

REDUCTION OF DEFORESTATION AND DEGRADATION IN TAMBOPATA NATIONAL RESERVE AND BAHUAJA- SONENE NATIONAL PARK WITHIN THE AREA OF MADRE DE DIOS REGION – PERU: MONITORING REPORT



Document Prepared By Asociación para la Investigación y el Desarrollo Integral – AIDER

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The REDD project is implemented in the area comprised by Tambopata National Reserve and Bahuaja-Sonene National Park sector within Madre de Dios region, corresponding to the Partial Administration Contract of TAMBNR and BSNP – Madre de Dios, signed between the Peruvian government and the Association for Research and Integrated Development - AIDER¹. The area of project have an extension of 541 620. 14 hectares and aim is conserve forests in both Protected Natural Area - NPA from the imminent advance of deforestation.

The project has implemented activities that have helped with the conservation of the forests of both NPA within Madre de Dios. The implemented activities come from five established components set forth in the REDD strategy, which was developed at the beginning of the project. The established components were: sustainable economic activities, conservation agreements, control and surveillance, forest governance and communication and dissemination.

The implemented activities were fundamentally aimed at reducing the pressure on land use change in the buffer area of the NPA by promoting sustainable economic activities and initiatives for establishing conservation agreements in the identified critical areas; both actions aimed at consolidating a "barrier" against the expansion of the economic frontier (agriculture and mining). The control and monitoring system of the TAMBNR and BSNP has been strengthened, emphasizing the conformation and operation of the surveillance community committees with official recognition, as a strategy for involving local populations in the management of the NPA. Work has also been done on the issue of forest governance and communication and dissemination across the area.

It has been verification two years of the project execution: July 1, 2011 to June 30, 2012 and 1 July 2012 to June 30, 2013, managed to avoid 262,440 tCO₂-e for the first year and 358,432 tCO₂-e in the second year.

1.2 Sectoral Scope and Project Type

Sectoral scope 14 – Agriculture, Forestry and Other Land Use

AFOLU project category: Reduced Emissions from Deforestation and Degradation (REDD)

Activity type: Avoiding Unplanned Deforestation and Degradation (AUDD)

Project activity type was defined according to a decision tree located in the methodology (REDD-MF, see 5 step 0). Forest areas are expected to be converted into non-forest areas in the "without-project" scenario, with the project area lacking legal authorization for a non-forest conversion.

Project is individual, not grouped.

¹ Granted by Intendancy Resolution Nº 053-2008-INRENA-IANP

1.3 Project Proponent

The project proponent is AIDER; contact information is detailed in Table 1.

Table 1. Description of the project proponent

Organization name	Association for Research and Integrated Development – AIDER
Contact person	Jaime Nalvarte Armas
Title	Chief Executive Officer
Address	Jorge Basadre Avenue 180 Office 6 – San Isidro. Lima, Perú
Telephone	(51 1) 421 5835
Email	lima@aider.com.pe

1.4 Other Entities Involved in the Project

Table 2. Description the SERNANP

Organization name	National Service of Protected Natural Areas - SERNANP
Role in the project	The National Service of Protected Natural Areas (SERNANP) is in charge of leading the management of the National System of Protected Natural Areas, of which the headship of Tambopata National Reserve and Bahuaja-Sonene National Park are part of. Their purpose is political support, monitoring and supervision of the taken commitments for the implementation of the project, in their capacity as the State entity responsible for the management of the NPA.
Contact person	Pedro Gamboa Moquillaza
Title	Chief of SERNANP
Address	Diecisiete Street N° 355 - El Palomar - San Isidro. Lima, Perú.
Telephone	(51 1) 225-2803
Email	sernanp@sernanp.gob.pe

Table 3. Description the Pontifical Catholic University of Peru

Organization name	Pontifical Catholic University of Peru - PCUP
Role in the project	PCUP complements AIDER's efforts as executor of the Administration Contract providing its extensive research experience in TAMBNR, through the participation of its professionals in the development of academic and research activities. Likewise, PUCP advises AIDER on the administration of the research component of the contract, specifically promoting further research and improving researching conditions. An example of this collective effort is the construction and implementation of a 45m high tower for continuous CO2 measurements over the forest, within the TAMBNR.
Contact person	Luis Guzman Barron Sobrevilla
Title	Rector of PCUP
Address	Universitaria avenue 1801- San Miguel. Lima, Peru
Telephone	(51 1) 626-2000
Email	www.pucp.edu.pe

1.5 Project Start Date

Project start date: July 01, 2010.

1.6 Project Crediting Period

Project crediting period: 20 years (July 01, 2010 – June 30, 2030).

First period of quantified GHG emissions reduction: 10 years (July 01, 2010 – June 30, 2020).

1.7 Project Location

The project area belongs politically to the districts of Tambopata and Inambari, Tambopata Province, Madre de Dios region, Republic of Peru. It occupies the southeast end of the region, reaching the international border of Plurinational State of Bolivia. Figure 1 shows the location map of the project area.

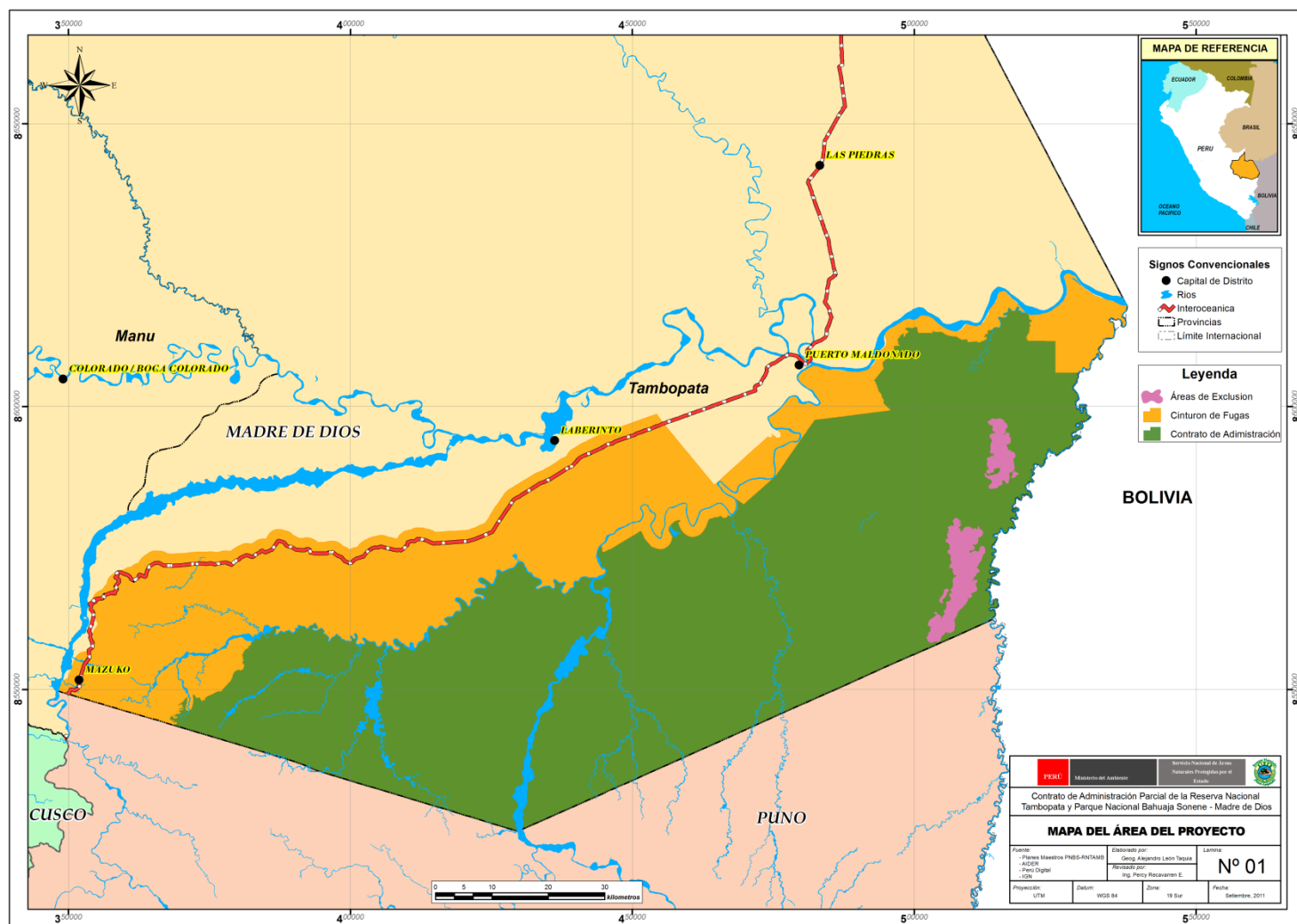


Figure 1. Location map of the project area

1.8 Title and Reference of Methodology

Approved VCS Methodology VM0007, REDD Methodology Modules (REDD-MF) version 1.4, developed by Avoided Deforestation Partners. The modules used for monitoring were the following:

- Module VCS VMD0015 "Methods for Greenhouse Gasses emissions and removals monitoring" (M-MON); noting that the PD was validated using version 1.0 of this module and that the monitoring period 2011-2013 used version 2.1, which was approved on November 20, 2012.
- Module VCS VMD0010 "Emissions estimate for activity displacement due to avoided unplanned deforestation" (LK-ASU), version 1.0.

- Module VCS VMD0013 “Greenhouse gases emissions estimate for burning biomass” (E-BB), version 1.0.

1.9 Other Programs

The project is not included in an emissions trading program; this type program does not exist in Peru to the date. It has neither participated in any other environmental accreditation program for GHG emissions elimination. Also, the project does not intend to create any type of environmental credit related to GHG emissions rather than through the VCS Program.

The project has not been registered by other GHG program.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

The activities implemented by the project were performed according to the specifications in the REDD strategy, which consists of 5 components. To ensure the effectiveness of the activities, it was decided for the field of implementation of activities to be split into seven sectors in order to perform coherent actions to the reality of each sector. The following were the established sectors:

- Sector I: Mazuko – Kotzimba
- Sector II: Farfán – Malinowski – A6
- Sector III: Malinowski – La Torre
- Sector IV: Infierno
- Sector V: Loero – Jorge Chávez – Nueva América
- Sector VI: Sandoval – Huisene
- Sector VII: Palma Real – San Antonio

During the monitoring period from July 1, 2011 to June 30, 2013, the following activities were performed:

Component 1. Productive Activities

Sector IV: Infierno

This sector has developed activities such as: sustainable use of the forest in Infierno Native Community and restoration of degraded areas to develop a sustainable model of payment for ecosystem services in Infierno Native Community.

