,i,t}$ (ha)	$\Delta C_{BSL,l}$ t CO _{2-e} ha ⁻¹	$\Delta C_{LK-AS,planned}$ t CO _{2-e}
2008	0	37.81	37.81	643.50	24,330.7
2009	0	11.35	11.35	643.50	7,303.7
2010	0	35.00	35.00	643.50	22,522.5
				total	54,157.0

Market leakage is treating applying module LK-ME. Leakage due to market effects is restricted to reductions in harvest of wood for charcoal production destined for domestic markets (all sawn wood harvested in the baseline is exported and thus not included in accounting of market leakage).

For estimation of market leakage, the main parameter monitored was annual volume of fuelwood harvested from the project area ($FG_{LP,t}$), which was monitored and reported in the annual harvest reports "RELATORIOS DE ATIVIDADES DO POA (ANNUAL OPERATION PLAN LOGGING REPORT)."

Wood volumes extracted in the baseline potentially subject to market leakage.

Year	ha	residues (bolts and firewood) (m ³)
2008	2846.3	790,469
2009	2838.8	788,391
2010	2951.1	819,588

Parameter D_{mn} is set as 0.65 metric tons per cubic meter, which represents the average basic wood density of the Forest Products Laboratory (LPF) of the Brazilian Forest Service database (accessed at <http://www.ibama.gov.br/lpf/madeira/pesquisa.php?idioma=portugues>). This is conservative, because the majority of tree species exploited for fuelwood/charcoal are successional/non-commercial species with relatively low wood densities.

Market leakage calculations are detailed in the table below.

Ex post calculations of market leakage applying module LK-ME of methodology VM0007.

Year	$FG_{BSL,t}$ m ³	$FG_{LP,t}$ m ³	D_{mn} t d.m.m ⁻³	CF t C t ⁻¹ d.m.	$C_{BSL,XBFWC,t}$ t CO ₂	LF_{ME}	$LK_{MarketEffects,FW/C}$ t CO ₂
2008	790,469	0	0.65	0.47	885,457	0.4	354,183
2009	788,391	0	0.65	0.47	883,130	0.4	353,252
2010	819,588	0	0.65	0.47	918,076	0.4	367,230
				$AL_{FWC,i}$	2,686,663	total	1,074,665

4.4 Summary of GHG Emission Reductions and Removals

Estimates of GHG credits eligible for issuance as VCU's are calculated in the table below.

Years	Estimated net baseline emissions or removals (tCO _{2e})	Estimated project emissions or removals (tCO _{2e})	Estimated leakage emissions (tCO _{2e})	Risk buffer (%)	Deductions for AFOLU pooled buffer account (tCO _{2e})	GHG credits eligible for issuance as VCUs (tCO _{2e})
2008	1,815,232	0	378,514	15.5%	281,361	1,155,357
2009	1,700,492	0	360,556	15.5%	263,576	1,076,360
2010	1,707,561	0	389,753	15.5%	264,672	1,053,136
					total	3,284,853

5 ADDITIONAL INFORMATION

Land-use class as determined from ground-truth points	Classification		Total	Accuracy (%)	Error of Commission (%)
	Forest	Non-forest		User's accuracy (# correct/ row total)	
Forest (100)	489	13	502	97,4	2,6
Non-forest (100)	22	358	380	94,2	5,8
Total	511	371	*882	96,0	4,0
Accuracy (%) Producer's accuracy (# correct/ column total)	95,7	96,5	96,0		
Error of Omission (%)	4,3	3,5	4,0		

*The total sample was note qual to 1000 due to the pixsel of cloud and shade that were excluded from the analysis.