CORDILLERA AZUL NATIONAL PARK REDD PROJECT

2015 CLIMATE MONITORING REPORT

Document Prepared By

Centro de Conservación, Investigación y Manejo de Áreas Naturales CIMA - Cordillera Azul

Lima, Peru

with technical assistance from TerraCarbon, LLC, Peoria, IL, USA

Project Title	Cordillera Azul National Park REDD+ Project
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Table of Contents

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

To best understand the implementation of the Cordillera Azul National Park (PNCAZ) REDD+ project between 8 August 2014 and 7 August 2015, and the status of project activities, a brief chronological history of CIMA's legal obligations for the management of the PNCAZ follow:

- 8 August 2008: CIMA signed a contract with the Peruvian government for Total Management of the PNCAZ, a state-owned Natural Protected Area (ANP).
- 9-11 September 2013: On the recommendation of the Monitoring Committee of the PNCAZ Management Contract, a "Five-Year Planning Workshop for the Total Operations Management Agreement for PNCAZ" was held in Lima to review (a) the results of the five-year period 2008-2013 and (b) the proposed 2014-2018 five-year plan.
- 6 November 2013: CIMA and SERNANP signed a contract addendum which modifies Annex C: "Expected Results 2008-2013" of this Service Agreement.
- 29 November 2013: The executant of the Administration Contract sent to SERNANP the proposed Five-Year Work Plan and Budget for the period between January 2014 and December 2018.
- 10 March 2014: The Five-Year Work Plan and Budget received approval by the Management Department for Protected Natural Areas (DGANP-SERNANP).
- 12 November 2014: CIMA and Althelia Climate Fund (GCF), with the authorization of SERNANP, signed a contract for financing the operations of PNCAZ and its buffer zone, compromising 8 million VCUs.

Implementation status of the PNCAZ REDD+ project

The Cordillera Azul REDD+ Project was jointly validated and verified against Verified Carbon Standard Version 3, by SCS Global Services:

- Validation and Verification Approved, February 1, 2013

Additionally, the project was validated against the Climate, Community and Biodiversity Standard, Second Edition, Biodiversity Gold Level, by SCS Global Services and verified by Rainforest Alliance:

- Validation Approved, February 19, 2013;
- Verification Approved, March 21, 2014;
- Verification Approved, January 04, 2016.

Total GHG emission reductions or removals

This monitoring report uses the convention that the project year is the year at the end of the annual interval, i.e. the project year 2015 is 8 August 2014 to 7 August 2015. The total GHG emission reductions or removals generated during the one year period of this monitoring report was **3,374,248 tCO2-e** (when deductions for risk buffer were also included, the available verified carbon units were **3,036,823 tCO2-e**. An explication of this calculation is found in this document, Table 4.4.3.

1.2 Sectoral Scope and Project Type

Project Scope 14: Agriculture, Forest and other Land Use (AFOLU);
Project Category: Reduction Emission from Deforestation and Degradation (REDD);
Type of Activity: Avoided Unplanned Deforestation (AUDD).
The project is not a grouped project.

1.3 Project Proponent

Organization name	Centro de Conservación, Investigación y Manejo de Áreas Naturales – Cordillera Azul (CIMA-Cordillera Azul)
Contact person	Patricia I. Fernández-Dávila M.
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1.4 Other Entities Involved in the Project

Organization name	TerraCarbon LLC
Role in the project	Provide technical assistance in the application of REDD methodologies and development of portions of the project documentation
Contact person	David Shoch
Title	Director, Forestry and Technical Services
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1.5 Project Start Date

The project start date is 8 August 2008.

1.6 Project Crediting Period

The project crediting period is 20 years, extending from 8 August 2008 to 7 August 2028.

1.7 Project Location

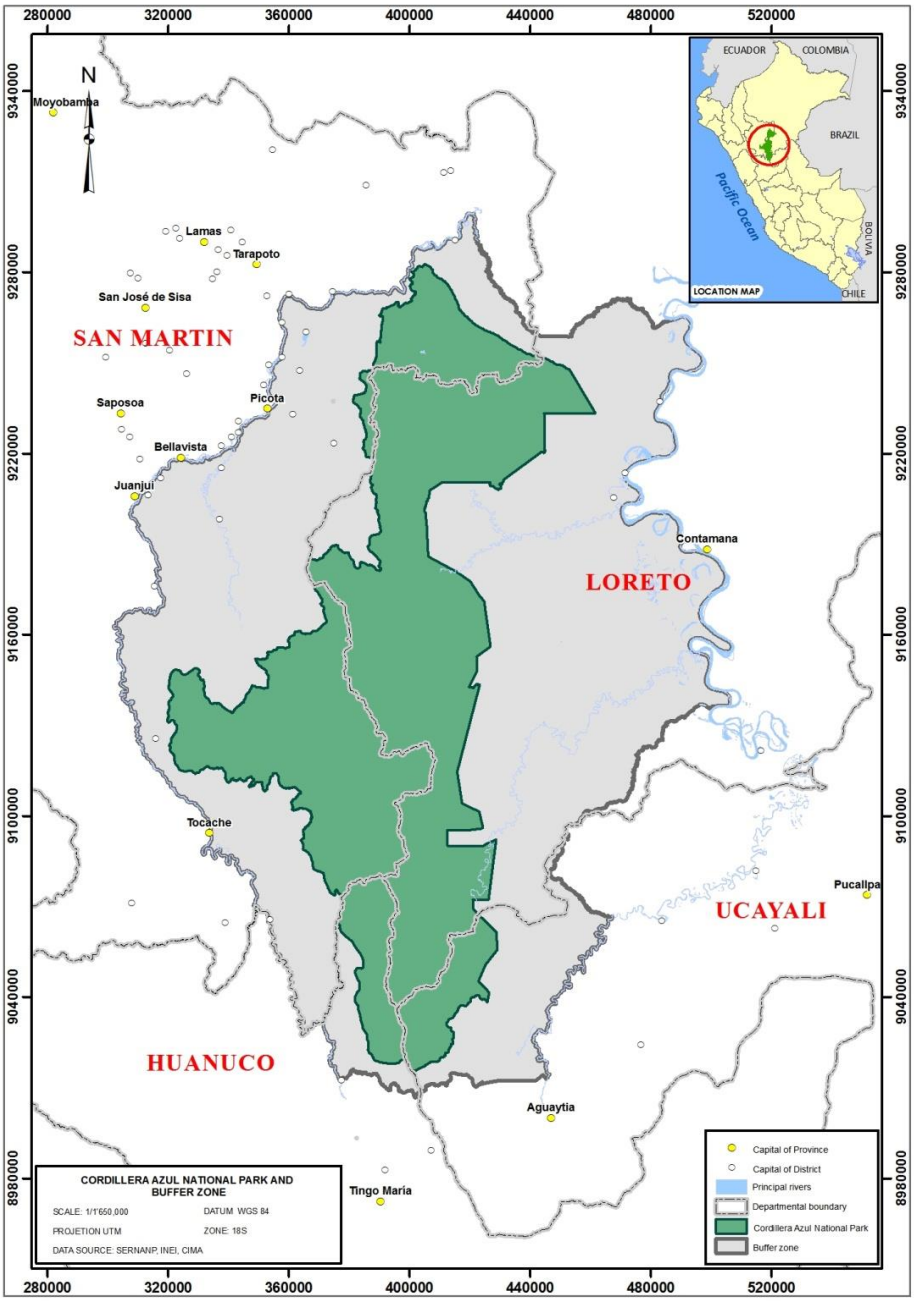
The project consists of the area within the boundaries of the PNCAZ owned by the government of Peru. The limits of the park were defined in the official *Supreme Decree No. 031-2001-AG*, and lie between 06°29'13.3" - 08°54'07.5" South and 75°20'52.3" - 76°24'17.4" West. The park has an area of 1,353,190.85 hectares as defined in the Supreme Decree and an approximate perimeter of 974 km. A small amount of land within the park is privately owned, so the project area is 1,351,963.85 hectares and covers portions of seven provinces in four departments in the Republic of Peru, San Martín, Ucayali, Huánuco, and Loreto. Note that by mistake the supreme decree names only six provinces; however, subsequent documents for management of the area (the "master plans") name all seven provinces. Additional information regarding the private land owners is located in Section 1.10.4. Figure 1.1 is a map of the project area and buffer zone.

The park's buffer zone was provisionally delineated by the Peruvian government in the Resolución Jefatural Nº 314-2001-INRENA on 13 December 2001, covering 2,061,259.79 hectares. In June of 2007, INRENA passed a resolution (Resolución Jefatural Nº 144-2007-INRENA) amplifying the buffer zone to more than 2.3 million hectares and making official the

limits proposed in the Plan Maestro 2003-2008 (Resolución Jefatural Nº 245-2004-INRENA). Finally, in 2011, through the Resolución Presidencial Nº 064-2011-SERNANP that approved the Plan Maestro 2011–2016 (SERNANP 2012), the buffer zone limits were adjusted once more, now to 2,303,414.75 hectares.

Figure 1.1: Project Map and Location in 2014

Map of the PNCAZ project area (shaded in green) and its buffer zone (shaded in grey). The project zone consists of the entire shaded area (project area and buffer zone). The inset shows the park's location in central Peru.



1.8 Title and Reference of Methodology

The methodology used to quantify the avoided emissions is the framework and component modules of the modular REDD methodology VM0007 REDD Methodology Modules Version 1.3 approved 20 November 2012.

This project uses the following modules and tools:

VM0007 REDD Methodology Module, REDD Methodology Framework (REDD-MF), version 1.3

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

CP-D "VMD0002 Estimation of carbon stocks in the dead-wood pool", version 1.0;

BL-UP "VMD0007 Estimation of baseline carbon stock changes and greenhouse gas emissions from unplanned deforestation", version 3.1;

LK-ASU "VMD0010 Estimation of emissions from activity shifting for avoided unplanned deforestation", version 1.0;

E-BB "VMD0013 Estimation of greenhouse gas emissions from biomass burning", version 1.0;

M-MON "VMD0015 Methods for monitoring of greenhouse gas emissions and removals" version 2.1;

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

X-UNC "VMD0017 Estimation of uncertainty for REDD project activities" version 2.0;

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;

T-BAR "Tool for AFOLU non-permanence risk analysis and buffer determination", version 3.1;

T-SIG CDM "Tool for testing significance of GHG emissions in A/R CDM project activities", version 1.0.

1.9 Other Programs

The avoided emissions from this project will not be used for compliance purposes in a regional or national compliance program or to demonstrate conformance with a binding limit on GHG emissions. Neither Peru nor regional or local governments have established a national target, a compliance program or a cap and trade system.

This project is only seeking registration under the VCS and CCB programs. CCB does not issue carbon credits and the project is not seeking to register credits with any other program.

This project has not and will not seek to generate any other form of environmental credit.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

A full description of the implementation status, outcomes and impacts of REDD+ project activities during this monitoring period are presented in the CCB Project Implementation Document (PIR); a summary of Goals and Objectives is presented below in Table 2.1, and detail of project activities, outputs, outcomes, and climate, community and biodiversity impacts are presented below in Table 2.2.

These activities were proposed by CIMA in its Five Year Work Plan in March 3rd, 2014 (Carta N° 014-2014-CIMA-DE) and approved by DGANP-SERNANP in March 10th 2014 (Carta N° 107-2014-SERNANP-DGANP).

Table 2.1. Summary of PNCAZ REDD+ project Goals and Objectives for the period 8 August 2014 to 7 August 2015

Goal 1: Protecting the park, maintaining its conservation targets and continuing work towards the recovery of degraded areas
Objective 1: The PNCAZ remains undamaged its conservation targets and continues the recovery of degraded areas.
Objective 2: PNCAZ and its buffer zone have become a place of research of global importance which gathers researchers/scientists and contributes to the management of natural protected areas.
Goal 2: Building local capacity for sustainable land use and improving the quality of life in buffer zone communities, expanding benefits for local people without causing negative impacts on the protected area, promoting land-use planning with support of regional and local governments, contributing to improved quality of life of neighboring populations through benefits generated by PNCAZ conservation.
Objective 3: Tourism promoted in PNCAZ's buffer zone has expanded benefits for local people without causing negative impacts to the protected area
Objective 4. Land-use planning is promoted in the "intervention areas" of the PNCAZ's buffer zone with the support of Regional and Local Governments
Objective 5. PNCAZ conservation contributes to improving the quality of life of neighboring populations through the benefits generated, especially those located in the intervention areas established in the Master Plan.
Goal 3: Strengthening relationships with local, regional and national government agencies, in order to insure PNCAZ's long-term and proper management, considering governance and administration.
Objective 6: Administration fee and distribution of carbon revenues
Objective 7: Government relations and fundraising

Table 2.2. PNCAZ REDD+ project activities, outputs, outcomes, and climate, community and biodiversity impacts for the period Aug 2014-Aug 2015

GOAL 1: Protecting the park, maintaining its conservation targets and continuing work towards the recovery of degraded areas.					
Objective 1: The PNCAZ remains undamaged its conservation targets and continues the recovery of degraded areas.					
Activities	**Outputs**			**Outcomes**	**Impacts**
	Units	**Number**			
		Aug-Dic 2014	Jan-Jul 2015		
1.1.1: Park Guards perform effective protection in PNCAZ	Patrols	105 (T3) 96 (T4)	103 (T1) 124 (T2)	Park Guard patrols and infrastructure maintenance were fully met as per annual plans. It was expected to carry out at least 400 patrols / year, but 428 patrols were done.	1.1 The PNCAZ's ecosystems remain intact.
1.1.2: Development and implementation of a Maintenance Plan for PNCAZ Control Posts including restoring/repairing infrastructure and equipment	Maintenance Plan	1			
	Control Posts	21	21		
1.1.3: Training for Park Guards and technical staff	Courses and training events	1	1	2014: Leadership and Management Skills for the Administration of Protected Areas Workshop 2015: Exchange training between PNCAZ and BPAM *Note*: Official Park Guards provide continuous training to Community Park Guards as part of their regular activities	
1.1.4: Monitoring the vegetation cover of PNCAZ with GIS support	Annual Report	1		Monitoring was carried out by GIS specialists with satellite data that was ground-truthed by Park Guards	
1.2.1: Control and surveillance	Quarterly reports	2	2	Monthly Park Guard reports were organized by staff as inputs for reports to SERNANP. Note: Since 2013, the indicator changed from counting monthly reports from each control post to consolidated quarterly or trimester reports prepared by the Director of the PNCAZ.	1.2. The conservation status of principal game species is maintained in the permitted hunting areas within the PNCAZ.