Sector V: Loero – Jorge Chavez – Nueva America

This sector comprises three associations (Nueva América, Loero y Jorge Chávez) in which the development of agroforestry systems have been encouraged by receiving some inputs and training on the matter, as well as sustainable “aguaje” and “ungurahui” palm management.

Component 2. Monitoring and Surveillance

The activities of this component are developed across the total project area, considering all of the established sectors.

Control and monitoring included training and organization activities; patrol activities of voluntary rangers located throughout New America, Loero and Jorge Chávez; as well as the development of a community surveillance system for TAMBNR and BSNP. Maintenance actions and expansion of control and surveillance stands of the NPA were also executed. They also trained rangers of TAMBNR and BSNP on issues related to monitoring, control and surveillance. Various types of monitoring for hunting, fishing and gathering chestnuts were performed. Also, the comprehensive biological monitoring system and the volunteer naturalists program were achieved.

Component 3. Forest governance

Strengthening of the management committees of Bahuaja Sonene National Park and TAMBNR, monitoring and technical assistance for strengthening participatory management of BSNP, skills development of the Bureau of Environmental and REDD+ Services Madre de Dios (BERS) under the leadership of the Madre de Dios Regional Government (GOREMAD), support in strengthening local organizations for participatory management of TAMBNR and BSNP-MDD.

Sector II: Farfán – Malinowski – A6

In this sector some working initiatives with artisanal miners located in the Yarinal A-6 Malinowski sector, corresponding to the buffer zone of TAMBNR (APAYLON), were developed. The activity consisted of organizational strengthening of the artisanal miners APAYLON association.

Sectors IV y VII: Infierno, Palma Real –San Antonio

Governance in Ese'eja Infierno Native Community was strengthened and there was also an interest in resolving border disputes in Tres Islas and San Jacinto communities.

Component 4. Conservation agreements

Feasibility study for the elaboration of a regional conservation agreement.

Component 5. Communication and dissemination

Alike the control and monitoring component, the communication and dissemination component is performed across all sectors. Activities such as the design and implementation of the communications strategy to promote a greater awareness of BSNP in Madre de Dios, with its corresponding monitoring and evaluation, and the First Regional Congress of Research and Biological Monitoring in Protected Natural Areas and Conservation Corridors in Madre De Dios, were performed. The promotion of research through biodiversity and biological monitoring courses in TAMBNR and BSNP - MDD have also been developed, as well as a virtual research system.

For further details of the activities review "Annex 1. List of project activities, period (2011-2013)".

Leaks were monitored through satellite images, according to the M-MON v2.1 established methodology. It has been determined that the amount of deforestation in the leakage belt is actually attributable to the project activity. The deforestation estimate by immigrant populations, used for the leakage calculation, will be estimated every 5 years based on the data that can be obtained from the National Institute of Statistics and Informatics - INEI.

Regarding the non-permanence risk factors monitoring and management, the following risk factors will be subject to monitoring:

✓ **Internal Risks**

Project management

- Every 5 years, the risk of invasion of external agents threatening more than 50% of the carbon stocks that have previously issued credits will be monitored.
- As part of the annual evaluation of AIDER's staff, institutional monitoring will be in charge of maintaining a multidisciplinary team that includes individuals with all the necessary capabilities for the implementation of the project activities.

Financial viability

- The cash flow of the project will be monitored on year 5, in order to verify if the equilibrium point has been reached according to what was predicted in the non-permanence risk evaluation.

✓ **External Risks**

Population involvement

- Consultations to the populations in the project area² have been anticipated; this will be done through their most representative organizations: the Management Committee of TAMBNR, the Management Committee of BSNP, and exploited resources user organizations: which will be done twice a year.
- The implementation of the community monitoring plan will allow evaluating the project's positive net impacts on the wellbeing of the populations.

Political risk: the World Bank governance rate will be monitored annually.

✓ **Natural Risks**

- Fire: fires are annually monitored using the procedure described in Annex 2; this action is part of the integral monitoring system that is being implemented as part of the Partial Operations Administration Contract of TAMBNR and BSNP - Madre de Dios.
- Pests and diseases: information from the Regional Agrarian Direction is collected annually.
- Extreme weather events: information from the National Service for Meteorology and Hydrology - SENAMHI³ is collected annually.

The non-permanence risk evaluation report is found in Annex 2.

² Delimited in the CCB Project Design Document, according to the definition found in CCB standards

³ http://www.senamhi.gob.pe/include_mapas/_dat_esta_tipo.php?estaciones=000808

2.2 Deviations

2.2.1 Methodology Deviations

There has not made any new deviation to the methodology for this monitoring. However is relevant to mention that during the PDD validation process there was made the following deviation: the PRA was omitted, which has been replaced with the ranger reports of the TAMBNR and BSNP, in Madre de Dios. With the information of the ranger reports was decided to perform a degradation study in order to determine the degradation occurred the project area according to each monitoring period, for this period were considered the ranger reports from 2011 - 2013. This study has not been considered as a monitoring parameter, but has been developed for this period of monitoring and are attached as to the annex the monitoring report.

The annex contemplates the methodological process established in the module VCS VMD0015 "Methods for monitoring greenhouse gas emissions and removals" (M-MON) v2.1.

2.2.2 Project Description Deviations

- **Discarding of Claslite software use to support delimitation of the area potentially impacted by degradation process**

During the previous verification, CLASLite software version 2.2 had not been updated for non-governmental users; this prevented to use it to support monitoring of degradation in this period, because the software requires updates every three months based on atmospheric data, which were not provided by the software creator.

Currently the delimitation of the potentially affected area by degradation processes being worked according to the provisions of the VCS VMD0015 module "Methods for monitoring greenhouse gas emissions and removals" (M-MON) v2.1, complying with the provisions of the methodological framework.

- **Monthly monitoring of hotspots**

Monthly monitoring of hotspots was not performed because little information was available. The data source selected for this monitoring and indicated at Project Description, the University of Maryland in agreement with Conservation International Peru, was not available because the reports of hotspots in the Amazon region of Peru were not continuous.

Likewise, the available information, provided by INPE from Brazil through their web data base⁴, had errors at hotspot location; these errors were detected when info was contrasted between satellite imagery and field observations (an example of these errors can be seen on Figure 2, where hotspots are located in the middle of water bodies). Therefore, using this data source was dismissed.

More trustable sources were sought, choosing data from National Aeronautics and Space Administration (NASA), which were available from user record in 2011. Nevertheless, monitoring of burned areas was performed according to specified in module E-BB.

⁴ <http://www.dpi.inpe.br/proarco/bdqueimadas/>
v3.3

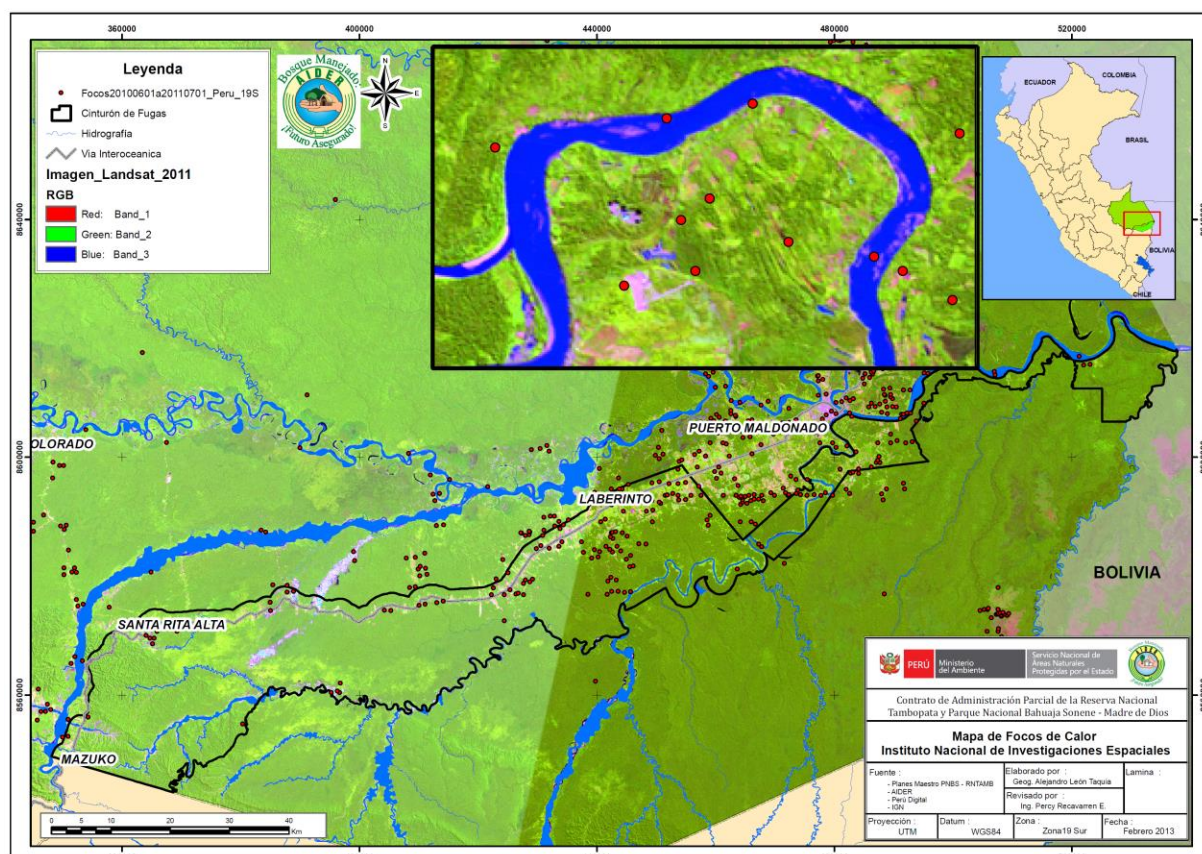


Figure 2. Errors in heat spots location at INPE-Brazil information

2.3 Grouped Project

Not applicable

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	Forest / Non Forest Cover Regional Map
Data unit	-
Description	Map showing the location of forest areas within the reference region, project area and leakage belt at the Start of the crediting period.
Source of data	Landsat 5 images. GPS points taken in the case of field verifications.
Value applied:	-
Justification of choice of data or description of	Image interpretation done using ENVI 5.1 and Arc Gis 10.1 software. Minimum precision of the map will be of 90%, according

measurement methods and procedures applied	to the specified in the M-MON module. The map will be validated on the field through a systematic unaligned sampling; precision calculation and commission and omission mistakes will be done through a confusion matrix.
Purpose of the data	Calculating emissions baseline
Comments	-