1.2.2 Wildlife observation reports from data collected by Park Guards	Wildlife reports	1	1	CIMA analyzed wildlife information annually, based on observations in monthly Park Guard reports; these data are presented in reports to SERNANP	
1.2.3 Hunting reports based on data records of hunters in the PNCAZ	Benefits reports	162 (T3) 100 (T4)	140 (T1) 9 (T2)	Data on hunting in the park was analyzed annually: 411 beneficiaries from PNCAZ's wildlife *Note*: The indicator used to evaluate hunting demand was changed to consider wildlife as a benefit from the park to buffer zone residents.	
1.3.1 Legal proceedings to evict illegal cattle rancher in park	Legal Report	1		The one cattle farmer within the park has still not been evicted. The legal process continues, led by SERNANP. CIMA will support livestock removal once this case is resolved.	1.3. Processes documented of natural vegetation recovery at sites disturbed by human activity.
1.3.2: Court-ordered evacuation of livestock	Livestock removal report	0			
1.3.3: Monitoring natural regeneration at disturbed sites	Disturbed site recovery report	1		Disturbed sites monitored by GIS specialists using satellite data and ground-truthed by Park Guards	

Objective 2: PNCAZ and its buffer zone have become a place of research of global importance which gathers researchers/scientists and contributes to the management of natural protected areas.

Activities	Outputs			Outcomes	Impacts
	Units	Number			
		Aug-Dic 2014	Jan-Jul 2015		
2.1.1: Development of research involving the PNCAZ team	Research projects	4	7	More than 11 research projects were carried out during the period of this evaluation. *Note*: The research goal of the initial contract was 2 projects/yr and in 2014 this was increased to 5/yr.	2.1. PNCAZ research priorities are known and attractive to scientists who are able to finance their own research.
2.1.2 Promotion of PNCAZ and its buffer zone as an opportunity for research.	Research dissemination events	2	2	Updating CIMA's web page. CIMA shares research information with SERNANP, Althelia, GiZ and researchers (i.e. Duke U.) Research carried out in the PNCAZ were presented as case studies in Peruvian university courses at least once a year.	

2.1.3 Development of a Research Strategy with the PNCAZ team (SERNANP, CIMA, PNCAZ's Management Committee).	Workshops and meetings	---		A Research Plan exists that is a supporting document of the Master Plan. An updated strategy to better promote research in the park is necessary. In 2016 the PNCAZ will start updating the Master Plan 2017-2022, based on new parameters.	
2.2.1: Periodic update of social and environmental databases in the project area.	Database with updated records	1	1	Geo-referenced social and biological information is available (2 databases) *Note*: A consultancy was carried out in 2013 to determine ways to improve the social and environmental database. Some suggestions have been implemented, but information continues to be managed in traditional fashion, until have a policy from SERNANP for handling information.	2.2. Research topics respond to identified priorities, and results and recommendations are taken into account in decision making for PNCAZ management.
2.2.2 Research dissemination events	Meeting minutes	1	1	2014: Pre-COP20 Event: From Science to Policy: Contributios from Science to cope with Climate Change, where the information stemming from the PNCAZ's REDD+ Project and the results from the camera trap fauna evaluation were presented (2 posters). 2014-2015: Land Use Zoning results were shared with communities where this work was carried out to improve land-use decision-making, especially as it relates to community strategic planning. All Land Use Zoning information and results were made available to technicians as well as all community members.	
2.2.3: Information analysis is incorporated into management documents that are available to the technical team and communities.	Reports	2	1		
2.3.1: Promote the participation of local people in research activities.	Events	3	3	2014: 3 research projects with direct local participation. 2014-2015: Land Use Zoning processes were carried out in a participatory manner as detailed in the "Guide for Development of Community Participatory Zoning" (unpublished). During the period under evaluation, CIMA worked intensively with three Aguaytía native communities.	2.3 Residents of PNCAZ's buffer zone are involved in research activities and are informed of their results.
2.3.3: Analysis and dissemination of the results of participatory research.	Informative meetings	3	3		

GOAL 2: Building local capacity for sustainable land use and improving the quality of life in the buffer zone communities, expanding benefits for local people without causing negative impacts to the protected area, promoting Land-use planning with the support of Regional and Local Governments, contributing to improving the quality of life of neighboring populations through the benefits generated by PNCAZ conservation.					
Objective 3. Tourism promoted in PNCAZ's buffer zone has expanded benefits for local people without causing negative impacts to the protected area.					
Activities	**Outputs**			**Outcomes**	**Impacts**
	Units	**Number**			
		Aug-Dic 2014	Jan-Jul 2015		
3.1.1 Identification, prioritization and strengthening of local populations with potential for sustainable tourism development, according to the results of land-use zoning and community interests.	Reports	1		For tourism, CIMA has focused on a single pilot community, the native community of Yamino, which showed interest in this activity during its own strategic planning. Previously in 2013, an analysis of the community's tourism potential was carried out as part of its land-use zoning project. 2014: Yamino approved its Quality of Life Plans where Tourism and Craftwork were priority activities. The Tourism and the Artisan Associations were formalized and registered in the Public Registry.	3.1. Local people are organized and empowered to participate in the development of sustainable tourism in their area.
	Population	1			
3.2.1: Sustainable tourism research.	Research projects	---			
3.2.1: Development of sustainable tourism plans.	Plans	1	1	2015: The actions plans of both formalized associations have been developed. They include strengthening and training actions for the Tourism and Craft Associations, the latter with women of the community. Furthermore, seeking inclusion of the community in the tourist route "Yamino-Aguaytía."	3.2. Local people receive benefits derived from sustainable tourism.
3.2.3: Support for the products and services related to sustainable tourism.	Promotion strategy	1	1		

Objective 4. Land-use planning is promoted in the "intervention areas" of the PNCAZ's buffer zone with the support of Regional and Local Governments					
Activities	**Outputs**			**Outcomes**	**Impacts**
	Units	**Number**			
		Aug-Dic 2014	Jan-Jul 2015		
4.1.1 Development of a local Land-use Zoning process (ZEE) in areas prioritized for intervention	Additional villages with ZEE	---		Until 2014, the number of communities and villages with ZEE increased to 24. At present, these processes have ended and CIMA has dedicated to the diffusion of the results to the communities. No new processes have started.	4.1 Local populations have land-use zoning as a tool for managing territories.
4.2.1. Development and implementation of Rules of Conduct.	Additional villages with Rules of Conduct	11 (Total 24)		Until August 2015 a total of 24 villages have developed and approved their Rules of Conduct or convivence as well as to continue the process of implementing them and assess their level of compliance. Previously through 2014, 13 villages had developed and implemented Rules of Conduct; between 2014 and 2015, 11 communities developed and implemented their Rules of Conduct.	4.2 Local populations have improved their strategic planning processes.
4.2.2 Updated Quality of Life Plans (Planes de Calidad de Vida-PCV) that include land-use zoning for strategic decision-making.	Additional villages with updated PCV	4 (Total 17)		Until August 2015 a total of 17 villages have developed their Quality of Life Plans as well as to continue the process of Implementing. Four new QLP has been development during this period. Through 2014, 13 plans Quality of Life Plans were well established and four will be updated. It is expected to reach 21 Quality of Life Plans 2016 and 34 in 2018.	
4.3.1 Priority activities are formalized with communities through signed agreements, roadmaps, minutes, etc.	Agreements		2	Agreements with indigenous federations Ucayali: *Federación de Comunidades Nativas del Bajo Ucayali* (FECONBU) and *Federación de Comunidades Nativas de la Cuenca del Rio Pisqui* (FECONACURPI). CIMA directors visit all new regional and local authorities, within the framework of change of government which took place in late 2014. CIMA continues working closely with local and regional authorities/governments, for mutual support for implement sustainable activities, i.e. implement priorities in PCV.	4.3 Local authorities use participatory management tools generated by the project that benefited buffer zone communities.

Objective 5. PNCAZ conservation contributes to improving the quality of life of neighboring populations through the benefits generated, especially those located in the intervention areas established in the Master Plan.					
Activities	**Outputs**			**Outcomes**	**Impacts**
	Units	**Number**			
		Aug-Dic 2014	Jan-Jul 2015		
5.1.1 Implementation of sustainable activities derived from strategic planning	Activities related to value chains	21 (21 organizations, from 23 communities)		Main economic activities are: cocoa in agroforestry systems, tourism and handicraft, improving infrastructure, etc. CIMA works with about 18 community organizations: producer associations/ committees (10 for cacao), *ronda campesina*, associations of artisans and tourism, mothers' clubs, among others; and at least 3 for conservation and reforestation activities. But there are other non-economic activities that also contribute to improving their quality of life, such as community forest conservation and protection, health, education, etc. CIMA works mainly strengthening neighborhood and community councils, educational organizations and rural patrols. Sustainable activities (economic and non-economic) are fully framed within strategic planning defined for each community in their Quality of Life Plans (QLP), and at the level of grassroots organizations in their Action Plans (AP).	5.1 Local communities develop sustainable economic activities derived from ZEE and prioritized in their PCV.
5.1.2 Strategic partnerships to develop productive activities prioritized in the PCV.	Strategic partnerships	9		Agreements for partnerships with diverse of institutions were used to develop productive activities prioritized in the PCV and in communal organizations: - Five (05) agreements in force with Municipalities: Provincial Municipality of Picota, Distrital Municipalities of Pampa Hermosa, Pólvora, Uchiza and Shamboyacu. - Four (04) agreements with Producers Cooperatives for Cocoa, to develop future sustainable productive activities. Additionally, four (04) agreements with native federations: FECONACURPI, FECONBU, CEPKA and FENACOCA.	
5.1.3 Development of actions linked to value chains to support economic activities that favor conservation.	Action plans	18 (6 QLP and 12 AP))		18 communities, 15 community organizations and 15 action plans. Action plans linked to value chains had been development with agricultural committees, associations and cooperatives, mainly for cocoa, tourism and handicraft in 18 villages and communities: Cachiyacu (Sector Tocache), Yamino,	

			Santa Rosa de Aguaytia (Sector Aguaytía), San Luis de Charashmana, La Cumbre, Manco Cápac, Nuevo Dorado De Insaya, Fernando Belaunde Terry, Nuevo San Martín, Isolaya, Nuevo Alan (Sector Contamana), Vista Alegre, Alto Ponaza, Paraiso, Santa Rosa, Chambira, Nuevo Arica, Vista Alegre (Sector Tarapoto). Business plans will be developed in future for these activities.	
5.2.1 Implementation of the *Monitoring and Impact Assessment (MUF)* of the quality of life of local people.	MUF events	0	MUF was not implemented further since 2012 because the process is carried out directly and permanently by CIMA technicians under the guidance of the Extension Director. A MUF is planned for 2016.	5.2 The quality of life of local people has improved thanks to the implementation of the MUF
5.3.1 Technical support for the formalization of action plans for community conservation initiatives	Action plans	15	Between 2014 and 2015, CIMA worked to support 6 conservation initiatives: 1. Santa Rosa de Shapaja 2. Nuevo Jaén 3. Nuevo San Martín 4. Alto Marona 5. Challual (jardín botánico) 6. Vista Alegre (Bosque escolar) Technical dossiers have been developed (description, inventory, limits, maps) for the recognition of conservation initiatives from local governments, however under the new Forestry Regulations, are still under evaluation. Updated action plans refer to processes of local organizations to develop sustainable activities with diverse stakeholders: associations, committees, vigilance teams, etc. CIMA addressed issues about forest conservation, control and surveillance, riparian protection, solid waste management, etc.	5.3 Based on the results of the ZEE, local communities manage conservation areas according to their interests.
5.4.1 Promotion and subscription of Conservation Agreements	Conservation Agreements (Acuerdos Azules)	0	In May 2014, the first five Conservation Agreements were signed with villages in the Shamboyacu area. These agreements were signed after the implementation of the FOCAL process was completed and are a way to build confidence and long-term commitment between CIMA and communities. *Note*: These agreements are different from other conservation agreements that were signed before activities began.	5.4 The local population and authorities are committed to sustainable land management and understand its link with PNCAZ's conservation.

GOAL 3: Strengthening relationships with local, regional and national government agencies, in order to insure PNCAZ's long-term and proper management, considering governance and administration.					
Objective 6: Administration fee and distribution of carbon revenues					
Activities	**Outputs**			**Outcomes**	**Impacts**
	Units	**Number**			
		Aug-Dic 2014	Jan-Jul 2015		
6.1.1 Update and implementation of the Financial Plan for PNCAZ.	Updated financial plan	0		The previous plan remains in use because the negotiation process for REDD+ have not been completed. For this reason, financing the management of the PNCAZ continues to depend on its REDD project and international cooperation.	6.1 Financial arrangements to support the PNCAZ's conservation are maintained and new arrangements are actively pursued.
6.1.2 Sale of carbon credits from the PNCAZ REDD+ Project	Signed contracts	2	0	2014: In November, CIMA, with an authorization from SERNANP, signs a contract with Althelia Climate Fund (ACF) for the financing of the PNCAZ's operations in exchange for VCU from the project. This Anthelia's investment (loan) covers 75% of PNCAZ's operations costs, and it shall be repaid by selling the credits ACF.	
6.2.1 Endowment Fund Management Derivation of the surplus from the sale of carbon credits from PNCAZ REDD+ Project.	Fund	1		Despite the poor success in selling credits to August 2014, at the end of 2014 CIMA achieving a successful partnership with Althelia Climate Fund to invest in PNCAZ, based on of VCUs generated. This allowed, even though there is no surplus from the sale of carbon credits, is achieved building an alliance with PROFONANPE for the establishment of the Endowment Fund.	6.2 Ideas for sustainable management of the PNCAZ include a long term fund (Endowment, Trust Fund, or other).
6.2.2 Setting the parameters for the Fund	Parameters	1		A joint work was developed with PROFONANPE and SERNANP for the management of the funds received from REDD; pending details will be evaluated in corresponding addendums.	

6.2.3 Establishment and functioning of the Board of Directors of the Fund.	Minutes	1	CIMA signed an agreement with PROFONANPE for the management of the PNCAZ's REDD+ Project funds, according to the agreement with SERNANP. In November 2014, the Fund Management Board is constituted.	