Data / Parameter	<i>COMFi</i>
Data unit	Dimensionless
Description	Combustion factor for stratum <i>i</i> (vegetation type)
Source of data	Default values in Table 2.6 of IPCC, 2006 (Annex 2).
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculating emissions baseline
Comments	-

Data / Parameter	<i>G gi</i>
Data unit	Dimensionless
Description	Combustion emissions factor for <i>i</i> stratum and <i>g</i> gas - source of data
Source of data	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (see Annex 2: emission factors for various types of burning for CH ₄ and N ₂ O).
Value applied:	6.80 for CH ₄ and 0,20 for N ₂ O in tropical forest
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculating emissions baseline
Comments	-

Data / Parameter	<i>PROPIMM</i>
Data unit	%

Description	Estimate of the ratio of deforestation caused by immigrant populations.
Source of data	INEI, 2007
Value applied:	18.65
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculating emissions baseline
Comments	-

3.2 Data and Parameters Monitored

Data / Parameter	Forest cover monitoring map for the project area.
Data unit	Ha
Description	Map showing the location of forest areas within the project area at the end of every monitoring period. If there were deforested areas within the project area, the comparison with the base map has to show the deforested areas in every monitoring period.
Source of data	Landsat 8 images. GPS points taken in the case of field verifications.
Description of measurement methods and procedures to be applied	Image interpretation done using geographic information systems (GIS).
Frequency of monitoring/recording	Annual
Value monitored:	541 599.51 ha
Monitoring equipment	Computer (desktop/laptop) with an i7 processor and 6 GB of RAM memory. Software: ENVI 5.1 and Arc GIS 10.1 GPS Garmin Navigator
QA/QC procedures to be applied	The map will be validated on the field through a systematic unaligned sampling; precision calculation and commission and omission mistakes will be done through a confusion matrix. Minimum precision of the map will be of 90%, according to the specified in the M-MON module. The elaboration of the map will be done according to the Standard Operational Procedure elaborated for this purpose. See annex 8.
Purpose of the data	Estimating project emissions

Calculation method	The selected image of the previous year serves as a reference, which is updated with the new "non-forest" areas generated by the software and by the knowledge the remote sensing analyst has of the area; thus, the forest area is defined for this monitoring period. The accuracy of the map is calculated by comparing it with the field data.
Comments	-

Data / Parameter	Forest cover monitoring map for the leakage belt.
Data unit	Ha
Description	Map showing the location of forest areas within the leakage belt age belt at the end of every monitoring period.
Source of data	Landsat 8 images. GPS points taken in the case of field verifications.
Description of measurement methods and procedures to be applied	Image interpretation done using geographical information systems.
Frequency of monitoring/recording	Annual
Value monitored:	189 993.24
Monitoring equipment	Computer (desktop/laptop) with an i7 processor and 6 GB of RAM memory. Software: ENVI 5.1 and Arc GIS 10.1 GPS Garmin Oregon600
QA/QC procedures to be applied	The map will be validated on the field through a systematic unaligned sampling; precision calculation and commission and omission mistakes will be done through a confusion matrix. Minimum precision of the map will be of 90%, according to the specified in the M-MON module. The elaboration of the map will be done according to the Standard Operational Procedure elaborated for this purpose. See annex 8.
Purpose of the data	Estimating leakage
Calculation method	The selected image of the previous year serves as a reference, which is updated with the new "non-forest" areas generated by the software and by the knowledge the remote sensing analyst has of the area; thus, the forest area is defined for this monitoring period. The accuracy of the map is calculated by comparing it with the field data.
Comments	-

Data / Parameter	<i>Aburn,i,t</i>
Data unit	ha
Description	Total of burnt areas within the project area for the monitoring period.
Source of data	Landsat 8 images. GPS points taken in the case of field verifications.
Description of measurement methods and procedures to be applied	Image interpretation through the use of geographic information systems (GIS).
Frequency of monitoring/recording	Annual
Value monitored:	1.17
Monitoring equipment	Computer (desktop/laptop) with an i7 processor and 6 GB of RAM memory. Software ENVI 5.1 and Arc GIS 10.1 GPS Garmin Navigator
QA/QC procedures to be applied	The map will be validated on the field through the sampling of 10% of the total analyzed area; the classes on the map must correspond to the ones on the field. Minimum precision of the map will be of 90%. The elaboration of the map will be done according to the Standard Operational Procedure elaborated for this purpose. See annex 9.
Purpose of the data	Estimating project emissions
Calculation method	The Landsat 8 images were analyzed by their spectral firms, color shades and shapes; subsequently, training samples were obtained from the image and the maximum likelihood algorithm was applied, extracting areas of interest. Finally, a post-classification was made to eliminate the isolated pixels in the area.
Comments	-

Data / Parameter	<i>ADefPA,i,t</i>
Data unit	ha
Description	Deforestation area registered for the monitoring period in the project area, i stratum.
Source of data	Landsat 8 images.
Description of measurement methods and procedures to be applied	Image interpretation done using geographical information systems.
Frequency of monitoring/recording	Annual
Value monitored:	8.88 ha
Monitoring equipment	Computer (desktop/laptop) with an i7 processor and 6

	GB of RAM memory. Software Arc GIS 10.1
QA/QC procedures to be applied	The mapping of deforested areas will be validated on the field through a systematic unaligned sampling; precision calculation and commission and omission mistakes will be done through a confusion matrix. Minimum precision of the map will be of 90%, according to the specified in the M-MON module. The elaboration of the map will be done according to the Standard Operational Procedure elaborated for this purpose. See annex 8.
Purpose of the data	Estimating project emissions
Calculation method	The selected image of the previous year serves as a reference, which is updated with the new "non-forest" areas generated by the software and by the knowledge the remote sensing analyst has of the area; thus, the deforested area is defined for this monitoring period. The accuracy of the map is calculated by comparing it with the field data.
Comments	-

Data / Parameter	$A_{DefLB,i,t}$
Data unit	ha
Description	Deforested area registered for the monitoring period in the leakage belt, i stratum.
Source of data	Landsat 8 images.
Description of measurement methods and procedures to be applied	Image interpretation through the use of geographic information systems (GIS).
Frequency of monitoring/recording	Annual
Value monitored:	2 167.70
Monitoring equipment	Computer (desktop/laptop) with an i7 processor and 6 GB of RAM memory. Software Arc GIS 10.1
QA/QC procedures to be applied	The mapping of deforested areas will be validated on the field through a systematic unaligned sampling; precision calculation and commission and omission mistakes will be done through a confusion matrix. Minimum precision of the map will be of 90%, according to the specified in the M-MON module. The elaboration of the map will be done according to the Standard Operational Procedure elaborated for this purpose. See annex 8.
Purpose of the data	Estimating project emissions

Calculation method	The selected image of the previous year serves as a reference, which is updated with the new "non-forest" areas generated by the software and by the knowledge the remote sensing analyst has of the area; thus, the deforested area is defined for this monitoring period. The accuracy of the map is calculated by comparing it with the field data.
Comments	An ex-ante deforestation estimate was made for the leakage belt for the "with project" scenario, according to the established procedures in the M-MON module, resulting in a total of 1 519 ha.

Data / Parameter	$A_{DegW,i}$
Data unit	ha
Description	Potentially impacted area by degradation processes in <i>i</i> stratum.
Source of data	Reports from the rangers of the TAMBNR and BSNP regarding illegal extraction of wood. Location map of the physical components of the project area.
Description of measurement methods and procedures to be applied	Delimitation of the potential area subject to forest degradation based on the expertise of the rangers (see the participatory workshop memory on Annex 5).
Frequency of monitoring/recording	Annual
Value monitored:	12 963.01 ha
Monitoring equipment	Computer (desktop/laptop) with an i7 processor and 6 GB of RAM memory. Software Arc GIS 10.1
QA/QC procedures to be applied	Participatory workshop performed with the rangers to validate the preliminary delineation of the potential area subject to forest degradation.
Purpose of the data	Estimating project emissions
Calculation method	Using the UTM coordinates of the points of interventions performed by the rangers during the monitoring period and their knowledge of the area and of degradation activities, the area of the critical sectors within the project area was determined.
Comments	-

Data / Parameter	AP_i
Data unit	ha
Description	Total area of the degradation sampling plots in <i>i</i> stratum

Source of data	Field measurements
Description of measurement methods and procedures to be applied	Systematic random sampling, covering at least 3% of the potential area subject to degradation.
Frequency of monitoring/recording	Annual
Value monitored:	392 ha sampled through a total of 98 000m of 40m wide transects, distributed systematically in the potential area subject to degradation.
Monitoring equipment	Computer (desktop/laptop) with an i7 processor and 6 GB of RAM memory. GPS Garmin Navigator
QA/QC procedures to be applied	The gathering of information on the field will be done according to the Standard Operational Procedure elaborated for this purpose. See annex 10.
Purpose of the data	Estimating project emissions
Calculation method	Cabinet processing of the information gathered on the field using geographic information systems (GIS).
Comments	-

Data / Parameter	$C_{DegW,i,t}$
Data unit	t CO ₂ -e
Description	Carbon in biomass of trees felled and removed on the degradation process for the monitoring period in / stratum.
Source of data	Field measurements
Description of measurement methods and procedures to be applied	Field measurements according to the procedure described in M-MON module, v2.1.
Frequency of monitoring/recording	Annual
Value monitored:	0
Monitoring equipment	Caliper
QA/QC procedures to be applied	The gathering of information on the field will be done according to the Standard Operational Procedure elaborated for this purpose. See annex 10.
Purpose of the data	Estimating project emissions
Calculation method	Allometric equations used to calculate aerial biomass (Brown, 1997, as quoted by Pearson <i>et al.</i> , 2005) and underground biomass (Source: Cairns <i>et al.</i> , 1997, as quoted by IPCC, 2003).

Comments	-
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3.3 Monitoring Plan

The monitoring purpose is to obtain the necessary information in order to estimate the amount of avoided emissions during the crediting period, evaluate the effectiveness of the project activities and collect all the information required to ensure the realization of the project's emissions reduction targets.

The monitoring plan is directed to the following activities that need to be monitored:

- Baseline revision
 - Monitoring of effective changes in carbon stocks and GHG emissions
 - Monitoring of changes in carbon stocks and GHG emissions due to leaks
 - Estimation of net ex-post changes in carbon stocks and GHG emissions
- a. Monitoring activities include the use of remote sensors and in-situ inspections. The combination of both data sources gives as a result the required calculations and estimates to determine whether the project is being developed in accordance to the VCS-PD.