Objective 7: Government relations and fundraising

Activities	Outputs			Outcomes	Impacts
	Units	Number			
		Aug-Dic 2014	Jan-Jul 2015		
7.1 Monitoring PNCAZ management	Decentralized coordination meetings	>8	4	This is the process of monitoring PNCAZ management conducted through: (1) financial, technical and administrative external audits, (2) supervision by the national government (SERNANP), and (3) internal supervision (CIMA) to ensure optimal management. Additionally: During T4-2014 the modifications of the five-year work plan 2014-2018 were approved (II Addendum of the PNCAZ's Total Management Contract). At the start of 2015 new local authorities were visited after the regional election.	7.1 PNCAZ's management used tools for transparent and proactive monitoring of implemented strategies to assess impact.
	Financial audits of CIMA	1/yr			
7.2: Monitoring the management contract with SERNANP	Meetings and supervision of performance	1	2		7.2 PNCAZ is emblematic as a protected area that reached high rates of conservation and maintained good social relations.
7.3: Participation in technical platforms and roundtables	Participatory events	>10	9	More than the projected number of events. Main work platforms: -Land Use Planning Platform -Protected Areas Forum -Global Landscape Forum - IUCN National Committee -UNDP to neutralize the carbon footprint of the COP20	7.3 Participation and interest in project activities at high level

7.4: Follow-up on the dossier for proposed PNCAZ expansion	Follow-up report	1		To keep the PNCAZ expansion issue alive, the dossier was sent again to SERNANP. There have been many meetings with SERNANP. Note: (1) As of August 2014, an oil block was still superimposed on the proposed extension area, but in late 2014 the "release" for the oil block occurs; and (2) no specific regulations had been developed for potential enlargement processes in Natural Protected Areas, so the regulations for creating ANP is applied.	7.4 The plan to increase the area of the PNCAZ remains open if legal hurdles overcome.
7.5. Meetings of the PNCAZ's Management Committee	Meetings	1	0	At least one meeting per year is required.	7.5 Good coordination by the PNCAZ management committee during the implementation period.
7.6: Dissemination of experiences	Publications and events	>6	4	Several publications and events appeared during 2014 and 2015, one of the most important of them has been CIMA's participation in the COP20 in Lima and its related events. The PNCAZ is used as a case study at an international level, mainly for its management effectiveness and its REDD project.	7.6 Good dissemination of scientific research park management achievements.
7.7 Verification with VCS and CCB	Verification certificate		1	In February 2015, the monitoring process of the Aug2012-Aug2014 period begins. The verification will be carried out during the second semester of 2015, against VCS Version 3 and CCBS Second Edition.	7.7. VCS and CCB certification process is completed

2.2 Deviations

2.2.1 Methodology Deviations

In accordance with the PIR 2008-2012 (section 2.2) a new classification technique used to overcome sensor errors had been done. This procedure was already justified and explained in the PIR 2008-2012, section 5 (Appendix 1).

2.2.2 Project Description Deviations

No deviations to the project description or monitoring plan were applied.

2.3 Grouped Project

The project is not grouped.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	$\Delta C_{BSL,PA,unplanned}$
Data unit	t CO_2-e
Description	Net CO_2 emissions in the baseline from unplanned deforestation in the project area
Source of data	Derived in Section 3.1 of PD
Value applied:	3,396,759.9 tCO_2-e (2014-2015)
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
Purpose of the data	Calculation of baseline emissions
Comments	

Data / Parameter	$\Delta C_{BSL,LK,unplanned}$
Data unit	t CO_2-e
Description	Net CO_2 emissions in the baseline from unplanned deforestation in the leakage belt
Source of data	Derived in Section 3.1 and 3.2 of PD
Value applied:	16,928,880.9 tCO_2-e (2014-2015)
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
Purpose of the data	Calculation of baseline emissions
Comments	

Data / Parameter	C_{OLB}
Data unit	t CO_2-e ha^{-1}
Description	Area-weighted average aboveground tree carbon stock for forests available for unplanned deforestation outside the Leakage Belt
Source of data	2010 FAO FRA Peru Country Report
Value applied:	376.3 t CO_2-e ha^{-1}
Justification of choice of data or description of measurement methods and procedures applied	Derived above in Section 3.3 of the Project Description
Purpose of the data	Calculation of baseline emissions
Comments	

Data / Parameter	C_{LB}
Data unit	t CO_2-e ha^{-1}
Description	Area weighted average aboveground tree carbon stock for forests available for unplanned deforestation inside the Leakage Belt
Source of data	Stocks were derived by first delineating three high order forest classes from Natureserve (Josse et al. 2007; and Ferreira et al. 2007), humedales-vegetacion inundable and tierra firme (corresponding roughly with aguajal/alluvial forest and hill/mountain forest, respectively, from the project area) and anthropogenic forest. For each of the three classes, spatially-explicit aboveground biomass data were obtained from Saatchi et al. 2009, from which an area-weighted mean live aboveground tree carbon stock was estimated.
Value applied:	358.8 t CO_2-e ha-1
Justification of choice of data or description of measurement methods and procedures applied	Derived above in Section 3 of the Project Description
Purpose of the data	Calculation of baseline emissions
Comments	

Data / Parameter	*CF*
Data unit	t C t $d.m.^{-1}$
Description	Carbon fraction of dry matter in t C t^{-1} d.m.
Source of data	Default value of from IPCC 2006GL
Value applied:	0.47 t C t^{-1} d.m
Justification of choice of data or description of measurement methods and procedures applied	As permitted by methodology VM0007 module CP-AB “Values from the literature (e.g. IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.3) shall be used if available, otherwise default value of 0.47 t C t^{-1} d.m. can be used”

Purpose of the data	Calculation of project emissions
Comments	

Data / Parameter	*D:RAD*
Data unit	Dimensionless
Description	Ratio of DBH to plot radius, specific to prism Basal Area Factor (BAF) employed in point sampling
Source of data	Avery, T.E. and H.E. Burkhart. 1994. Forest Measurements. Fourth Edition. McGraw Hill, Boston, Massachusetts, USA. 408 pp.

Value applied:

	BAF gauge				
ft^2/acre	5	10	15	20	40
m^2/ha	1.15	2.29	3.44	4.59	9.18
ratio dbh/plot radius	1:46.7	1:33	1:26.9	1:23.3	1:16.5

Justification of choice of data or description of measurement methods and procedures applied	
Purpose of the data	Calculation of project emissions
Comments	

Data / Parameter	$f_j(X,Y)$
Data unit	t d.m. tree^{-1}
Description	Allometric equation for species *j* linking measured tree variable(s) to aboveground biomass of living trees, expressed as t d.m. tree^{-1}
Source of data	Chave, J., Andalo, C., Brown, S., Cairns, M.A., Chambers, J.Q., Eamus, D., Folster, H., Fromard, F., Higuchi, N., Kira, T., Lescure, J.P., Nelson, B.W., Ogawa, B., Puig, H., Riera, B. and T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145:87-99. Freitas Alvarado, L., Otarola Acevedo, E., del Castillo Torres, D., Linares Bensimon, C., Martinez Davila, P. and G.A. Malca Salas. 2006. Servicios ambientales de almacenamiento y secuestro de carbono del ecosistema aguajal en la Reserva Nacional Pacaya Samiria, Loreto, Perú. Instituto de Investigaciones de la Amazonía Peruana. Documento Técnico Nº 29. Iquitos, Perú.
Value applied:	Detailed in PNCAZ 2009 forest inventory report
Justification of choice of data or description of measurement methods and procedures applied	Both equations validated in PNCAZ 2009 forest inventory report
Purpose of the data	Calculation of project emissions
Comments	

Data / Parameter	*R*
Data unit	t root d.m. t^{-1} shoot d.m.
Description	Root to shoot ratio appropriate to species or forest type / biome; note that as defined here, root to shoot ratio is applied as belowground biomass per unit area: aboveground biomass per unit area (not on a per stem basis).
Source of data	Cairns, M. A., S. Brown, E. H. Helmer, and G. A. Baumgardner. 1997. Root biomass allocation in the world's upland forests. Oecologia 111, 1-11. Freitas Alvarado, L., Otarola Acevedo, E., del Castillo Torres, D., Linares Bensimon, C., Martinez Davila, P. and G.A. Malca Salas. 2006. Servicios ambientales de almacenamiento y secuestro de carbono del ecosistema aguajal en la Reserva Nacional Pacaya Samiria, Loreto, Perú. Instituto de Investigaciones de la Amazonía Peruana. Documento Técnico Nº 29. Iquitos, Perú.
Value applied:	Detailed in PNCAZ 2009 forest inventory report
Justification of choice of data or description of measurement methods and procedures applied	Note that rather than using a constant root to shoot ratio to estimate belowground biomass, belowground biomass was estimated using an allometric equation, where the relationship varies continuously with aboveground biomass. The equation is derived from 151 observations from a global dataset of upland forests. For *Mauritia flexuosa* root biomass (lowland palm swamps) a fixed root:total biomass ratio of 0.276 derived from in-country empirical data was used.
Purpose of the data	Calculation of project emissions
Comments	

Data / Parameter	D_{DWdc}
Data unit	t d.m. m^{-3}
Description	Mean wood density of dead wood in the density class (dc) – sound (1), intermediate (2), and rotten (3); t d.m. m^{-3}
Source of data	Measured from dead wood samples, 30 from each decomposition class, collected in the project area. Density of dead wood was determined through sampling and laboratory analysis as follows. Discs were collected in the field and decomposition class and green volume determined as per standard protocols (Appendix 2). Discs were then transferred to a laboratory (Laboratorio de Análisis de Suelos del Instituto Nacional de Investigación Agraria, INIA) in Tarapoto and oven-dried at 80°C, conducting continuous weight measurements until reaching constant weight. The resulting dry weight was recorded and used to calculate dead wood density as oven-dry weight (g) / green volume (cm^3) for each sample.
Value applied:	Detailed in PNCAZ 2009 forest inventory report
Justification of choice of data or description of measurement methods and procedures applied	Measurements follow procedures as outlined in methodology VM0007 module CP-D
Purpose of the data	Calculation of project emissions
Comments	

Data / Parameter	*Regional Forest Cover / Non-Forest Cover Benchmark Map*
Data unit	ha
Description	Map showing the location of forest land within the reference region at the beginning of the crediting period
Source of data	Classified satellite imagery
Value applied:	3,271,261 ha (at beginning of first baseline period)
Justification of choice of data or description of measurement methods and procedures applied	Detailed procedures provided below under monitoring plan description.
Purpose of the data	Calculation of baseline emissions
Comments	Updated every 10 years at baseline revision

Data / Parameter	*Project Forest Cover Benchmark Map*
Data unit	ha
Description	Map showing the location of forest land within the project area at the beginning of each monitoring period. If within the Project Area some forest land is cleared, the benchmark map must show the deforested areas at each monitoring event
Source of data	Classified satellite imagery
Value applied:	1,349,501ha (at beginning of monitoring period)
Justification of choice of data or description of measurement methods and procedures applied	Detailed procedures provided below under monitoring plan description
Purpose of the data	Calculation of baseline emissions
Comments	Updated at each monitoring/verification event

Data / Parameter	*Leakage Belt Forest Cover Benchmark Map*
Data unit	ha
Description	Map showing the location of forest land within the leakage belt area at the beginning of each monitoring period. Only applicable where leakage is to be monitored in a leakage belt
Source of data	Classified satellite imagery
Value applied:	1,832,002ha (at beginning of monitoring period)
Justification of choice of data or description of measurement methods and procedures applied	Detailed procedures provided below under monitoring plan description.

Purpose of the data	Calculation of leakage
Comments	Updated at each monitoring/verification event

Data / Parameter	$COMF_i$
Data unit	dimensionless
Description	Combustion factor for stratum *i* (vegetation type)
Source of data	Default values in Table 2.6 of IPCC 2006 (Annex 2)
Value applied:	Not applied, $A_{burn,i,t} = 0$ for 2014-2015 monitoring period
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of the data	Calculation of project emissions
Comments	

Data / Parameter	G_{gi}
Data unit	g kg^{-1} dry matter burnt
Description	Emission factor for stratum *i* for gas *g*,
Source of data	Defaults in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 (Annex 2: emission factors for various types of burning for CH_4 and N_2O).
Value applied:	Not applied, $A_{burn,i,t} = 0$ for 2014-2015 monitoring period.
Justification of choice of data or description of measurement methods and procedures applied	
Purpose of the data	Calculation of project emissions
Comments	

3.2 Data and Parameters Monitored

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

- 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 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.

Data / 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* at time *t*
Source of data	Calculated
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every ≤ 5 years
Value monitored:	19,759.7 t CO_2-e (2015, all strata)
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of project emissions
Calculation method	Equation 3, VMD0015
Comments	

Data / Parameter	$\Delta C_{P,DefLB,i,t}$
Data unit	t CO_2-e
Description	Net carbon stock change as a result of deforestation in the project case in the leakage belt 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 monitored:	5,450,159.5 t CO_2-e (2015, all strata)
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of leakage
Calculation method	Equation 4, VMD0015
Comments	

Data / 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* at time *t*
Source of data	Calculated
Description of measurement methods and procedures to be applied	

Frequency of monitoring/recording	Every ≤ 5 years
Value monitored:	**2,751.5** t CO_2-e (2015, all strata)
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of project emissions
Calculation method	Equation 20, VMD0015
Comments	

Data / Parameter	$A_{DefPA,u,i,t}$
Data unit	Ha
Description	Area of recorded deforestation in the project area stratum *i* converted to land use *u* 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 0.5 ha Peru DNA forest definition with Landsat.
Frequency of monitoring/recording	Every ≤ 5 years
Value monitored:	38.6 ha (2015, all strata, all land uses)
Monitoring equipment	Image processing, classification and assessment work was conducted using IDRISI, TerrSet, Eastman, J.R., 2014. I (Worcester, MA: Clark University). Some steps in accuracy assessment were conducted using: Arc GIS 10.0 ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	$A_{DefLB,u,i,t}$
Data unit	ha
Description	Area of recorded deforestation in the leakage belt stratum *i* converted to land use *u* 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 to3 pixels by 3pixels Landsat resolution (90m by 90m), providing closest conformance possible to 0.5 ha Peru DNA forest definition with

	Landsat.
Frequency of monitoring/recording	Every ≤ 5 years
Value monitored:	12,281.4 ha (2015, all strata, all land uses)
Monitoring equipment	Image processing, classification and assessment work was conducted using IDRISI, Selva edition, Eastman, J.R., 2012. IDRISI Selva (Worcester, MA: Clark University). Some steps in accuracy assessment were conducted using: Arc GIS 10.0 ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description
Purpose of the data	Calculation of leakage
Calculation method	
Comments	

Data / Parameter	$A_{DistPA,q,i,t}$
Data unit	ha
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 to3 pixels by 3 pixels Landsat resolution (90m by 90m), providing closest conformance possible to 0.5 ha Peru DNA forest definition with Landsat.
Frequency of monitoring/recording	Every ≤ 5 years
Value monitored:	5.6 ha (2015, all strata, all land uses)
Monitoring equipment	Image processing, classification and assessment work was conducted using IDRISI, Selva edition, Eastman, J.R., 2012. IDRISI Selva (Worcester, MA: Clark University). Some steps in accuracy assessment were conducted using: Arc GIS 10.0 ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	Accounts only area of overlap with cumulative baseline deforestation in the project area through 2015

Data / 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. For strata identified in the leakage belt from vegetation maps from NatureServe (Josse et al. 2007), but not represented in the project area inventory, stock estimates specific to each stratum will be obtained from peer-reviewed values from Peru.
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 2018.
Value monitored:	Detailed in PNCAZ 2009 forest inventory report
Monitoring equipment	Detailed in PNCAZ 2009 forest inventory report
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	$C_{P,post,u,i}$
Data unit	t CO_2-e ha^{-1}
Description	Carbon stock in all pools in post-deforestation land use *u* in stratum *i*
Source of data	Post deforestation carbon stocks are set as the historical area-weighted average carbon stock for pasture and cultivation land uses, derived from historical land use survey data and stocks estimates from regional studies in PD Section 3.
Description of measurement methods and procedures to be applied	None
Frequency of monitoring/recording	Every ≤ 10 years. Value to be re-assessed in 2018.
Value monitored:	41.3 t CO_2-e ha^{-1}
Monitoring equipment	none
QA/QC procedures to be applied	
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	$C_{P,Dist,q,i}$
Data unit	t CO_2-e ha^{-1}
Description	Carbon stock in pools in post-natural disturbance strata *q* in stratum *i*
Source of data	Conservatively assumed to be zero post disturbance

Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every 10 years; so, not monitored during this period, and conservatively assumed to be zero post disturbance.
Value monitored:	0 t CO_2-e ha^{-1}
Monitoring equipment	none
QA/QC procedures to be applied	
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	$A_{DegW,i,t}$
Data unit	ha
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 monitored:	Not estimated. PRA did not indicate potential for degradation.
Monitoring equipment	
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description.
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / 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 monitored:	Not estimated for 2015 monitoring period
Monitoring equipment	
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description.
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	AP_i
Data unit	Ha
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 monitored:	Sampling not carried out for 2015
Monitoring equipment	
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description.
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / 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 monitored:	Sampling not carried out for 2015
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of project emissions

Calculation method	Equation 8, VMD0015
Comments	

Data / Parameter	$PROP_{IMM}$
Data unit	Proportion
Description	Estimated proportion of baseline deforestation caused by immigrating population
Source of data	Calculated based on results of survey of communities within 2 km of the PNCAZ boundary.
Description of measurement methods and procedures to be applied	Detailed procedures provided below under monitoring plan description. Questions will be structured as: how long have you lived here and where did you come from prior? Immigrants are defined as someone who has lived in the area less than 5 years and came from an area outside the leakage belt. As there are sensitivities to assessing responsibility for deforestation in an interview context, the proportion of baseline deforestation caused by immigrating population will be assumed to be equal to the proportion of immigrants in the surrounding population.
Frequency of monitoring/recording	Every $\leq$ 5 years
Value monitored:	19.7%
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of leakage emissions
Calculation method	
Comments	

Data / Parameter	*MANFOR*
Data unit	Ha
Description	Total area of forests under active management nationally
Source of data	Official data, peer reviewed publications and other verifiable sources
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every $\leq$ 5 years
Value monitored:	
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of leakage emissions
Calculation method	
Comments	May be conservatively set to zero

Data / Parameter	*PROTFOR*
Data unit	Ha
Description	Total area of fully protected forests nationally
Source of data	Official data, peer reviewed publications and other verifiable sources
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every ≤ 5 years
Value monitored:	0
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of leakage emissions
Calculation method	
Comments	May be conservatively set to zero A demonstration is required that areas will be protected against deforestation. Such a demonstration shall include either: 1. Designation as a UNESCO World Heritage Site, or 2. Management by an international NGO, or Evidence that the government has immediately acted to evict any and all illegal squatters

Data / Parameter	*TOTFOR*
Data unit	ha
Description	Total available national forest area
Source of data	Official data, peer reviewed publications and other verifiable sources, including Peru FAO FRA reports, e.g. FAO. 2010. Global Forest Resources Assessment 2010, Peru Country Report. Forestry Department, Food and Agriculture Organization of the United Nations, Rome.
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every ≤ 5 years
Value monitored:	67,992,000 ha
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of leakage emissions
Calculation method	
Comments	

Data / Parameter	$PROP_{RES}$
Data unit	Proportion
Description	Estimated proportion of baseline deforestation caused by population that has been resident for ≥5 years
Source of data	Calculated based on results of survey of communities within 2 km of the PNCAZ boundary.
Description of measurement methods and procedures to be applied	Equals 1 - $PROP_{IMM}$ Detailed procedures provided under monitoring plan description below.
Frequency of monitoring/recording	Every ≤ 5 years
Value monitored:	80.3%
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of leakage emissions
Calculation method	
Comments	

Data / Parameter	*N*
Data unit	Dimensionless
Description	Number of samples (i.e. clusters of 5 variable radius plots)
Source of data	Detailed in PNCAZ 2009 forest inventory report
Description of measurement methods and procedures to be applied	
Frequency of monitoring/recording	Every ≤ 10 years
Value monitored:	64 clusters of 5 variable radius plots
Monitoring equipment	N/A
QA/QC procedures to be applied	
Purpose of the data	Calculation of project emissions
Calculation method	Detailed in PNCAZ 2009 forest inventory report
Comments	

Data / Parameter	*DBH*
Data unit	cm
Description	Diameter at breast height of a tree in cm
Source of data	Measured in the field
Description of measurement methods and procedures to be	Detailed in PNCAZ 2009 forest inventory report

applied	
Frequency of monitoring/recording	Every ≤ 10 years
Value monitored:	Detailed in PNCAZ inventory analysis database and field data sheets
Monitoring equipment	Detailed in PNCAZ 2009 forest inventory report
QA/QC procedures to be applied	Detailed in PNCAZ 2009 forest inventory report and in description of monitoring plan below
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	$Dia_{n,i,t}$
Data unit	cm
Description	Diameter of piece *n* of dead wood along the transect in stratum *i*, at time *t* in *cm*
Source of data	Measured in the field
Description of measurement methods and procedures to be applied	Detailed in PNCAZ 2009 forest inventory report
Frequency of monitoring/recording	Every ≤ 10 years
Value monitored:	Detailed in PNCAZ inventory analysis database and field data sheets
Monitoring equipment	Detailed in PNCAZ 2009 forest inventory report
QA/QC procedures to be applied	Detailed in PNCAZ 2009 forest inventory report and in description of monitoring plan below
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	*BDia*
Data unit	cm
Description	Basal diameter of standing dead tree in cm
Source of data	Measured in the field
Description of measurement methods and procedures to be applied	Detailed in PNCAZ 2009 forest inventory report
Frequency of monitoring/recording	Every ≤ 10 years
Value monitored:	Detailed in PNCAZ inventory analysis database and field data sheets
Monitoring equipment	Detailed in PNCAZ 2009 forest inventory report
QA/QC procedures to be applied	Detailed in PNCAZ 2009 forest inventory report and in description of monitoring plan below
Purpose of the data	Calculation of project emissions

Calculation method	
Comments	

Data / Parameter	TD_{SDW}
Data unit	cm
Description	Top diameter of standing dead tree in cm
Source of data	
Description of measurement methods and procedures to be applied	Not measured
Frequency of monitoring/recording	
Value monitored:	
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	Standing dead wood volume calculations assume volume of a paraboloid, i.e. volume = cross sectional area * height * ½ (no need for top diameter)

Data / Parameter	H_{SDW}
Data unit	m
Description	Height of standing dead tree in m
Source of data	Measured in the field
Description of measurement methods and procedures to be applied	Detailed in PNCAZ 2009 forest inventory report
Frequency of monitoring/recording	Every ≤ 10 years
Value monitored:	Detailed in PNCAZ inventory analysis database and field data sheets
Monitoring equipment	Detailed in PNCAZ 2009 forest inventory report
QA/QC procedures to be applied	Detailed in PNCAZ 2009 forest inventory report and in description of monitoring plan below
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	*Project Forest Cover Monitoring Map*
Data unit	ha

Description	Map showing the location of forest land within the project area at the beginning of each monitoring period (= updated *Project Forest Cover Benchmark Map).*
Source of data	Classified satellite imagery
Description of measurement methods and procedures to be applied	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording	Updated at each monitoring/verification event every ≤ 5 years
Value monitored:	1,348,258.6ha (at end of monitoring period)
Monitoring equipment	Image processing, classification and assessment work was conducted using IDRISI, TerrSet edition, Eastman, J.R., 2014. (Worcester, MA: Clark University). Some steps in accuracy assessment were conducted using: Arc GIS 10.0 ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description.
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	*Leakage Belt Forest Cover Monitoring Map*
Data unit	
Description	Map showing the location of forest land within the leakage belt area at the beginning of each monitoring period (= updated *Leakage Belt Forest Cover Benchmark Map).*
Source of data	Classified satellite imagery
Description of measurement methods and procedures to be applied	Detailed procedures provided below under monitoring plan description.
Frequency of monitoring/recording	Updated at each monitoring/verification event every ≤ 5 years
Value monitored:	1,819,720.6ha (at end of monitoring period)
Monitoring equipment	Image processing, classification and assessment work was conducted using IDRISI, TerrSet edition, Eastman, J.R., 2014. (Worcester, MA: Clark University). Some steps in accuracy assessment were conducted using: Arc GIS 10.0 ESRI 2011. ArcGIS Desktop: Release 10. Redlands, CA: Environmental Systems Research Institute.
QA/QC procedures to be applied	Detailed procedures provided below under monitoring plan description.
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

Data / Parameter	$A_{burn,i,t}$
Data unit	ha
Description	Area burnt in stratum *i* at time *t*
Source of data	GPS coordinates and/or Remote Sensing data
Description of measurement methods and procedures to be applied	Remote sensing analysis detailed below under monitoring plan description
Frequency of monitoring/recording	Areas burnt shall be monitored at least every five years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
Value monitored:	0 ha (2015, all strata)
Monitoring equipment	
QA/QC procedures to be applied	
Purpose of the data	Calculation of project emissions
Calculation method	
Comments	

3.3 Monitoring Plan

3.3.1 Revision of the baseline

The baseline as outlined here in the Project Description is valid for 10 years, through August 7, 2018. The baseline will be revised every 10 years from the project start date.

3.3.2 Monitoring of actual carbon stock changes and greenhouse gas emissions

For accounting purposes the project conservatively assumes stable stocks and no biomass monitoring is conducted in areas potentially 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 biomass burning;
- Emissions due to illegal degradation.

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

3.3.3 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 ($\ddot{A}C_{P,Def,i,t}$ and $\ddot{A}C_{P,DistPA,i,t}$ 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 $\ddot{A}C_{P,Dist,q,i,t}$ and $\ddot{A}C_{pools,Def,u,i,t} = C_{BSL,i}$). Stock estimates from the initial field inventory completed in 2009, are valid for 10 years (per VM0007), minimally through 2018. Post 2018, forest carbon stock estimates will be updated for any strata where deforestation or natural disturbance is detected.

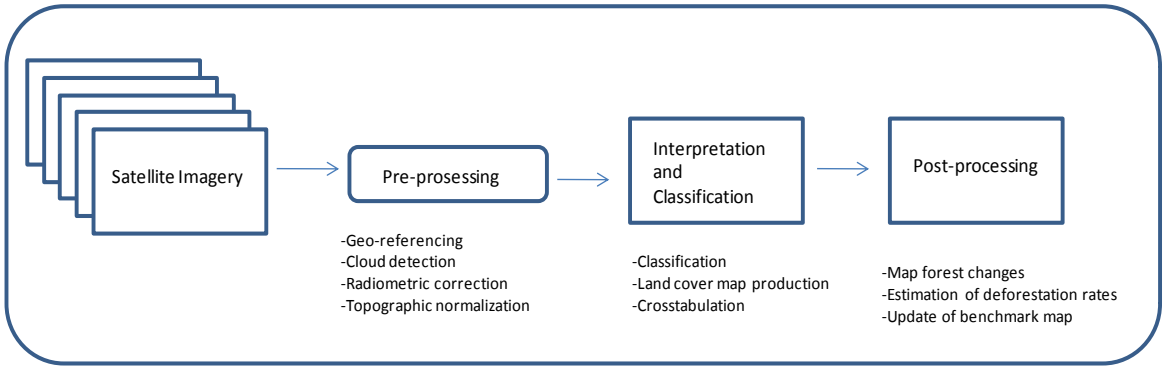
Monitoring changes in forest cover

The project boundary, as set in the PD, will serve as the initial "forest cover benchmark map" against which changes in forest cover will 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, satellite imagery for that year will be acquired and interpreted to produce a classified forest cover map in which forest and non-forest are distinguished. A Minimum Mapping Unit (MMU) of 0.81 ha, corresponding to 3 pixels by 3 pixels Landsat resolution (90m x 90m) will be used throughout the duration of the project crediting period. The general work flow for monitoring forest cover change is shown in Figure 3.1.

Figure 3.1: General workflow for monitoring forest cover change in the project area and leakage belt



The forest cover benchmark map for the project start date in August 2014 (Figure 3.2) establishes the extent and location of forest and non-forest at the beginning of the crediting period and the first verification interval.