For the monitoring of the areas subject to deforestation and forest degradation and associated emissions, the VCS VMD0015 module "Methods for GHG emissions and removals monitoring" (M-MON) version 2.1 will be used; likewise, the report of leakages caused by the project due to activity displacement will be prepared according to the VCS VMD0010 module "Emissions estimate for activity displacement due to avoided unplanned deforestation" (LK-ASU) version 1.0. As for the estimate of GHG other than CO₂ produced by burning biomass, the VCS VMD0013 module "Greenhouse gases emissions estimate for burning biomass" (E-BB) version 1.0 will be used. The remaining carbon stored in long-lasting wood products reservoir, as a result of logging activities, will be calculated using the VCS VMD0005 module "Estimate of the carbon content in long-lasting wood products" (CP- W) version 1.1; and finally, the "Tool for testing the significance of GHG emissions from A/R CDM project activities" (T -SIG) will be used in order to evaluate if it is correct to rule out emission sources, leakage sources and long-lasting wood products reservoir.

- b. It is conservatively considered that the carbon stored in the aerial and underground biomass reservoirs keeps constant, so it will not be monitored. Likewise, the secondary forest growth (carbon increment) is omitted in a conservative way, considering, however, the mosaic of secondary forest and agriculture as a single category, due to the complications in differentiating secondary forests from areas with agricultural management (by presenting similar visual and spectral characteristics) on the pixel size of the images to be used. It is necessary to point out that, in many occasions, forest regeneration is impeded (as in the case of areas affected by mining or those invaded by aggressive and competitive exotic).

Monitoring the changes in land use, based on Landsat 8 images, will be performed annually, involving all the changes in forest cover. The deforested area (in hectares) is calculated for the project area and leakage belt. Also, once the deforestation map is generated, it will be validated through a nonaligned systematic sampling on the field.

On the other hand, the areas of the fires that may affect the project activities are monitored annually through the online reporting system provided by NASA, USA.

Spatial information that may be provided by government entities will be updated annually.

- c. All the monitoring activities will be implemented using Standard Operational Procedures (SOP) elaborated by the project team (see annexes 8, 9 and 10). The staff will be permanently trained to ensure the quality of the data.
- d. The Group Assurance and Quality Control program schedules auditing visits to verify the compliance of the SOPs, choosing random processes to ensure their correct implementation.
- e. Monitoring data is stored and processes in the cities of Puerto Maldonado and Lima following the procedure described in the Annex 11.
- f. Monitoring is performed by a professional monitoring team that will be found in the cities of Lima and Puerto Maldonado, in coordination with the headship of Tambopata National Reserve and Bahuaja-Sonene National Park. The monitoring team answers to the Ecosystem Services Area of AIDER coordinator, with an office in Lima.

In-situ monitoring will be in charge of the professional monitoring team in Madre de Dios, with the cooperation of the Rangers of the Protected Natural Areas (within the project area) and their extensive knowledge, the ones who receive training through training workshops to fulfill these tasks.

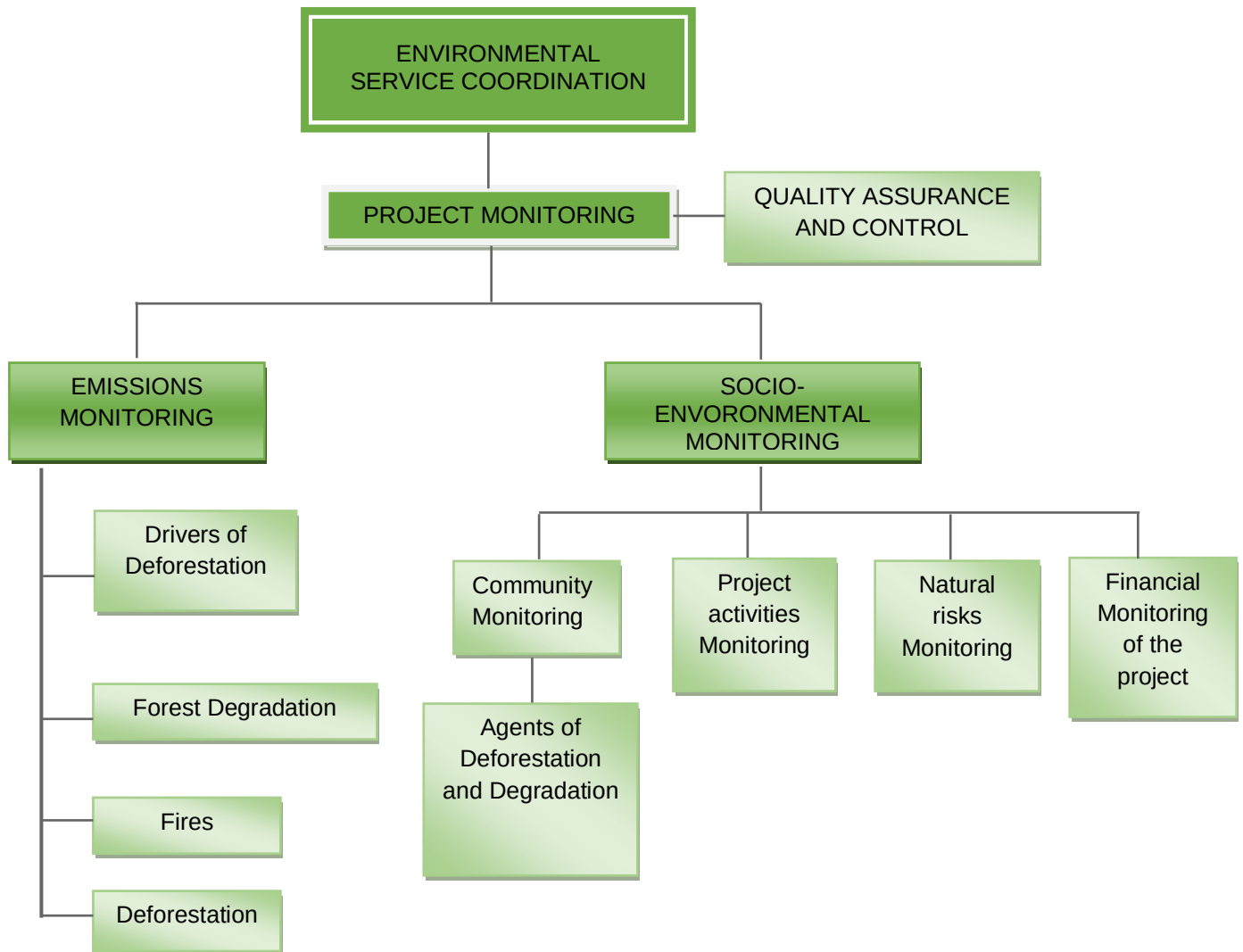


Figure 3. Monitoring organization chart

- **Baseline Review**

The reference scenario will be reviewed every 10 years. The deforestation rate will be updated for the reference region, the project area and the leakage belt, and the same will be done for the drivers of deforestation. Also, the information of the stored carbon will be verified by evaluating 10% of the plots in every stratum to determine the reference scenario. Using the updated information, the deforestation model will be adapted for the project area and the leakage belt in the reference scenario, projecting the deforested areas once again and calculating the carbon emissions in the reference scenario for the subsequent period.

- **Monitoring of effective changes in stored carbon and GHG emissions**

Monitoring is performed using geographic software to process and interpret satellite images, complementing them with field verifications; the parameters subject to monitoring are specified on section 3.2. The following enumerates the procedure steps according to the specified in the

M-MON module, v2.1.

STEP 1. Selection and analysis of land use change and land cover change data sources

The complete procedure is found in Annex 3.

At the end of the monitoring period:

- Forest cover maps for the project area and leakage belt were elaborated (see Annexes 6 and 7).
- The area of the forest and non-forest cover within the project area and leakage belt were obtained.

Table 4. Forest and non-forest cover area within the project area and leakage belt

Category	Forest cover (ha)	Non-forest cover (ha)
Project area	541 599.5	20.6
Leakage belt	189 993.24	7 503.81

STEP 2. Interpretation and analysis

Monitoring deforestation

The development of this step consisted in the estimation of the emissions produced due to deforestation within the project area and leakage belt for the years of execution running from July 1, 2011 to June 30, 2012 and 1 July 2012 to June 30, 2013. The estimate was developed following the applicability of the VMD0015 M-MON module, v2.1.

Emissions produced due to deforestation

$$\Delta C_{P,DefPA,i,t} = \sum_{u=1} (A_{DefPA,u,i,t} * \Delta C_{pools,P,Def,u,i,t}) \quad \text{(M-MON Equation 3)}$$

Where:

$\Delta C_{P,DefPA,i,t}$	net changes in carbon stocks as a result of deforestation in the case of the project, in the project area, i stratum in t time; tCO ₂ -e.
$A_{DefPA,u,i,t}$	registered deforestation in the project area, i stratum converted into u land use in t time; ha.
$\Delta C_{pools,P,Def,u,i,t}$	net changes in carbon stocks in all reservoirs in the case of the project, in u land use, i stratum and t time; t CO ₂ -e ha ⁻¹ .
$u = 1, 2, 3, \dots$	U post-deforestation land uses
$i = 1, 2, 3, \dots$	M stratum
$t = 1, 2, 3, \dots$	t* years since the implementation of the REDD project

Table 5. Net changes in carbon stocks in the project area

Project year	Strata	$A_{DefPA,u,t}$	$\Delta C_{pools,P,Def,u,t}$	$\Delta C_{P,DefPA,t}$
July 1, 2011 to June 30, 2012	Mixed Aguajal		267.59	-
	Alluvial floodplain		401.37	-
	Strong High Hill		541.69	-
	Soft High Hill		474.63	-
	Strong Low Hill		628.41	-
	Soft Low Hill		803.60	-
	High Terrace		474.93	-
	Low Terrace		531.69	-
	Strong Dissected Terrace		532.20	-
	Soft Dissected Terrace	4.44	377.53	1,677.08
July 1, 2012 to June 30, 2013	Mixed Aguajal			
	Alluvial floodplain			
	Strong High Hill			
	Soft High Hill			
	Strong Low Hill			
	Soft Low Hill			
	High Terrace			
	Low Terrace			
	Strong Dissected Terrace			
	Soft Dissected Terrace	4.44		1,677.08

Calculations are detailed in the "REDD project emissions (years old project 2011-2012 and 2012-2013).xls" spreadsheet and "Equations 3 and 4" sheet.

$$\Delta C_{P,DefLB,i,t} = \sum_{u=1} (A_{DefLB,u,i,t} * \Delta C_{pools,P,Def,u,i,t}) \quad (\text{M-MON Equation 4})$$

$\Delta C_{P,DefLB,i,t}$ = net changes in carbon stocks as a result of deforestation in the case of the project, in the project area and leakage belt, i stratum in t time; tCO₂-e.