Figure 3.2: Forest cover benchmark map for project area, August 2014

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 forest cover benchmark map to detect forest cover change for the monitoring period, and becomes the updated forest cover benchmark map for the subsequent monitoring period. Thus, the forest benchmark map is updated at each monitoring event.

Data acquisition

To estimate the change of forest cover within the project area, the benchmark map generated at the previous monitoring event (or at project start August 2008 for the first monitoring event) will be compared with a newly-generated classified forest cover map for the monitoring date. The new forest cover map for the project area will comply with the following requirements.

Base satellite imagery will cover both the project area and leakage belt (i.e. monitoring of project area and leakage belt will use the same data source) and will be from a single year, though it may include a mosaic of scenes over several months. Landsat imagery has been used in historical analysis, and will likely be used in the future, but with the failure of Landsat

5 in 2011, and the sensor error with Landsat 7, a final determination of the which sensor will be used will hinge on the continuity of the Landsat program. Landsat 8 was launched successfully in 2013 and continues to collect data along with Landsat 7. In the case that both of these sensors fail before their replacement, other medium resolution remotely sense data will be used that can calibrate to acceptable levels with the previous imagery.

Imagery will be 90% cloud free. This typically can be achieved by mosaicking multiple scenes from the same year together. In the case that imagery alone cannot achieve 90% classified area, where possible, clouded areas will be classified on the basis of other data sources (e.g. ground surveys in the year of interest, radar, over-flights or classified imagery from a year subsequent to the monitored year).

Per module M-MON, "If the areas with 10% cloud cover in either date in question do not overlap exactly, then the rate [will] come from areas that were cloud free in both dates in question.... estimated in % per year. Then, a maximum possible forest cover map [will] be made for the most recent time period [i.e. monitoring date]. The historical rate in % [will] be multiplied by the maximum forest cover area at the start of the period for estimating the total area of deforestation during the [monitoring] period."

The following cartographic data has also been collected to aid in geo-referencing and delineation of project area and leakage belt (all projected in UTM WGS 84 Zone 18 S):

- Carta Nacional 1:1 000,000 IGN (Hojas 13L, 14K, 14L, 19M, 15J, 15K, 15L, 15M, 16J, 16K, 16L, 16M, 17J, 17K, 17L, 17M, 18K, 18L, 18M)
- Rivers and roads - CIMA Cordillera Azul.
- Project area
- Leakage belt area

Pre-processing

As stated above Landsat moderate resolution imagery will be used preferentially. Landsat imagery is 30m multispectral data that is composed of 7 -11 bands. Some of these bands are not used in image classification since they are designed for collection of other data (i.e thermal bands or aerosols) The other 6 bands will be included in image analysis.

Collected imagery will be prepared for processing and analysis to ensure that the imagery displays and overlays accurately. The following pre-processing tasks will be conducted and are detailed below: geo-referencing, cloud and shadow removal. Each scene will be pre-processed and classified separately, eliminating need for radiometric corrections or topographic normalization where scenes must be puzzled together.

The majority of Landsat imagery from USGS is obtained from EROS (Earth Resource Observation Systems) with multiple pre-processing steps completed. These processing steps are summarized below and more detail information can be found from NASA[1].

The 1G product available to users is both radiometrically and geometrically corrected. The correction algorithms employed model the spacecraft and sensor using data generated by onboard computers during imaging events and ground control points and a digital elevation model are also used to improve the overall geometric fidelity. The geometric correction process utilizes both ground control points (GCP) and digital elevation models (DEM) to attain

[1] http://landsathandbook.gsfc.nasa.gov/level/

absolute geodetic accuracy. The WGS84 ellipsoid is employed as the Earth model for the Universal Transverse Mercator (UTM) coordinate transformation. Associated with the UTM projection is a unique set of projection parameters that flow from the USGS General Cartographic Transformation Package. The end result is a geometrically rectified product free from distortions related to the sensor (*e.g.,* jitter, view angle effects), satellite (e.g. altitude deviations from nominal), and Earth (*e.g.,* rotation, curvature, relief).

When landsat data is imported in the image processing software, it is converted from raw digital numbers to reflectance values. For this conversion a dark-object subtraction method is applies using the module in Idrisi, For Landsat data reflectance rescaling coefficients and the solar elevation angle parameter which are found in the metadata are applied, and a haze digital number is automatically determined. The results are ground reflectance images which are used in all further image processing steps

When using Level 1G processed imagery, pre-processing success must be confirmed, but frequently few extra pre-processing steps are necessary. The potential additional steps are detailed below.

Radiometric correction

Since change detection is conducted after classification, the only time additional radiometric correction is required is if severe atmospheric distortions are present in the only available imagery, or extreme topographic relief makes cloud shadows problematic. In these cases a haze reduction algorithm using a dark object subtraction may be used or a topographic normalization using a digital elevation model may be used.

Geo-referencing

For this procedure the August 2008 benchmark map will be used as a reference image from which all subsequent images will be geo-referenced. At least seven well distributed ground control points (GCP) will be identified for the geo-referencing procedure. Each GCP will be known and recognizable in the source image and the reference image. A resampling operation using the nearest neighbor interpolation method and a linear polynomial function will be used to ensure minimal distortion. The average geo-location error will not exceed one pixel. In the case that multiple images are mosaicked, a final image may be geo-referenced to ensure accurate location. In the case that imagery is obtained with geo-rectification conducted by the image producer or provider, secondary geo-referencing is not necessary.

Cloud and shadow detection and removal

Detection of clouds and shadows will be accomplished through visual inspection or combining automated cloud identification techniques and visual inspection. An unsupervised clustering technique and a post classification assessment will be used to identify all areas affected by clouds and cloud shadow. Other imagery from with 12 months of the image date may be used to fill in these cloud areas.

Interpretation and classification

In this step, the scenes are interpreted by applying a classification algorithm to identify forest and non-forest categories. A two-step approach to classification will be used. In the first step, an unsupervised clustering algorithm technique will be used to classify each scene. Visual interpretation of clusters by an image analyst with knowledge of the land cover and/or with the assistance of high resolution imagery will be conducted to identify and then group all clusters into forest, non-forest, fire or fire scars, cloud and cloud-shadow and water classes. In the

case of mixed classed, a second stage clustering may be employed on just the areas of confusion to see if clear classes may be identified. If clear categorization has been obtained (tested through the accuracy assessment) then step 2 can be skipped. If the classification accuracy using the unsupervised technique is not sufficient, or if the analyst prefers the use of supervised techniques, then a maximum likelihood algorithm will be used for supervised classification using samples of known areas selected for training areas (AOI, Areas of Interest) for a minimum of the following classes: "non-forest," "forest," “fire scars,” “water”. A final land use map with 2 categories (forest and non-forest) will be created to assess forest loss against the previous benchmark map. In the case of fire evidence, as can be detected through the distinct spectral signature of burn scars, typically for >18 months, or naturally shaped (as opposed to more typically geometrically shaped anthropogenic disturbance) patches of re-growth, or from field reports of fires that have been investigated and substantiated through remote sensing evidence, these areas will be maintained as a separate category to calculate parameter $A_{burn,i,t}$; and for estimation of biomass burning emissions using the module E-BB, calculated emissions from biomass burning will be incorporated in project accounting only where they are not determined to be insignificant applying T-SIG. As mentioned above, each scene will be classified separately.

The following guidelines will be taken into consideration for the imagery classification process:

Each scene will be classified separately using a hard classification method. The geospatial analyst performing the classification will take into consideration the variety of features in the scene and reference training sites representing a range of categories (from within forest and non-forest) sufficient to facilitate the identification of forested locations from locations with no forest. Special attention will be given to grasslands or herbaceous wetlands, and especially old fallows and shade crops like coffee (which can be confused with forest) to avoid classification errors. Where necessary, corrections to the supervised classification will be made from visual interpretation of imagery. Once the classified map is produced, categories will be merged into two categories for change assessment: forest and non-forest.

Following classification, classified scenes will then be joined to produce a final map that will be compared against the benchmark map.

Post classification

To ensure that the minimum forest definition is met, the final classification will be filtered using a 3 x 3 mode filter. This will increase the MMU to 90m x 90 m to most closely meet the national forest definition. It will also improve any “speckle” in the classification due to small error.

Change detection

Post-classification change detection techniques will be implemented for identifying forest cover change.

Basic cross-tabulation techniques will be used to identify changes from forest to non-forest. Area data from the two maps (benchmark map at beginning of monitoring interval and newly-generated map for current monitoring year) will be cross-tabulated to identify locations that change from forest to non-forest during the monitoring period, which represent deforestation in the actual with-project case.

The project area has many extreme topographic features- Including very steep slopes, and areas at high elevation that have minimal tree cover. These areas were removed from the spatial modeling due to their inaccessibility, and will also be removed from the change

detection analysis since any land cover change in these areas is due to non-anthropogenic sources. GIS files that delineate these masked areas are archived so that each analysis will maintain the same masks.

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 Rapideye 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 50 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 (Table 3.1), such that the following errors are presented:

- Overall classification accuracy;
- Error of omission of each land-use category (forest and non-forest);
- Error of commission of each land-use category (forest and non-forest).

Table 3.1: Example accuracy assessment results

Land-use class as determined from ground-truth points	Classification		Total	Accuracy (%) *User's accuracy (# correct/ row total)*	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 (%) *Producer's accuracy (# correct/ column total)*	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 CIMA at its main office in Lima as described in Section 3.3.8.

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 2030. 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. Initial above- and belowground biomass and dead wood stock estimates from the 2009 inventory are valid and treated as constant through 2018, after which they will be re-estimated from new field measurements.

To re-assess forest carbon stocks, twenty (20) point samples (four clusters of five points) will be randomly located in each forest strata and measured (following field protocols in Appendix 8) in 2018. Biomass will be estimated applying the allometric equations of Chave et al. 2005 and otherwise maintain consistency with analytical procedures applied in the original 2009 inventory. For each strata, where the re-measured estimate of total forest biomass carbon (live and dead) is within the 90% confidence interval of the 2009 estimate, the 2009 stock estimate will continue to be used in the next 10 year baseline period. If the re-measured estimate is outside (i.e., greater than or less than) the 90% confidence interval of the 2009 estimate, then the 2018 stock estimate will be used in the next 10 year baseline period.

3.3.4 Quality Assurance /Quality Control and Data Archiving Procedures

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

1. Field crews with prior training in forest inventory will carry out all field data collection and adhere to field measurement protocols outlined in PD Appendix 8. Pilot sample plots shall be measured before the initiation of formal measurements to train and 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. During the course of implementation, field crews were periodically apprised of measurement errors to assess progress. 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. 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. Calibration of prisms will be confirmed prior to formal field measurements. All borderline trees will be measured and assessed against prism plot radius factor, which is standardized as distance to the center of the tree: diameter at breast height.
3. An opportunistic sample of plots will be re-measured 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 < 5%.
4. Field measurement data will be recorded on standard field data sheets (PD Appendix 8) and transferred to electronic media ("entrada de datos PNCAZ inventario.xls") following each return from the field. Original data sheets will be permanently archived at the CIMA office in Tarapoto and Lima, and the electronic database of all field measurements will be housed in the dedicated long-term electronic archive maintained on the CIMA server at its main office in Lima. The electronic database will also archive GIS coverage detailing forest and strata boundaries and plot locations.
5. Checks will be run for unusual (high or low) values to identify and correct any errors in recorded field data or transcription. Personnel involved in data analysis will consult with personnel involved in measurement to clarify any ambiguities in recorded field data.
6. For laboratory analysis of dead wood specific gravity, all balances for measuring dry weights will be calibrated against known weights prior to use. All calibration results will be documented and archived along with sample analysis results. 10% of samples will be re-analyzed/re-weighed to produce an error estimate

3.3.5 Emissions due to illegal degradation

Emissions due to illegal logging will be tracked by conducting MUF surveys in communities with access to the project area at least every three years. If necessary to make the assessment more frequently, then *ad hoc* surveys may be made to gather information on specific parameters.

Communities surveyed will include, but not necessarily be limited to those listed in Table 3.2.

Table 3.2: Communities to be surveyed

Reference region (District)	Population center
Huimbayoc	Pongo Isla
Huimbayoc	Pucallpa
Chazuta	Ricardo Palma
Chazuta	Callanayacu
Shamboyacu	Porvenir
Pampa Hermosa	Tahiti
Pampa Hermosa	Playa Hermosa
Alto Biavo	Los Cedros
Bajo Biavo	Selva Andina
Alto Biavo	Challual
Alto Biavo	Juanita
Padre Abad	Yamino
Contamana	La Cumbre

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.

In the event that any potential of illegal logging occurring in the project area is detected from the surveys (*i.e*. ≥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.

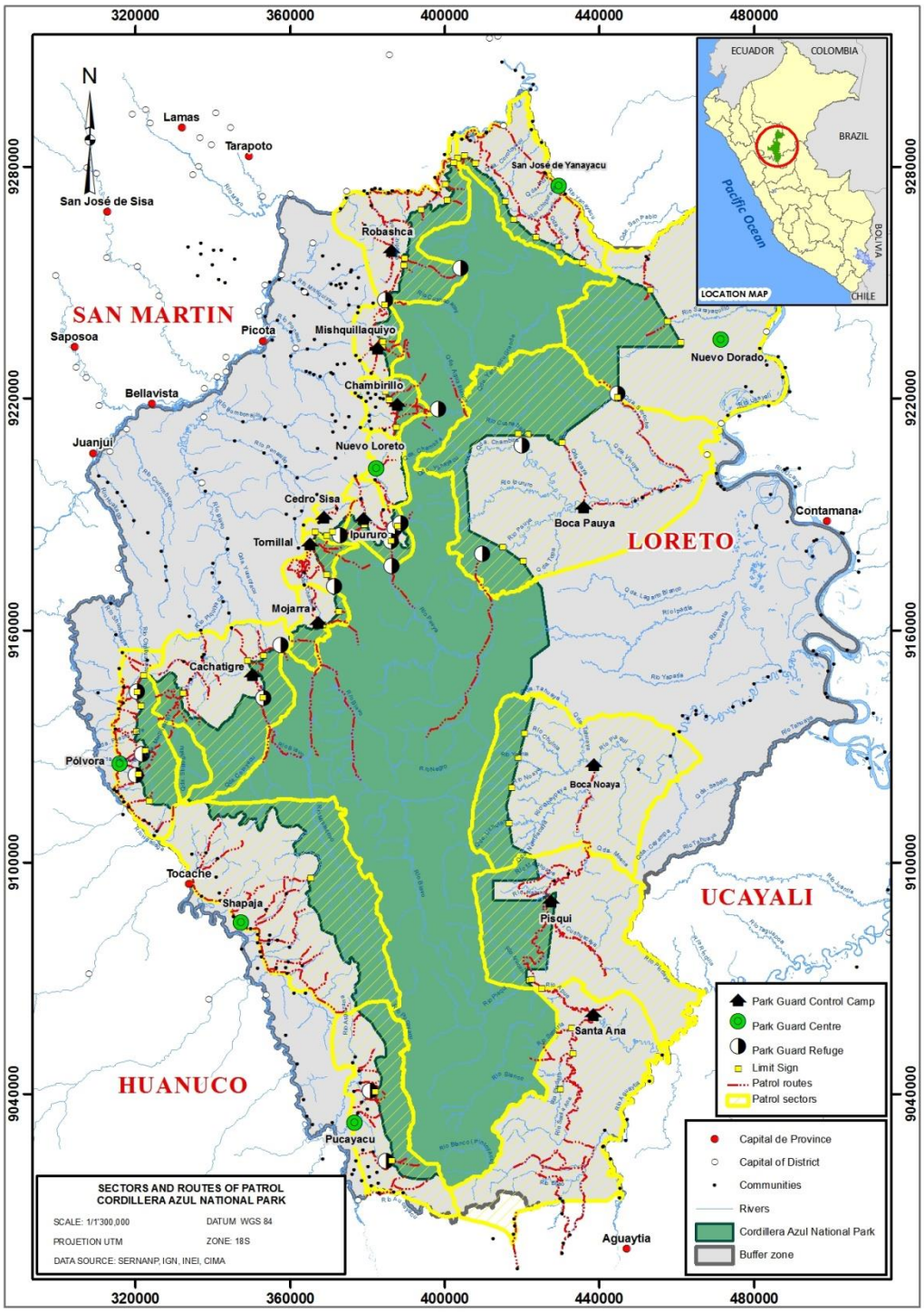
In the event that the sample plot assessment indicated that illegal logging is occurring in the area, supplemental plots will be allocated to achieve a 3% sample of the area. Biomass will be estimated from measured diameters (conservatively assuming that diameters of stumps cut below breast height are equivalent to diameter at breast height) applying the allometric equation of Chave et al. 2005 and otherwise maintain consistency with analytical procedures applied in the original 2009 PNCAZ inventory. Emissions due to illegal logging ($\ddot{A}C_{P,DegW,i,t}$) 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 ($\ddot{A}C_{P,DegW,i}$). Estimates of emissions will be annualized (to produce estimates in t CO_2-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.

Within the project area and area bordering the park (PNCAZ buffer zone), routine patrols will be carried out throughout the year by park guards. Patrols will identify, and resolve where possible, any illegal wood harvest taking place in the PNCAZ and project area. There are 18 control posts and park guard centers on or near the border of the project area, from which guards will be routinely fielded on patrol routes totaling 2,041 km distance (544.6 km within PNCAZ). The total area to be routinely patrolled is located closest to communities with potential access to the park (i.e. highest potential pressure area for illegal harvest) and totals 1,779,984.7 ha (507,364.2 ha within PNCAZ). The density of patrol trails in the monitored area within PNCAZ is 1 km per 10 km^2. The location of patrol areas and park control posts are shown in Map 3.1.

Map 3.1: Location of patrol areas and park control posts

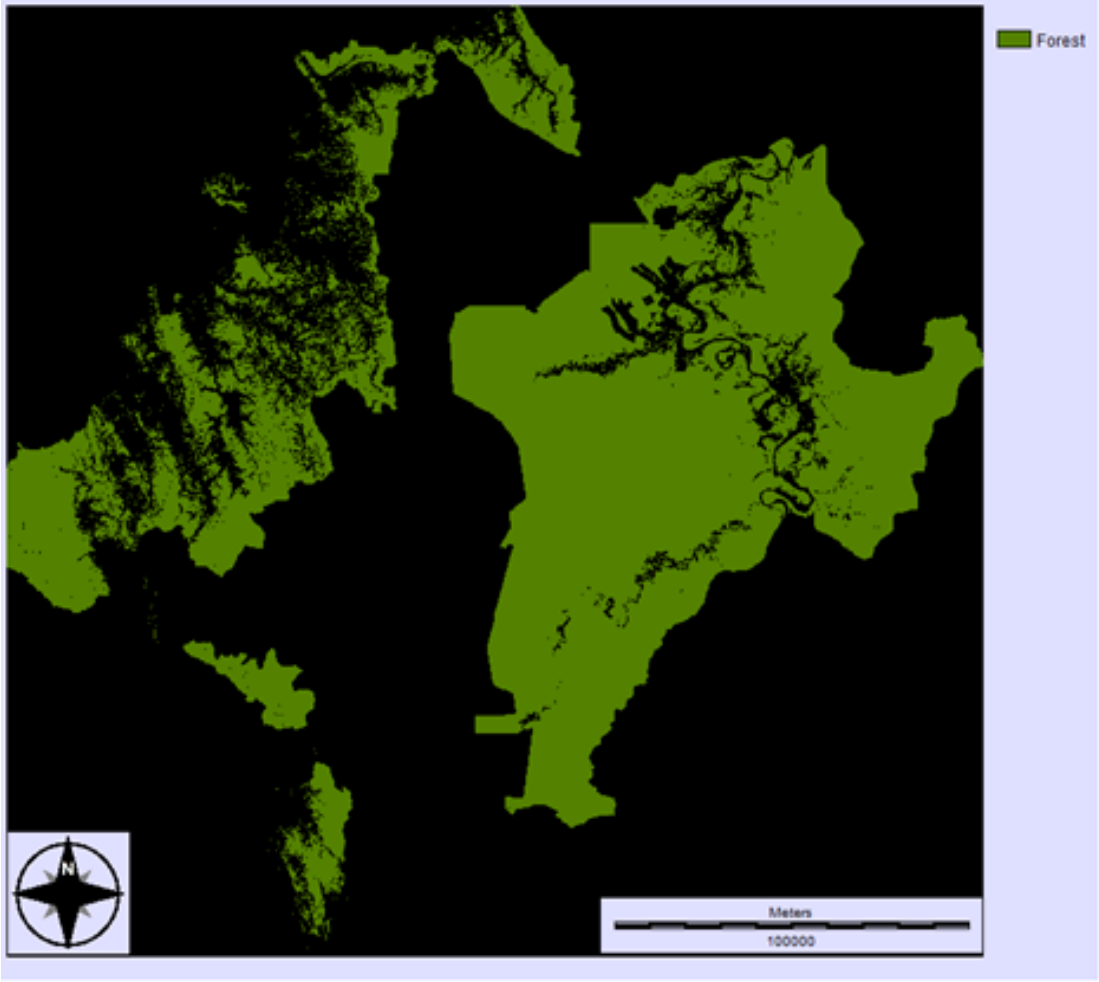


3.3.6 Monitoring of leakage carbon stock changes

Activity-shifting leakage in the leakage belt will be monitored by tracking forest cover change in the leakage belt (ADefLB,u,i,t), using classified satellite imagery produced following the same procedures outlined above in Section 3.3.3, referencing the 2014 forest cover benchmark map for the leakage belt (Figure 3.3). 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.

Note that the leakage belt includes private inholdings and ineligible areas (without forest >10 years old) within PNCAZ as well as planned deforestation areas for oil palm production in the northeast. The initial area of forest in the leakage belt is 1,832,002 ha.

Figure 3.3: Benchmark map of forest cover in 2014 in the leakage belt



Parameter, $\Delta C_{pools,Def,u,i,t}$, is derived from estimates of $C_{BSL,i}$ (forest carbon stock in all pools in the baseline case in stratum *i*) from PNCAZ forest inventory measurements, or for strata identified in the leakage belt but not represented in the PNCAZ inventory from peer-reviewed regional literature sources, as for initial estimates derived in PD Section 3. Parameter, $C_{P,post,u,i}$ (carbon stock in all pools in post-deforestation land use *u* in stratum) is assigned as the historical area-weighted average carbon stock for the converted (non-forest) baseline land-use(s), the initial estimate derived in PD Section 3. Stock estimates will be re-assessed every $\leq$10 years.

Monitored parameters will be entered into the table format (Table 3.3, following page) to complete calculations of activity shifting leakage occurring in the leakage belt in the with-project case ($\Delta C_{LK\text{-}ASU\text{-}LB}$).

Activity shifting leakage outside the leakage belt (Table 3.4, following page) will be tracked by monitoring deforestation in the project area ($A_{DefPA,i,t}$) and leakage belt ($A_{DefLB,i,t}$).

The value for the first verification period was 32.5%. For the previous (2012-2014) and current (2014-2015) verification periods, we updated the value of PROPImm referencing new data collected in January/February 2015, the new value is derived in Section 4.3, see Table 4.3.5, and is 19.7%. Subsequently, the parameter, $PROP_{IMM}$, will be derived from the results of surveys conducted among neighboring communities every $\leq$5 years. The same communities identified above for assessing potential for illegal degradation in the project area will be surveyed to determine for each interviewee how long the person has lived there and where did they come from prior to moving to the area. As there are sensitivities to assessing responsibility for deforestation in an interview context, the proportion of baseline deforestation caused by immigrating population will be assumed to be equal to the proportion of immigrants in the surrounding population. Immigrants are defined as someone who has lived in the area less than 5 years and came from an area outside the leakage belt.

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

Estimates of GHG credits eligible for issuance as VCUs will be calculated entering data into the table format (Table 3.5, following page), 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).

Table 3.3: Calculation format for area subject to activity shifting leakage in the leakage belt

Equation	Derived in PD Sections 3.1 and 3.3		Derived from forest inventory estimates	M-MON 4	LK-ASU 1
Year	$\Delta C_{BSL,LK,unplanned}$ t CO_2	$A_{DefLB,u,i,t}$ ha	$\Delta C_{pools,Def,u,i,t}$ t CO_2/ha	$\Delta C_{P,DefLB,i,t}$ t CO_2	$\Delta C_{LK\text{-}ASU\text{-}LB}$ t CO_2
2009	6,910,840.7				
2010	7,497,174.1				
2011	9,658,074.5				
Etc…	Etc...				

Table 3.4: Calculation format for area subject to activity shifting leakage outside the leakage belt

Equation		Derived in PD Section 3.1	LK-ASU 7			LK-ASU 8	LK-ASU 9	Derived in PD in Section 3.3	LK-ASU 11
Year	$PROP_{IMM}$	$A_{BSL,PA,unplanned,t}$ ha	$A_{LK\text{-}IMM,t}$ ha	$A_{DefPA,i,t}$ ha	$A_{DefLB,i,t}$ ha	$A_{LK\text{-}ACT\text{-}IMM,t}$ ha	$A_{LK\text{-}OLB,t}$ ha	$PROP_{CS}$	$\Delta C_{LK\text{-}ASU,OLB}$ t CO_2
2009	32.5%	4,256.82						1.049	
2010	32.5%	5,420.34						1.049	
2011	32.5%	3,216.33						1.049	
Etc…	Etc...	Etc.						Etc.	

Table 3.5: Calculation format for estimates of GHG credits eligible for issuance as VCUs

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO2e)	Risk buffer (%)	Deductions for AFOLU pooled buffer account	Estimated net GHG emission reductions or removals (tCO_2e)
2009	1,834,510.1					
2010	1,960,580.9					
2011	1,337,026.1					
Etc…						

3.3.8 Organization and Responsibilities

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

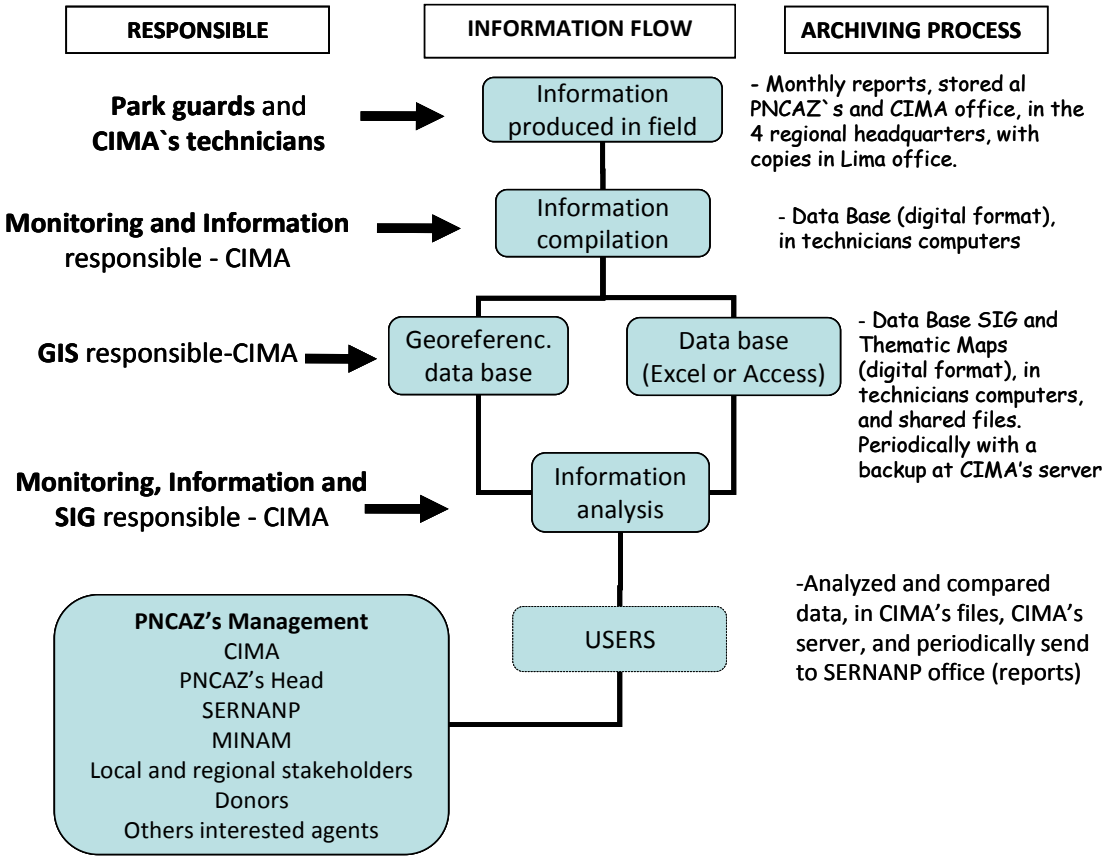
Remote sensing image analysis is conducted by CIMA's GIS team periodically according to the procedures discussed in PD Appendix 4.