$A_{DefLB,u,i,t}$ = registered deforestation area in the leakage belt area, i stratum converted into u land use in t time; ha.

$\Delta C_{pools,P,Def,u,i,t}$ = net changes in carbon stocks in all reservoirs in the case of the project, in u land use, i stratum and t time; t CO₂-e ha⁻¹

u = 1, 2, 3,... U post-deforestation land uses

i = 1, 2, 3,... M stratum

t = 1, 2, 3,... t* years since the implementation of the REDD project

Table 6. Net changes in carbon stocks in the leakage belt

Project year	Strata	$A_{DefLB,u,i,t}$	$\Delta C_{pools,P,Def,u,i,t}$	$\Delta C_{P,DefLB,i,t}$
July 1, 2011 to June 30, 2012	Alluvial floodplain	176.98	401.37	71,033.88
	Strong High Hill	17.91	541.69	9,699.26
	Soft High Hill	0.25	429.65	106.34
	Strong Low Hill	0.02	583.43	9.39
	Soft Low Hill	-	803.60	-
	High Terrace	189.11	474.93	89,813.21
	Low Terrace	422.48	531.69	224,628.50
	Strong Dissected Terrace	85.71	487.22	41,757.21
	Soft Dissected Terrace	191.41	377.53	72,261.59
July 1, 2012 to June 30, 2013	Alluvial floodplain	176.98	401.37	71,033.88
	Strong High Hill	17.91	541.69	9,699.26
	Soft High Hill	0.25	429.65	106.34
	Strong Low Hill	0.02	583.43	9.39
	Soft Low Hill	-	803.60	-
	High Terrace	189.11	474.93	89,813.21
	Low Terrace	422.48	531.69	224,628.50
	Strong Dissected Terrace	85.71	487.22	41,757.21
	Soft Dissected Terrace	191.41	377.53	72,261.59

Calculations are detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “Equations 3 y 4” sheet.

Changes in carbon content due to deforestation

$$\Delta C_{pools,Def,i,t} = C_{BSL,i} - C_{P,post,i} - C_{WP,i} \quad (\text{M-MON Equation 5})$$

Where:

$\Delta C_{pools,Def,u,i,t}$	net changes in carbon stocks in all reservoirs as a result of deforestation in the case of the project, in u land use, i stratum and t time; t CO ₂ -e ha ⁻¹ .
$C_{BSL,i}$	carbon stocks in all reservoirs for the baseline scenario, i stratum; t CO ₂ -e ha ⁻¹ .
$C_{P,post,u,i}$	post-deforestation carbon stocks in all reservoirs, u land use, i stratum; t CO ₂ -e ha ⁻¹ .
$C_{WP,i}$	sequestered carbon in wooden products extracted from i stratum; tCO ₂ -e ha ⁻¹
u = 1, 2, 3,...	U post-deforestation land use

$i =$ 1, 2, 3,... M stratum
 $t =$ 1, 2, 3,... t^* years since the implementation of the REDD project

Table 7. Net changes in carbon stocks for the project area, per stratum

Strata	$C_{BSL,i}$	$C_{P,post,i}$	$C_{WP,i} (*)$	$\Delta C_{pools,Def,i,t}$
Mixed Aguajal	267.59		0	267.59
Alluvial floodplain	401.37			356.39
Strong High Hill	541.69			541.69
Soft High Hill	474.63			474.63
Strong Low Hill	628.41			628.41
Soft Low Hill	803.60			803.60
High Terrace	474.93			429.95
Low Terrace	531.69			486.71
Strong Dissected Terrace	532.20	-		487.22
Soft Dissected Terrace	422.51	44.98		377.53

(*) Sequestered carbon for the wooden products is zero, as said reservoir has been considered as not significant in the PD.

Table 8. Net changes in carbon stocks for the leakage belt, per stratum

Strata	$C_{BSL,i}$	$C_{P,post,i}$	$C_{WP,i} (*)$	$\Delta C_{pools,Def,i,t}$
Alluvial floodplain	401.37	0	0	401.37
Strong High Hill	541.69	0		541.69
Soft High Hill	474.63	44.98		429.65
Strong Low Hill	628.41	44.98		583.43
Soft Low Hill	803.60	-		758.62
High Terrace	474.93	0		429.95
Low Terrace	531.69	0		531.69
Strong Dissected Terrace	532.20	44.98		487.22
Soft Dissected Terrace	422.51	44.98		377.53

(*) Sequestered carbon for the wooden products is zero, as said reservoirs have been considered as not significant in the PD.

Calculations are detailed in the "REDD project emissions years old project 2011-2012 and 2012-2013).xls" spreadsheet and "Equation 5" worksheet.

Post-deforestation carbon stocks

$$C_{post,u,i} = C_{AB_tree,i} + C_{BB_tree,i} + C_{AB_nom-tree,i} + C_{BB_{nom}-tree,i} + C_{DW,i} + C_{LI,i} + C_{SOC,PD-BSL,i}$$

(M-MON Equation 6)

Where:

- $C_{post,u,i}$ = post-deforestation carbon stocks in all reservoirs, u land use, i stratum; tCO₂-e ha⁻¹.
- $C_{AB_tree,i}$ = carbon stocks in aerial tree biomass in i stratum; tCO₂-e ha⁻¹.
- $C_{BB_tree,i}$ = carbon stocks in underground tree biomass in i stratum; tCO₂-e ha⁻¹.
- $C_{AB_nom-tree,i}$ = carbon stocks in aerial other vegetation biomass in i stratum; tCO₂-e ha⁻¹.
- $C_{BB_{nom}-tree,i}$ = carbon stocks in underground other vegetation biomass in i stratum; tCO₂-e ha⁻¹.
- $C_{DW,i}$ = carbon stocks in dead wood in i stratum; tCO₂-e ha⁻¹.
- $C_{LI,i}$ = carbon stocks in dead leaves in i stratum; tCO₂-e ha⁻¹.
- $C_{SOC,PD-BSL,i}$ = post-deforestation average carbon content in the organic carbon in the soil, i stratum; t CO₂-e ha⁻¹.
- $u = 1, 2, 3, \dots$ U post-deforestation land uses
- $i = 1, 2, 3, \dots$ M "with project" scenario strata

Within the project area, deforestation and subsequent land use change is aimed at developing agricultural activities; on the northwestern corner of the project area, deforestation due to mining is also registered, but for calculation purposes, it is not considered in the post-deforestation carbon for the mining stratum (which is zero) to have conservative results.

Agricultural activity:

$$C_{post,u,i} = C_{AB_tree,i} + C_{BB_tree,i} + C_{AB_nom-tree,i} + C_{BB_{nom}-tree,i} + C_{DW,i} + C_{LI,i} + C_{SOC,PD-BSL,i}$$

$$C_{post,u,i} = 31.19 + 13.79 + 0 + 0 + 0 + 0 + 0$$

$$C_{post,u,i} = 44.98 \text{ tCO}_2\text{-e}$$

For further detail see "Post-deforestation.xls" spreadsheet and "post-deforestation index" worksheet.

Monitoring forest degradation

✓ Degradation through extraction of trees for illegal timber

Degradation monitoring is performed according to the established procedure in Annex 5.

✓ **Monitoring degradation due to selective logging of forest management areas possessing a FSC certificate**

Does not apply because there is no FSC forest management areas within the project area, as these operations are incompatible with the objectives of the Protected Natural Areas found within the project area, according to the Project Description.

Monitoring areas undergoing natural disturbance

- Legal base

In Peru there is a system for natural disasters management. The National Disaster Risk System – SINAGERD was created with Law No. 29664. Article 1 mentions that it is an inter-institutional, synergistic, decentralized and participatory system, which aims to identify and reduce hazard associated risks or minimize their effects, as well as prevent the generation of new risks by establishing principles, policy guidelines, components, processes or instruments of the Disaster Risk Management.

Article 9 specifies that the National Institute of Civil Defense - INDECI is an integral part of SINAGERD. Article 13 defines the functions of INDECI, which are to develop, coordinate and facilitate the formulation and implementation of the National Plan for Disaster Risk Management.

By Supreme Decree No. 059-2001-PCM, Chapter IV, Article 57, it is established that INDECI is the responsible entity in charge of the programming, gathering and processing of statistical Civil Defense information; it also provides permanent, timely and up to date computer services and communications system of Civil Defense.

Considering the legal reference, it was deemed necessary to search INDECI's webpage in order to obtain information related to disturbances. Because of this, SINPAD is supported by a computer system under the Internet platform, the same that is composed of a series of a computer services, looking to register, maintain, access and use the Response and Rehabilitation information by all public or private institutions, as well as by the general public, actively interacting with members of SINAGERD.

From this web was downloaded the occurrence of events (natural or human-induced) on each district of Madre de Dios department, for the period from 2011 to 2013; this data was gathered by each Emergency Operations Centre COE (that works to a municipality level) and systemized in the National Information System for Response and Rehabilitation - SINPAD

From this database was selected information for the monitoring period from July 1st 2011 to June 30th 2013 for districts in which is located the project area (Tambopata and Inambari).
Revise table 9.