Field data is the result of CIMA technicians' trips and the park guards routine and special patrols as part of their planning activities. Technicians and park guards are the key personnel in the generation of information – threats, social and environmental aspects of PNCAZ and buffer zone – and are trained to ensure that they are aware of the importance of the data they are generating. They are the first link in the chain of information flow (Figure 3.4).

This data is recorded in the monthly reports of the technicians and park guards at the offices of the Head of PNCAZ and CIMA, and copies of the park guards' reports are send to CIMA office in Lima headquarters. This information is analyzed by the CIMA Information and Data Specialists to provide quarterly and annual technical reports to SERNANP (or donors) about the progress in PNCAZ's management activities, to report results and impacts of management to SERNANP, and for review by CIMA Management as appropriate. This critical information is systematized and analyzed annually by the technical staff of CIMA.

Hard copies of all of the data is stored in Lima or Tarapoto. The most important information and data is converted to electronic format and placed on the server for sharing between the Lima and Tarapoto offices. This server is periodically backed up.

Figure 3.4: Data flow in CIMA



4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline emissions for the project activities for project year 2015 is shown in Table 4.1.1 below (derived from Section 3.1 of the VCS PD). Recall that the monitoring report uses the convention that the project year is the year at the end of the interval, *i.e.* project year 2015 is 8 August 2014 to 7 August 2015.

Table 4.1.1: Calculation of baseline emissions

Year	$C_{TOT\ PA}$	$C_{TOT\ LB}$
2015	3,396,759.9	16,928,880.9

4.2 Project Emissions

Project emissions from deforestation are calculated as the total area deforested multiplied by the emission per unit area.

Table 4.2.1: Parameters used to calculate *ΔCP,DefPA,i,t*

ADefPA,u,i,t (ha)	Area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t*; ha	Calculated in imagery analysis
ΔCpools,Def,u,i,t	Net carbon stock changes in all pools in the project case in land use *u* in stratum *i* at time *t*; t CO_2-e ha^{-1}	Calculated below

Landslides have occurred in the project area and have been delineated in the image classification from other deforestation. This determination was based on distinguishing deforestation that occurred on very steep slopes in areas of known susceptibility to landslides based on previous landslide events and expert knowledge.

Table 4.2.2: Components of *ADefPA,u,i,t (ha)*

	ADefPA,u,i,t (ha)				
	Alluvial	Collinsos (Hill forest)	Montanosos	Humedales (Aguajal)	*TOTAL*
2015	*4.3*	*14.1*	*20.0*	*0.2*	*38.6*

Figure 4.1: Project land cover change and baseline projections 2015

Calculation of emission per unit area is equal to the difference between the stocks before and after deforestation. There are no indications of any commercial wood products recovery associated with the forest clearance process.

Table 4.2.3: Parameters used to calculate $\Delta C_{pools,Def,u,i,t}$

Parameter	Description	Calculation	Value
CBSL,i	Carbon stock in all pools in the baseline case in stratum	Calculated in forest inventory (PD section 3)	Varies by stratum
CP,post,u,I	Carbon stock in all pools in post-deforestation land use u in stratum i; t CO_2-e ha-1	Historical area-weighted average carbon stock for the converted (non-forest) baseline, cultivation and pasture (derived in PDD section 3)	41.3

Table 4.2.4: Components of $\Delta CP,DefPA,i,t$

Year	ΔCP,DefPA,i,t (tCO2)				Total
	Alluvial	Collinsos (Hill forest)	Montanosos	Humedales (Aguajal)	$\Delta CP,DefPA,i,t$
2015	1,096.7	6,010.4	12,593.0	59.7	19,759.7

Monitoring areas undergoing natural disturbance

Per module M-MON, "For unplanned deforestation the sum of $A_{DistPA,q,i,t}$ shall be equal to the area of overlap between the delineated area of the disturbance and the summed area of unplanned deforestation in the project area ($A_{BSL,PA,unplanned,t}$), summed to the year in which the disturbance occurred." Thus emissions from natural disturbance that are accounted for are only those taking place in the area of projected deforestation in the baseline. Because the baseline incorporates topographic features (elevation) in the spatial modeling, which assign higher probabilities of deforestation in lower elevation and more level areas suitable for settlement and agriculture, risk of landslides (that tend to occur on higher elevation, steeper sites less suitable for settlement and agriculture) that produce reversals in project accounting is expected to be low.

Some landslides have occurred in the project area during the monitoring period and have been delineated in the image classification (Figure 4.2.1) There was very little overlap between these areas and the summed area of unplanned deforestation in the project area ($A_{BSL,PA,unplanned,t}$). These areas of natural disturbance area are included in project accounting.

Table 4.2.5: Components of *ADistPA,q,i,t (ha)*

Year	*ADistPA,q,i,t (ha)*				
	Alluvial	Collinsos (Hill forest)	Montanosos	Humedales (Aguajal)	*TOTAL*
2015	0.0	4.86	0.72	0.0	5.6

Table 4.2.6: Parameters used to calculate ΔCP,Dist,q,i,t

Parameter	Description	Value
CBSL,i	Carbon stock in all pools in the baseline case in stratum t CO_2-e ha-1	Calculated in forest inventory (PD annex)
CP,Dist,q,i	Carbon stock in all pools in post-natural disturbance strata *q,* in stratum i; t CO_2-e ha-1	Conservatively assumed to be 0
CDist, WP,q,i	Carbon stock sequestered in wood products from harvests following natural disturbance in post-natual disturbance stratum *q,* in stratum i; t CO_2-e ha-1	0

Table 4.2.7: Components of ΔCP,Dist,q,i,t

Stratum	CBSL,i	CP,Dist,q,i	CDist, WP,q,i	ΔCP,Dist,q,i,t
Alluvial	295.2	0.0	0.0	295.2
Colinosos (Hill forest)	466.8	0.0	0.0	466.8
Montanosos	671.7	0.0	0.0	671.7
Humedales (Aguajal)	372.9	0.0	0.0	372.9

Table 4.2.8: Components of *ΔCP,DistPA,i,t*

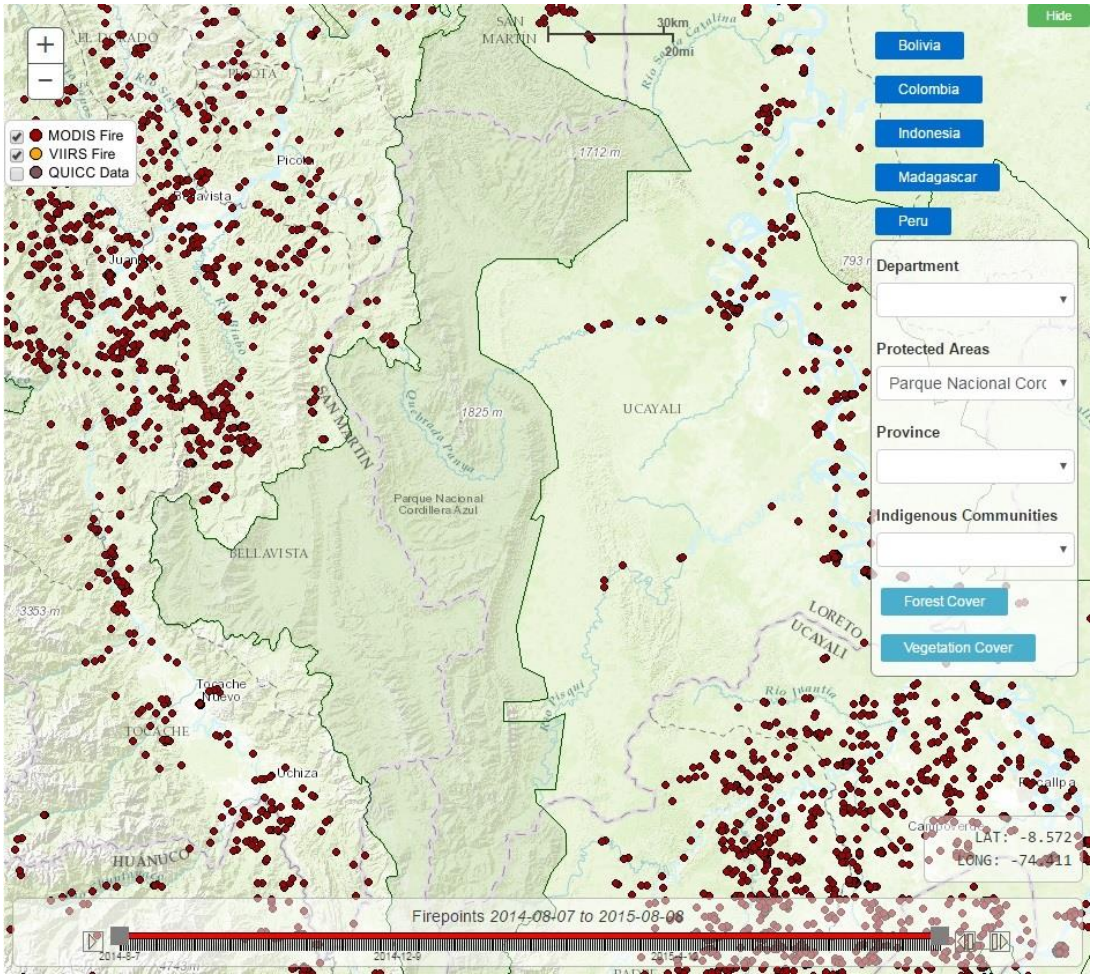
Year	*ΔCP,DistPA,i,t*				
	Alluvial	Collinsos (Hill forest)	Montanosos	Humedales (Aguajal)	Total
2015	0.0	2,267.9	483.5	0.0	2,751.5

Monitoring biomass burning

In the classification process, no evidence of fire scars was detected. Further, no fires were reported within PNCAZ during the 2014-2015 period from park guard patrols, and therefore $A_{burn,i,t}$ was 0.

Further, during the monitoring period, no fires were detected in the project area by Firecast [2] is a MODIS-based fire monitoring system developed by Conservation International, NASA and ESRI, with highly precise detection of fires $\geq$50m^2. A map showing the location of all reported fires from Firecast is shown in Figure 4.1.2

Figure 4.1.2 Firecast report for the monitoring period showing that no fires were detected within the park boundaries



Monitoring illegal logging

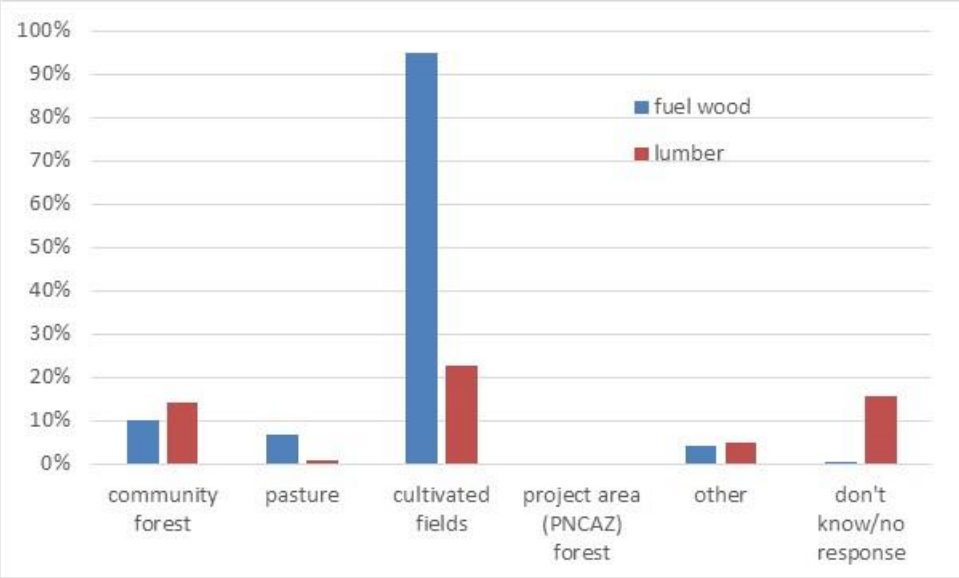
From April to June 2016, surveys were carried out in 14 communities in the buffer zone of PNCAZ by CIMA to determine the potential of degradation occurring in the project area as a result of illegal logging of fuel wood and lumber for construction. In each community, 12 to 32 households were surveyed, depending on the size of the community (i.e. number of surveys was proportional to the size of the community). Communities were selected based on their

[2] http://firecast.conservation.org

relative dependence on the forest in the project area, and hence targeted those communities most likely to include baseline agents of degradation.

With respect to fuel wood/lumber use and collection, a total of 284 persons were interviewed. Among those respondents, none mentioned sourcing wood of any kind from within the project area. Most of the wood was collected from within community forests, and from remnant timber in cultivated fields outside the project area (Figure 4.2.2).