Table 9. Report of the Occurrences for period from July 1st 2011 to June 30th 2013

Code	Date	Phenomenon	District	Locality	Acts
46066	20/07/2011	Urban fire	Tambopata	Palmichal	The Palmiche
46931	16/09/2011	Urban fire		The Castañal	On the road Puerto Maldonado (Km 18)
46049	18/06/2011	Urban fire		Bajo Tambopata	In the community under Tambopata
46446	22/08/2011	Urban fire		Puerto Maldonado	Fire housing

48959	13/01/2012	Flooding	Inambari	Mazuko	Inambari River Flooding, number about 25 people isolated
50056	21/02/2012	Flooding	Tambopata	The Pilar	Flooding of large areas of cultivation and housing
52125	05/05/2012	Forest fire		Puerto Maldonado	Fire in the 5km road to Puerto Maldonado Tambopata right bank
53175	15/07/2012	Urban fire		Puerto Maldonado	Fire 2 homes, located in the city of Puerto Maldonado
53232	18/07/2012	Forest fire		The Joya	Burning a pasture alongside the soup kitchen in the Lomas
53253	19/07/2012	Forest fire		Puerto Maldonado	Fire in a pasture located in the Higher Pedagogical Institute Nuestra Señora del Rosario
53270	21/07/2012	Forest fire		Centro Pastora	Fire in a pasture on a farm
53336	25/07/2012	Forest fire		The Triunfo	Fire in a pasture in the Interoceanic Highway
53366	29/07/2012	Forest fire		The Triunfo	Fire in a pasture extension 1 ha located in the Triunfo
53410	01/08/2012	Forest fire		The Joya	Burning of a grassland area of 2 ha in private lands
53688	15/08/2012	Forest fire		The Pastora	Forest fire in a pasture of 0.4 ha extension
53728	20/08/2012	Forest fire		The Triunfo	Incendio forestal de un pastizal de extensión 1 ha
53782	22/08/2012	Forest fire		Puerto Maldonado	Forest fire in a pasture extension 1 has
53832	27/08/2012	Urban fire		Puerto Maldonado	Urban fire
53846	28/08/2012	Forest fire		The Pastora	Forest fire in a pasture extension 1 ha
53978	07/09/2012	Forest fire		Puerto Maldonado	Forest fire in a pasture of 0.3 ha extension
54040	08/09/2012	Forest fire		Samaria	Fire grassland extension 2 ha
54077	13/09/2012	Forest fire		The Joya	Forest fire in the picuros, city of Puerto Maldonado
54106	16/09/2012	Forest fire		Chorrillos	Forest fire in an area of 4 ha
54138	17/09/2012	Forest fire		The Pastora	1 Fire rural housing
54220	19/09/2012	Forest fire		The Prado	Forest fire in the town of the Prado
54407	27/09/2012	Forest fire		Centro Cachuela	Wildfire at km 10 of the highway Center Cachuela
54593	15/10/2012	Forest fire		Jorge Chavez	A house fire caused by burning farm
54720	23/10/2012	Urban fire	Inambari	Virgen the of Candelaria	Urban fire in the community of Virgen the of Candelaria
55197	28/11/2012	Forest fire	Tambopata	Puerto Maldonado	Forest fire in an area where the Naranjales
55605	25/12/2012	Urban fire		Puerto Maldonado	Fire housing in the city of Puerto Maldonado
55887	13/01/2013	Urban fire		Puerto Maldonado	Fire from a tap in the city Puerto Maldonado
56995	06/03/2013	Urban fire		Puerto Maldonado	Urban fire in a multifamily housing 33 rooms
57476	25/03/2013	Flooding	Inambari	Virgen the of Candelaria	The overflow of the gorge had Macaw flooding the population center Virgen the of Candelaria
59052	24/06/2013	Urban fire	Tambopata	Puerto Maldonado	Fire housing in the town of Puerto Maldonado

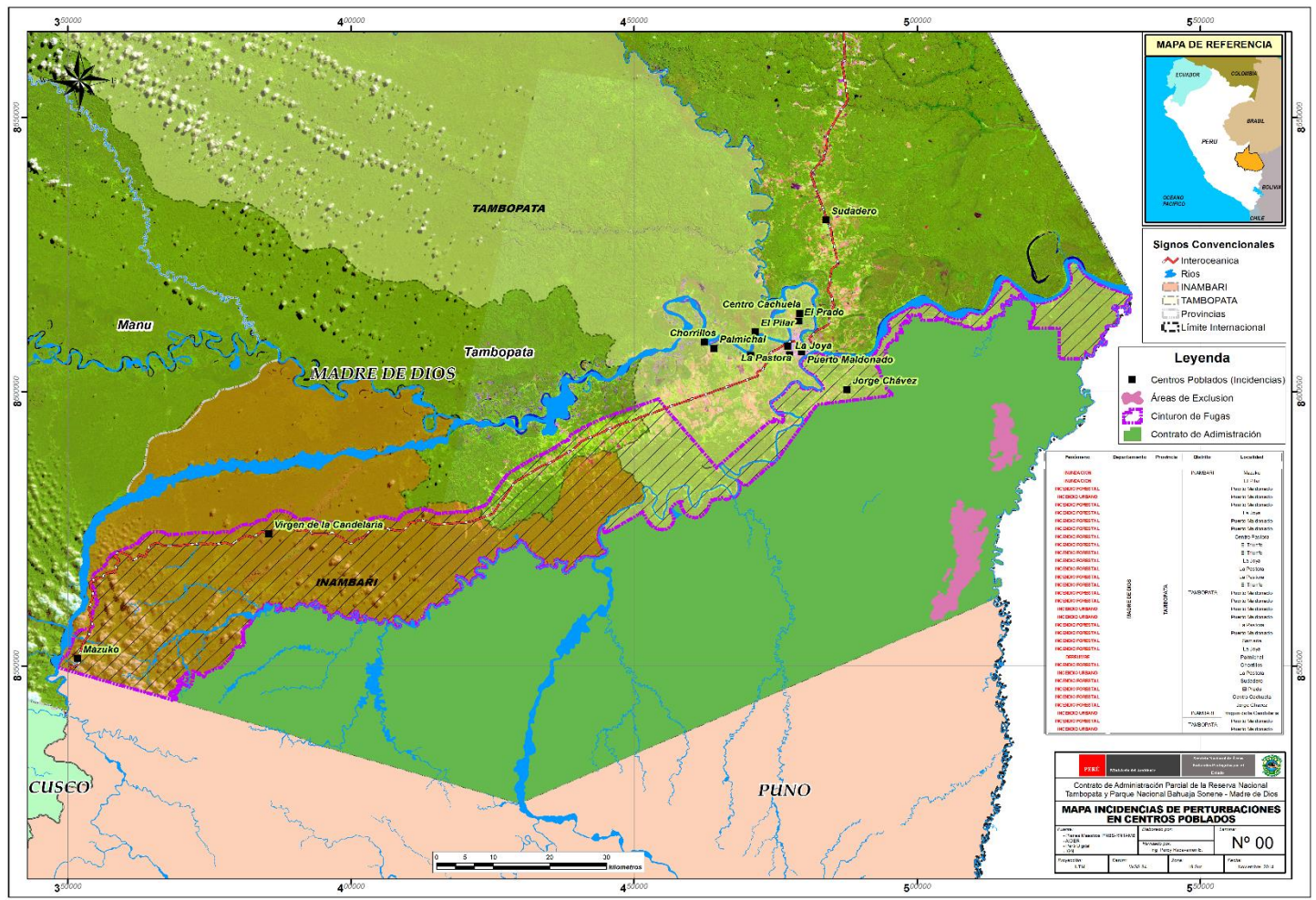


Figure 4. Disturbance locations related to populated areas in the districts for Tambopata and Inambari (July 1st 2011 to June 30th 2013)

According to data obtained from this official information source, inside the project area natural disturbances have not taken place, as tectonic activity (earthquake, landslide, volcano), pests, diseases that could result on a carbon stock degradation. As specified in module M-MON V2.1, any fire emissions were estimated using E-BB module (section Monitoring project emissions).

Monitoring areas undergoing carbon stock enhancement

Carbon stock enhancement due to forest re-growth has been omitted in a conservative way as specified on the project description.

Monitoring project emissions

The areas burned during monitoring period have been delineated, in order to calculate resulting emissions produced by fires, according to procedure indicated in module E-BB; burned areas mapping procedure can be found in annex 4.

$$B_{i,t} = (C_{AB_trees,i,t} + C_{DWit} + C_{LI,i,t}) * \frac{12}{44} * \left(\frac{1}{CF}\right) \quad \text{(Equation 2 de E-BB)}$$

Where:

$B_{i,t}$ = Average aboveground biomass stock before burning for stratum i, time t; tonnes d. m. ha⁻¹

$C_{AB_trees,i,t}$ = Mean aboveground biomass carbon stock in stratum i at time t; t CO₂-e ha⁻¹ (estimated using the CP-AB)

C_{DWit} = Carbon stock in dead wood for stratum i, at time t; t CO₂-e ha⁻¹ (estimated using CP-D)

$C_{LI,i,t}$ = Mean carbon stock in litter for stratum i, at time t; t CO₂-e ha⁻¹ (estimated using CP-L)

$\frac{12}{44}$ = Inverse ratio of molecular weight of CO₂ to carbon, t CO₂-e t C⁻¹

CF = Carbon fraction of biomass; t C t⁻¹ d.m. (default carbon fraction of biomass is 0.47 tC t⁻¹ d.m. (see also section III))

i = 1, 2, 3 ...M strata

t = 1, 2, 3, ... t* years elapsed since the start of the REDD project activity

Only there were identified areas burned in the stratum of soft dissected terrace. The area appears in the following table:

Table 10. Average aboveground biomass stock before burning for stratum

Project year	Strata	$C_{AB_trees,i,t}$	C_{DWit}	$C_{LI,i,t}$	$B_{i,t}$
July 1, 2011 to June 30, 2012	Soft Dissected Terrace	422.51	0	0	245.17
July 1, 2012 to June 30, 2013		422.51	0	0	245.17

Calculations are detailed in the "REDD project emissions (years old project 2011-2012 and 2012-2013).xls" spreadsheet and "Equation - burned" worksheet.

$$E_{BiomassBurn,i,t} = \sum_{g=1}^G (((A_{burn,i,t} * B_{i,t} * COMF_i * G_{g,i}) * 10^{-3}) * GWP_g)$$

(Ecuación 1 de E-BB)

Where:

$E_{BiomassBurn,i,t}$ = Greenhouse emissions due to biomass burning as part of deforestation activities in stratum i in year t; tCO₂-e of each GHG (CO₂, CH₄, N₂O)

$A_{burn,i,t}$ = Area burnt for stratum i at time t; ha

$B_{i,t}$ = Average aboveground biomass stock before burning stratum i, time t; tonnes d. m. ha⁻¹

$COMF_i$ = Combustion factor for stratum i; dimensionless (see annex 1 for default values as derived from Table 2.6 of IPCC, 2006)

$G_{g,i}$ = Emission factor for stratum i for gas g; kg t⁻¹ dry matter burnt (see section III and annex 2 for default values as derived from Table 2.5 of IPCC, 2006)

GWP_g = Global warming potential for gas g; t CO₂/t gas g (default values from IPCC SAR: CO₂ = 1; CH₄ = 21; N₂O = 310)

g = 1, 2, 3 ... G greenhouse gases (to include carbon dioxide¹, methane and nitrous oxide)

i = 1, 2, 3 ... M strata

t = 1, 2, 3, ... t* years elapsed since the start of the REDD project activity

Table 11. Emissions de GEI due to the burned biomass

Project year	Strata	$A_{burn,i,t}$	$B_{i,t}$	$COMF_i$	$G_{g,i}$	GWP_g	$E_{BiomassBurn,i,t}$
July 1, 2011 to June 30, 2012	Soft Dissected Terrace	1.17	245.17	0.5	6.80	25	12.15
					0.2	298	4.26
							16.41
July 1, 2012 to June 30, 2013	Soft Dissected Terrace	1.17	245.17	0.5	6.80	25	12.15
					0.2	298	4.26
							16.41

Calculations are detailed in the "REDD project emissions (years old project 2011-2012 and 2012-2013).xls" spreadsheet and "Equation - burned" worksheet.

$$GHG_{P,E,i,t} = E_{FC,i,t} + E_{BiomassBurn,i,t} + N_2O_{direct-N,i,t} \quad (\text{Ecuación 30 de M-MON})$$

Where:

$GHG_{P,E,i,t}$ = Greenhouse gas emissions as a result of deforestation activities within the project area in the project case in stratum i in year t; t CO₂-e

$E_{FC,i,t}$ = Emission from fossil fuel combustion in stratum i within the project area in year t; t CO₂-e

$E_{BiomassBurn,i,t}$ = Non-CO₂ emissions due to biomass burning in stratum i in year t; t CO₂-e

$N_2O_{direct-N,i,t}$ = Direct N₂O emission as a result of nitrogen application on the alternative land use in stratum i within the project area in year t; t CO₂-e

i = 1, 2, 3 ...M strata

t = 1, 2, 3 ...t* years elapsed since the start of the REDD VCS project activity

Table 12. Emission GEI from activities of the project

Project year	$E_{FC,i,t}$	$E_{BiomassBurn,i,t}$	$N_2O_{direct-N,i,t}$	$GHG_{P,E,i,t}$
July 1, 2011 to June 30, 2012	0	16.41	0	16.41
July 1, 2012 to June 30, 2013	0	16.41	0	16.41

The emission by burning of fossil fuels and application of fertilizers is considered to be insignificant, in agreement to the explained in the section 2.3 of the description of the project, for what for effects of the calculation they are equal to zero.

Calculations are detailed in the "REDD project emissions (years old project 2011-2012 and 2012-2013).xls" spreadsheet and "Equation - burned" worksheet.

- **Monitoring of changes in carbon stock and GHG emissions caused by leakage**

Relevant parameters for monitoring of leakage caused by activities shifting are found in section 3.2. Deforested areas at leakage belt are being monitored, trying, as much as possible, to cross information from ground- truth data with information of social monitoring at the different populations (according to Climate, Community & Biodiversity standards), to confirm that leakages are, effectively, attributable to the project activity.

- **Monitoring of measures to avoid deforestation and reduce risk of leakage**

The implementation of the Strategy to Reduce Emissions from Deforestation and Forest Degradation in Tambopata National Reserve (RNTAMB) and Bahuaja-Sonene National Park (PNBS)- Madre de Dios area is annually monitored; in this management document the project activities described on section 1.8 of PD.

Emissions that could result from project activities are considered insignificant, due to the selected technology level (see section 1.7 of PD) and the selected emissions sources (see section 2.3 of PD).

- **Estimation of net ex-post changes in carbon stocks and GHG emissions**

The estimation of net ex-post changes in carbon stocks will be conducted according methodology REDDMF. Calculations are detailed in the "REDD project emissions (years old project 2011-2012 and 2012-2013).xls".

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Net emissions for the reference scenario and the monitoring July 1, 2011 to June 30, 2012 and 1 July 2012 to June 30, 2013 they are of 264,117 tCO₂-e and 360,109 tCO₂-e, according to the specified calculations in the Project Description.

4.2 Project Emissions

Emissions produced due to the project's activities have been considered insignificant according to the justification given in section 2.3 of the Project Description.

Net emissions calculation

$$\Delta C_P = \sum_{t=1}^{t^*} \sum_{i=1}^M (\Delta C_{P,DefPA,i,t} + \Delta C_{P,Deg,i,t} + \Delta C_{P,DistPA,i,t} + GHG_{P-E,i,t} - \Delta C_{P,Enh,i,t}) \quad (\text{M-MON Equation 1})$$

Where:

ΔC_P = Net GHG emissions within the project area under the "with project" scenario, tCO₂-e.

$\Delta C_{P,DefPA,i,t}$ = Net change in carbon stocks as a result of deforestation in the case of the project, within the project area, *i* stratum and *t* time; t CO₂-e ha⁻¹.

$\Delta C_{P,Deg,i,t}$ = Net change in carbon stocks as a result of degradation in the case of the project, within the project area, *i* stratum and *t* time; t CO₂-e.

$\Delta C_{P,DistPA,i,t}$ = Net change in carbon stocks as a result of natural disturbances in the case of the project, within the project area, *i* stratum and *t* time; t CO₂-e.

$GHG_{P-E,i,t}$ = GHG emissions as a result of deforestation and degradation in the case of the project, within the project area, i stratum, t time; t CO₂-e.

$\Delta C_{P,Enh,i,t}$ = Net change in carbon stocks as a result of the growth of the forest and carbon sequestration during the project for areas that are expected to be deforested in the baseline, i stratum and t time; t CO₂-e.

i = 1, 2, 3,...M stratum.

t = 1, 2, 3,... t^* years since the implementation of the REDD project.

Table 13. Net GHG emissions within the project area under the “with project” scenario

Project year	Net changes in the carbon stocks due to deforestation (tCO ₂ -e) $\Delta C_{P,DefPA,i,t}$	Net changes in the carbon stocks due to degradation (tCO ₂ -e) $\Delta C_{P,Deg,i,t}$	Net changes in the carbon stocks due to natural disturbances (tCO ₂ -e) $\Delta C_{P,DistPA,i,t}$	GHG emissions due to project activities (tCO ₂ -e) $GHG_{P-E,i,t}$	Net changes in the carbon stocks due to forest growth and carbon sequestration (tCO ₂ -e) $\Delta C_{P,Enh,i,t}$	GHG emissions within the project area (tCO ₂ -e) ΔC_P
July 1, 2011 to June 30, 2012	1,677.08	0	0	16.41	0	1,677.08
July 1, 2012 to June 30, 2013	1,677.08	0	0	16.41	0	1,677.08

Emissions produced due to forest degradation were zero because there was no indication of degradation found for the years 2011-2012 and 2012-2013 (annex 5 describes the whole degradation study process according to the methodology).

Areas under natural disturbances have not been registered during the monitoring period, so this factor is equal to zero; further details are in step 2, "Monitoring of areas under natural disturbances".

The emissions of fires is 16.41 for each monitoring year, these are considered insignificant because representing less than 5% of the net benefits of the project for the 2011-2012 and 2012-2013 years, so they have not been considered in the final calculation (see “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “Equations 1-2” and “significance” worksheets).

Carbon increases are conservatively omitted according to the specified in the Project Description.

Increases of carbon are omitted conservatively, according to the specifications in the Project Description, leaving only the sum total of net GHG emissions within the project area for each year the monitoring is 1,677.08, result of deforestation in the project area.

4.3 Leakage

Emissions produced due to leaks have been considered equal to zero, according to the procedure of the methodology.

$$\Delta C_{P, LB} = \sum_{t=1}^t \sum_{i=1}^M \Delta C_{P, DefLB, i, t} \quad \text{(M-MON Equation 2)}$$

Where:

$\Delta C_{P, LB}$ = Net GHG emissions in the leakage belt in the case of the project; t CO₂-e.

$\Delta C_{P, DefLB, i, t}$ = Net change in carbon stocks as a result of deforestation in the case of the project, in the leakage belt, *i* stratum and *t* time; t CO₂-e.

i = 1, 2, 3, ... M strata in the “with project” scenario.

t = 1, 2, 3, ... *t** years since the implementation of the REDD project.

Table 14. Net GHG emissions in the leakage belt in the case of the project

Project year	Net GHG emissions in the leakage belt (tCO ₂ -e) $\Delta C_{P, LB}$
July 1, 2011 to June 30, 2012	509,309.38
July 1, 2012 to June 30, 2013	509,309.38

Calculations are detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “Equations 1-2” worksheet.

Emissions calculation due to deforestation displacement from the project area to the leakage belt

$$\Delta C_{LK-ASU-LB} = \Delta C_{P, LB} - \Delta C_{BSL, LK, unplanned} \quad \text{(LK-ASU Equation 1)}$$

Where:

$\Delta C_{LK-ASU-LB}$ = Net CO₂ emissions due to unplanned deforestation displaced from the project area to the leakage belt; t CO₂-e.

$\Delta C_{P, LB}$ = Net GHG emissions within the leakage belt in the “with project” scenario; tCO₂-e.

$\Delta C_{BSL, LK, unplanned}$ = Net CO₂ emissions in the baseline scenario due to unplanned deforestation in the leakage belt; t CO₂-e.

If $\Delta C_{LK-ASU-LB}$ is <0 then $\Delta C_{LK-ASU-LB}$ will be established as 0 (to prevent a positive leak).

Table 15. Net CO₂ emissions due to unplanned deforestation displaced from the project area to the leakage belt

Project year	Net emissions within the leakage belt (tCO ₂ -e) $\Delta C_{P,LE}$	Net emissions in the reference scenario due to deforestation in the leakage belt (tCO ₂ -e) $\Delta C_{BSL,LK,unplanned}$	Net due to unplanned deforestation displaced from the project area to the leakage belt (tCO ₂ -e) $\Delta C_{LK-ASU-LB}$
July 1, 2011 to June 30, 2012	509,309.38	4,528,069.32	-4,018,759.94
July 1, 2012 to June 30, 2013	509,309.38	4483261.441	-3,973,952.06
			0

Calculations are detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “Real leaks” worksheet.

Ex-post estimate of the total deforested area due to immigrant agents

Ex post, the ratio of the total area deforested by immigrant agents in the “with project” scenario will be determined from the same ratio calculated with baseline data. It is assumed that the proportional area deforested by immigrant agents in baseline and “with project” scenarios remains the same.

$$A_{LK-IMM,T} = PROP_{IMM} * A_{BSL,PA,unplanned,t} \quad (\text{LK-ASU Equation 7})$$

Where:

$A_{LK-IMM,T}$ = Total deforested area due to immigrant agents in the baseline and “with project” scenarios in t time; ha.

$PROP_{IMM}$ = Ratio of the deforested area due to immigrant agents in the leakage belt and project area; ratio.

$A_{BSL,PA,unplanned,t}$ = Expected area for unplanned deforestation baseline in the project area on t time; ha.

t = 1, 2, 3...t* years since the implementation of the REDD VCS project.

Table 16. Total deforested area due to immigrant agents in the reference scenario and “with project” scenario.

Project year	Ratio of deforested area due to immigrant agents in the leakage belt and project area $PROP_{IMM}$	Expected area for unplanned deforestation baseline in the project area (ha) $A_{BSL,PA,unplanned,t}$	Total deforested area due to immigrant agents in the baseline and “with project” scenarios (ha) $A_{LK-IMM,T}$
July 1, 2011 to June 30, 2012	0.187	577.92	108.07
July 1, 2012 to June 30, 2013	0.187	792.52	148.20

Calculations are detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “Baseline IMM. agents” worksheet.

Calculation of the deforested area due to immigrants in the project area and leakage belt

$$A_{LK-ACT-IMM,t} = PROP_{IMM} * (\sum_{i=1}^M A_{DefPA,i,t} + A_{DefLB,i,t}) \quad \text{(LK-ASU Equation 8)}$$

Where:

$A_{LK-ACT-IMM,t}$ = Deforested area due to immigrants in the project area and leakage belt under the “with project” scenario in t time; ha.

$PROP_{IMM}$ = Ratio of deforested area due to immigrants in the project area and leakage belt; ratio.

$A_{DefPA,i,t}$ = Deforested area registered for the project area under the “with project” scenario in i stratum and t time; ha.

$A_{DefLB,i,t}$ = Deforested area registered for the leakage belt under the “with project” scenario in i stratum and t time; ha.

i = 1, 2, 3,...M stratum for the “with project” scenario.

t = 1, 2, 3...t* years since the implementation of the REDD VCS project.

Table 17. Deforested area due to immigrants in the project area and leakage belt

Project year	Ratio of deforested area due to immigrants in the project area and leakage belt $PROP_{IMM}$	Deforested area registered for the project area (ha) ⁵ $A_{DefPA,t}$	Deforested area registered for the leakage belt (ha) ⁶ $A_{DefLB,t}$	Deforested area due to immigrants in the project area and leakage belt (ha) $A_{LK-ACT-IMM,t}$
July 1, 2011 to June 30, 2012	0.187	4.44	1,083.85	203.51
July 1, 2012 to June 30, 2013	0.187	4.44	1,083.85	203.51

Calculations are detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “IMM. Agents activity” worksheet.

Calculation of the deforested area due to immigrants outside of the project area and leakage belt

$$A_{LK-OLB,t} = A_{LK-IMM,t} - A_{LK-ACT-IMM,t} \quad \text{(LK-ASU Equation 9)}$$

Where:

$A_{LK-OLB,t}$ = Deforested area due to immigrants outside of the project area and leakage belt under the “with project” scenario in t time; ha.

$A_{LK-IMM,t}$ = Total deforested area due to immigrant agents in the baseline and “with project” scenarios in t time; ha.

$A_{LK-ACT-IMM,t}$ = Deforested area due to immigrants in the project area and leakage belt under the “with project” scenario in t time; ha

$t = 1, 2, 3 \dots t^*$ years since the implementation of the REDD VCS project

5 Fuente: Anexo IV

6 Fuente: Anexo IV

Table 18. Deforested area due to immigrants outside of the project area and leakage belt

Project year	Total deforested area due to immigrants in the baseline and “with project” scenarios (ha) $A_{LK-IMM,t}$	Deforested area due to immigrants in the project area and leakage belt under the “with project” scenario (ha) $A_{LK-ACT-IMM,t}$	Deforested area due to immigrants outside of the project area and leakage belt (ha) $A_{LK-OLB,t}$
July 1, 2011 to June 30, 2012	108.07	203.51	-95.44
July 1, 2012 to June 30, 2013	148.20	203.51	-55.31
			0

Calculations are detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “Outside of the leakage belt” worksheet.

Determining if there have been leaks outside of the leakage belt

If: $A_{LK-OLB,t} \leq 0 \rightarrow$ there have been no leaks outside of the leakage belt.

If: $A_{LK-OLB,t} > 0 \rightarrow$ there have been leaks outside of the leakage belt.

If there have been no leaks outside of the leakage belt:

$$\Delta C_{LK-ASU-OLB} = 0$$

Where:

$\Delta C_{LK-ASU-OLB}$ = Sum of the changes in carbon stocks and GHG emissions due to unplanned deforestation displacement outside of the leakage belt; t CO₂-e.

Total leakage estimate due to displacement of unplanned deforestation (LK-ASU STEP 6)

$$\Delta C_{LK-AS,unplanned} = \Delta C_{LK-ASU-LB} + \Delta C_{LK-ASU-OLB} + GHG_{LK,E} \quad (\text{LK-ASU Equation 13})$$

$\Delta C_{LK-AS,unplanned}$ = Net GHG emissions due to leaks for displacement of activities for projects preventing unplanned deforestation; t CO₂-e

$\Delta C_{LK-ASU-LB}$ = Net CO₂ emissions due to unplanned deforestation displaced from the project area to the leakage belt; t CO₂-e.

$\Delta C_{LK-ASU-OLB}$ = Net CO₂ emissions due to unplanned deforestation displaced outside of the leakage belt; t CO₂-e.

$GHG_{LK,E}$ = GHG emissions from leaks of activities to prevent deforestation; t CO₂-e.

Table 19. Net GHG emissions due to leaks for displacement of activities.

Project year	Emissions due to deforestation displacement from the project area to the leakage belt $\Delta C_{LK-ASU-LB}$	Emissions due to deforestation outside of the leakage belt $\Delta C_{LK-ASU-OLB}$	GHG emissions from activities that prevent deforestation (*) $GHG_{LK,E}$	Net GHG emissions due to leaks related to displacement of activities (t CO ₂ -e) $\Delta C_{LK-ASunplanned}$
July 1, 2011 to June 30, 2012	0	0	0	0
July 1, 2012 to June 30, 2013	0	0	0	0

(*) As the activities of the project will not produce significant emissions, this parameter is equal to zero.

Calculations are detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “Significant” and “Emissions-leaks-displace-act” worksheet.

Calculation of net emissions due to leaks

$$\Delta C_{LK} = \Delta C_{LK-AS-planned} + \Delta C_{LK-AS-unplanned} + \Delta C_{LK-AS,des rad-FW/C} + \Delta C_{LK-ME}$$

(REDD-MF Equation 3)

ΔC_{LK} = Net GHG emissions due to leaks; t CO₂-e

$\Delta C_{LK-AS-planned}$ = Net GHG emissions due to leaks from displacement of activities for projects preventing planned deforestation; t CO₂-e (from LK-ASP) Note: this parameter is equal to zero for not presenting planned deforestation.

$\Delta C_{LK-AS-unplanned}$ = Net GHG emissions due to leaks from displacement of activities for projects preventing unplanned deforestation; t CO₂-e (from LK-ASU).

$\Delta C_{LK-AS,des rad-FW/C}$ = Net GHG emissions due to leaks from displacement of activities for degradation caused by fuel wood extraction; t CO₂-e (from LK-DFW). Note: this parameter is equal to zero for not presenting a significant firewood and coal extraction

ΔC_{LK-ME} = Net GHG emissions due to market effect leaks; t CO₂-e (from LK-ME). Note: As these leaks have been considered not significant in the PD, this parameter is equal to zero.

Table 20. Net GHG emissions due to leaks

Project year	Emissions due to leaks for APD projects $\Delta C_{LK-AS-planned}$	Emissions due to leaks for AUD projects $\Delta C_{LK-AS-unplanned}$	Emissions due to degradation leaks (coal and firewood extraction) $\Delta C_{LK-AS,des rad-FW/C}$	Emissions due to market effect leaks (*) ΔC_{LK-ME}	Net GHG emissions due to leaks (tCO ₂ -e) ΔC_{LK}
July 1, 2011 to June 30, 2012	0	0	0	0	0
July 1, 2012 to June 30, 2013	0	0	0	0	0

(*) Considered zero according to the justification given in the Project Description

Calculations are detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013).xls” spreadsheet and “Net leaks emissions” worksheet.

4.4 Net GHG Emission Reductions and Removals

$$C_{REDD,t} = \Delta C_{BSL} - \Delta C_P - \Delta C_{LK} \quad (\text{REDD-MF Equation 1})$$

$C_{REDD,t}$ = Net total GHG emissions reduction in t time; tCO₂-e

ΔC_{BSL} = Net GHG emissions in the baseline scenario; t CO₂-e

ΔC_P = Net GHG emissions within the project area in the “with project” scenario; tCO₂-e (from M-MON)

ΔC_{LK} = Net GHG emissions due to leaks; t CO₂-e

Table 21. Net total emissions reductions for the monitoring period

Project year	Baseline emissions or removals (tCO ₂ e) ΔC_{BSL}	Project emissions or removals (tCO ₂ e) ΔC_P	Leakage emissions (tCO ₂ e) ΔC_{LK}	Net GHG emissions reduction or removal (tCO ₂ e) $C_{REDD,t}$
July 1, 2011 to June 30, 2012	264,117	1,677	-	262,440
July 1, 2012 to June 30, 2013	360,109	1,677	-	358,432
Total	624,226	3,354	-	620,872

The ex post uncertainty analysis in the “with project” scenario was performed. The calculation is detailed in the “REDD project emissions (years old project 2011-2012 and 2012-2013) having as a result 13.40 %. It has not generated uncertainty discount.

The amount of Voluntary Carbon Units (VCUs) can be seen in Table 22; for this calculation, the net annual emissions reductions were subtracted a 13%, which is the credit reservation for non-permanence risk, calculated according to the AFOLU Non-permanence Risk Tool (VCS Version 3). The development of the tool and the calculation of the reservation can be found in Annex III.

Table 22. Voluntary Carbon Units

Project year	Net GHG emissions reduction (tCO ₂ -e)	AFOLU pooled buffer account (13%)	Voluntary Carbon Units
July 1, 2011 to June 30, 2012	262,440	34,118	228,322
July 1, 2012 to June 30, 2013	358,432	46,597	311,835
Total	620,872	80,715	540,157

ANNEXS

Annex 1. List of Project Activities Period (2011-2013)
Annex 2. VCS Non-Permanence Risk Report
Annex 3. Deforestation Monitoring Report Period (2011-2013)
Annex 4. Burned Areas Monitoring Period (2011-2013)
Annex 5. Degradation Monitoring Period (2011-2013)
Annex 6. Project Area Monitoring Map 2011-2013
Annex 7. Leakage Belt Monitoring Map 2011-2013
Annex 8. SOP Deforestation Monitoring
Annex 9. SOP Burning Monitoring
Annex 10. SOP Forest Degradation Monitoring
Annex 11. SOP Information storage
Annex 12. Forest_Non Forest Cover Map July 2013
Spreadsheet - REDD Project Emissions (years old project 2011-2012 and 2012-2013).xls
Uncertainty Calculation
VCS Risk Report Calculation Tambopata