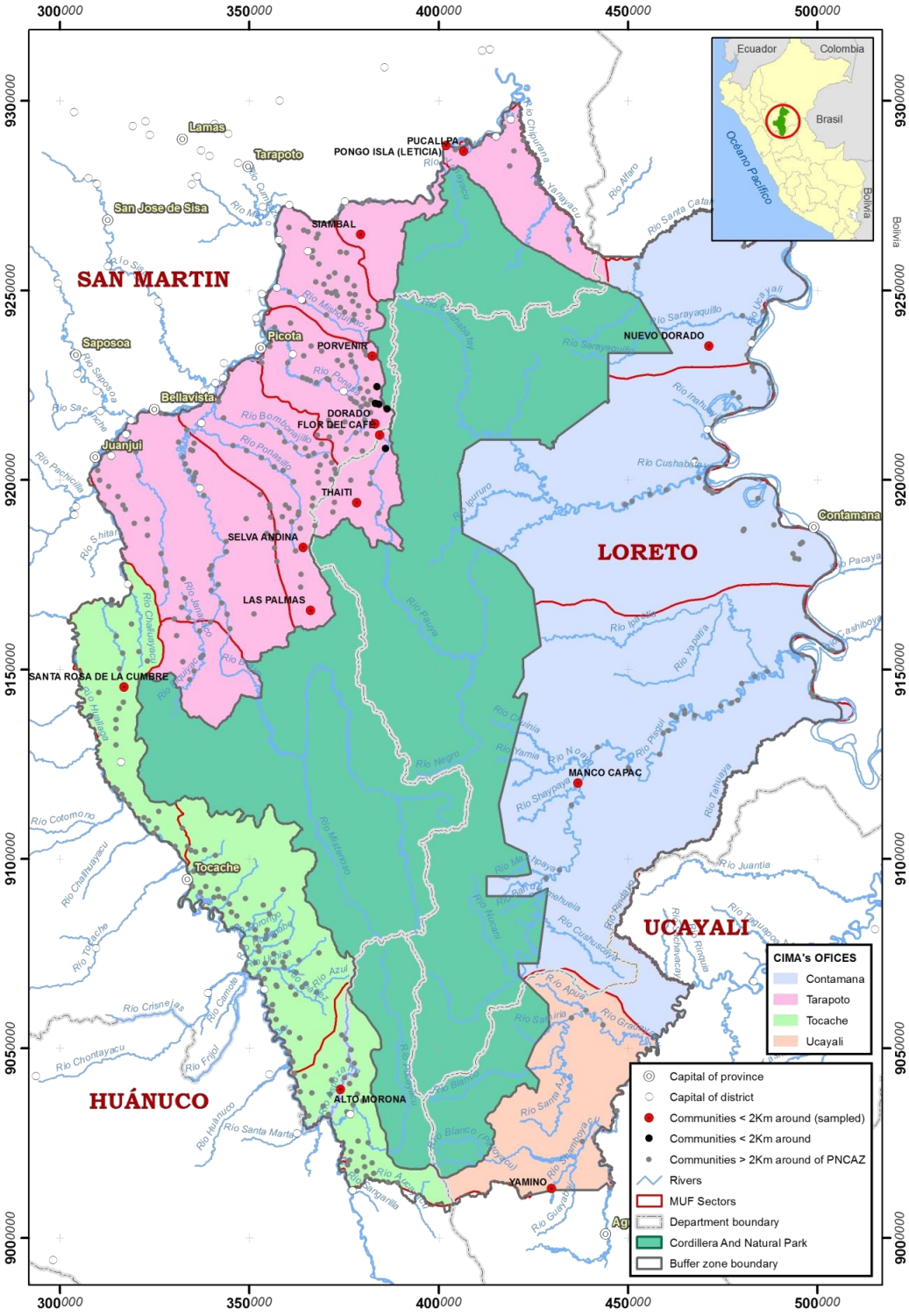
Figure 4.2.2. Results of 2016 wood collection surveys, source areas of wood collection by respondents (percentages represent % of respondents identifying a given source area; percentages do not sum to 100% across source areas as multiple source areas may be identified by a single respondent).



The methodology module M-MON requires that "If ≥ 10% of those interviewed/surveyed believe that degradation may be occurring within the project boundary then the limited on-the-ground degradation survey shall be triggered." Thus, no further surveys are warranted.

Among respondents giving information on the maximum distance travelled to collect wood, the average maximum distance stated was 1.2 km for fuel wood (min: 0 km, max: 8 km) and 2.9 km for lumber (min: 0.1 km, max: 10 km). There are only 20 communities located within 2 km of the project area (Figure 4.2.3), thus the potential for degradation from fuel wood and lumber collection is small.

Figure 4.2.3: Communities identified within 2 km of the project area/leakage belt interface



Further, the results of the degradation surveys are supported by reports from PNCAZ park guards during the 2014-2015 monitoring period, with a total of 428 control patrols focused on the boundaries between the PNCAZ and its buffer zone (Table 4.2.9), which reported only one instance of illegal timber extraction, reported and resolved in the area of Rio Blanco, just in the boundary between the project area and its buffer zone, in December 2014. In fact, many respondents to the degradation surveys noted the lack of a local commercial market for fuel wood or timber.

Table 4.2.9: Routine park guard patrols, infractions encountered and estimated area of impact in the PNCAZ and its buffer zone

Year	No. of patrols	No. of infractions	Conservative estimate of area of impact[3]
2014 (Aug-Dec)	201 patrols from 21 Control Points	0 infractions in the project area and 1 in buffer zone	---
2015 (Jan-Ago)	227 patrols from 21 Control Points	0 infractions in the project area	---

Source: Annual report to SERNANP

Net project emissions within the project area calculated in Table 4.2.10 are based on the change in carbon stocks during the 2015 monitoring period.

Table 4.2.10: Net project emissions with the project area *ΔCP (*t CO_2-e)

Year	ΔCP,DefPA,i,t	ΔCP,Deg,i,t	ΔCP,DistPA,i,t	ΔCP
2015	19,759.7	0	2,751.5	22,511.2

4.3 Leakage

Leakage monitored in the project case is related to activity shifting of local and immigrant agents. Activity shifting from local agents (in the leakage belt) was tracked by monitoring deforestation and stock changes in the leakage belt in 2015

Table 4.3.1: Area deforested in the leakage belt in 2015 *ADefLB,u,i,t* (ha)

Year	*ADefLB,u,i,t* (ha)			Total
	Anthropogenic (forest)	Humedales – wetlands	Terra firme	
2015	2,110.1	1,803.5	8,367.8	12,281.4

Emissions were calculated as the difference between stocks before and after deforestation, as for project emissions.

Table 4.3.2: Emissions from deforestation in the leakage belt in 2015 (t CO_2e)

Year	ΔCP,DefLB,i,t (tCO_2)			Total
	Anthropogenic (forest)	Humedales – wetlands	Terra firme	*ΔCP,DefLB,i,t*
2015	943,400.6	1,015,979.4	3,490,779.5	5,450,159.5

The net greenhouse gas emission in the project case for the leakage belt, parameter *ΔCP,LB*, is equal to the sum of stock changes dues to deforestation in 2015, equal to 5,450,159.5 t CO_2e. Calculations of activity shifting leakage occurring in the leakage belt in the with-project case ($\Delta C_{LK\text{-}ASU\text{-}LB}$) are consolidated in Table 4.3.3 below.

[3] Previous findings indicate that the impacts of illegal harvest in the project area, if they do occur, are insignificant at the project scale. Conservative assumptions: (1) reported infraction represented an area of impact of 0.9 ha, (2) park guards only detect 10% of incidents of illegal logging in the patrolled area and (3) illegal logging is likely to be concentrated along access routes which are travelled by the patrols.

Table 4.3.3: Calculations of area subject to activity shifting leakage in the leakage belt

equation	Derived in PD Sections 3.1 and 3.3		Derived from forest inventory estimates	M-MON 4	LK-ASU 1
Year	$\Delta C_{BSL,LK,unplanned}$ t CO_2	$A_{DefLB,u,i,t}$ ha	$\Delta C_{pools,Def,u,i,t}$ t CO_2/ha	$\Delta C_{P,DefLB,i,t}$ t CO_2	$\Delta C_{LK\text{-}ASU\text{-}LB}$ t CO_2
2015	16,928,880.86	12,281.4	Varies by strata	5,450,159.45	-11,478,721.41

Emissions from deforestation in the leakage belt were less than the projected emissions from deforestation in the leakage belt, and thus no leakage from activity shifting within the leakage belt is accounted.

Activity shifting leakage outside the leakage belt was tracked by monitoring deforestation in the project area ($A_{DefPA,i,t}$) and leakage belt ($A_{DefLB,i,t}$) and carrying out community surveys to update information on the proportion of recent immigrants in the population within the proximity of the project area bounds.

Derivation of $PROP_{IMM}$ parameter

From January to February 2015, surveys were carried out in 13 communities in the buffer zone of PNCAZ by CIMA to determine the percentage of recent immigrants (i.e. arrived after 2009, within less than or equal to 5 years of the survey). In each community, 20 to 40 households were surveyed depending on the size of the community (*i.e.* number of surveys was proportional to the size of the community). Communities were selected based on their relative dependence on the forest in the project area, and hence targeted those communities most likely to include baseline agents of deforestation. A total of 493 households and 1,721 persons were interviewed in total.

Persons who had immigrated to the community after 2009 (i.e. having arrived less than or equal to 5 years ago), and older than five years, were identified as recent immigrant potential deforestation agents. Per VM0007, the parameter $PROP_{IMM}$ is defined as "the proportion of area deforested by population that has migrated into the area in the last 5 years ($PROP_{IMM}$)." As it is extremely sensitive to ask explicit questions regarding responsibility for deforestation, interviewed persons were instead asked where they were originally from and when they had moved to the area. Thus, the percentage of recent immigrants among local population with potential access to the project area was used to infer "the proportion of area deforested by population that has migrated into the area in the last 5 years" (i.e. without directly asking if they are deforestation agents).

Results are detailed in Table 4.3.4. The resulting $PROP_{IMM}$ parameter is 19.7%, which is the average percent recent immigrant (potential deforestation agents) among the survey participants.

Leakage outside of the leakage belt has not occurred as calculated in Table 4.3.5. As stated in Module LK-ASU if parameter ALK-OLB,t <0 then leakage outside the Leakage Belt has not occurred. If leakage outside the Leakage Belt has not occurred: $\Delta C_{LK-ASU,OLB} = 0$

Table 4.3.4: Immigrant survey results 2015

Zone	Community	Number of surveyed households	Number of surveyed persons	Recent imm arrived > 2009 and >5 yrs ago	% recent immigrants
Tocache	Alto Marona	20	103	9	8.7%
Tarapoto	El Dorado	22	78	33	42.3%
Pampa Hermosa	Flor de Café	40	186	26	14.0%
Tarapoto	Flor de Selva	40	159	46	28.9%
Alto Biavo	Las Palmas	40	164	40	24.4%
Contamana	Nuevo Dorado	112	131	41	31.3%
Huimbayoc	Pongo Isla	12	48	5	10.4%
Shamboyacu	Porvenir	28	124	12	9.7%
Huimbayoc	Pucallpa	40	172	5	2.9%
Bajo Biavo	Selva Andina	40	179	47	26.3%
Tarapoto	Siambal	37	118	10	8.5%
Pampa Hermosa	Tahiti	40	158	64	40.5%
Aguaytia	Yamino	22	101	1	1.0%
	TOTAL	493	1721	339	19.7%

Table 4.3.5: Emissions calculations for activity shifting leakage outside the leakage belt

equation		Derived in PD Section 3.1	LK-ASU 7			LK-ASU 8	LK-ASU 9	Derived in PD in Section 3.3	LK-ASU 10
Year	$PROP_{IMM}$	$A_{BSL,PA,unplanned,t}$ ha	$A_{LK\text{-}IMM,t}$ ha	$A_{DefPA,i,t}$ ha	$A_{DefLB,i,t}$ ha	$A_{LK\text{-}ACT\text{-}IMM,t}$ ha	$A_{LK\text{-}OLB,t}$ ha	$PROP_{CS}$	$\Delta C_{LK\text{-}ASU,OLB}$ t CO_2
2015	19.70%	7939.9	1,564.2	38.6	12,281.4	2,427.0	-862.9	1.049	0

4.4 Net GHG Emission Reductions and Removals

Uncertainty

Deductions for uncertainty in carbon stock estimates and baseline deforestation projections were calculated applying module X-UNC. Total error in stock estimates (including live and dead above and belowground biomass C) from the 2009 PNCAZ forest inventory was +/- 7.5% of the mean at the 95% confidence level (Table 4.4.1).

Table 4.4.1: Overall forest carbon density (live and dead above and belowground biomass C)

Mean Forest Carbon Density (t C/ha)	151.0
Standard Error (t C/ha)	5.68
90% Confidence Interval (t C/ha)	9.5
95% Confidence Interval (t C/ha)	11.4
90% Confidence Interval as percentage of mean	6.3%
95% Confidence Interval as percentage of mean	7.5%

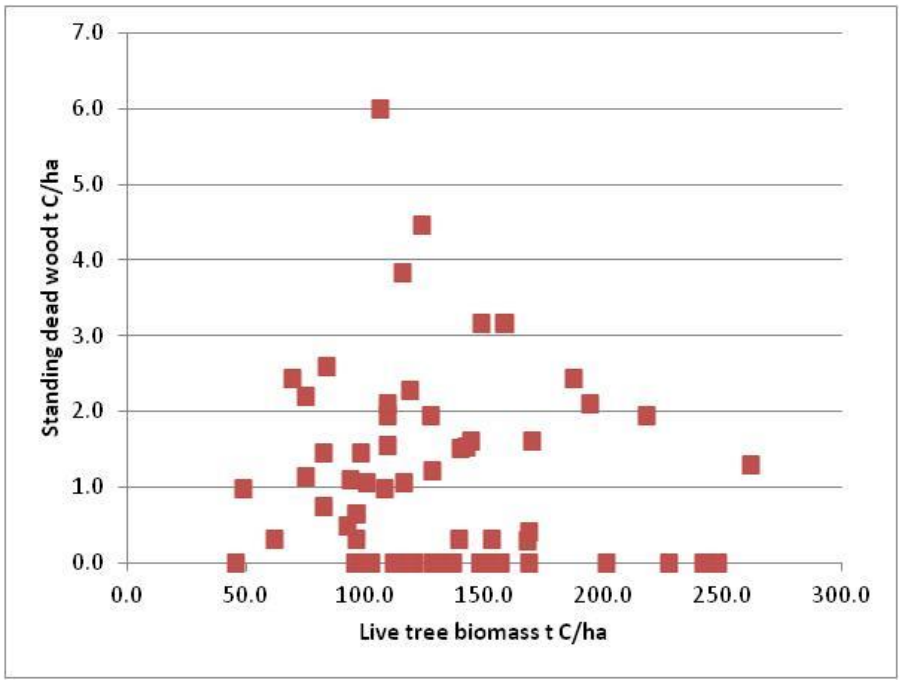
Source: Shoch et al. 2009 *Forest biomass carbon inventory of the Parque Nacional Cordillera Azul (PNCAZ)*

Note that error was not propagated across pools, because error propagation formulas require independence among component sources of error. This assumption often does not hold for aboveground biomass and dead wood, which are often inversely correlated (Figure 4.4.1), and instead pools are summed and composite errors estimated at the strata level, then propagated across strata.

Uncertainty in baseline deforestation projections was assessed referencing the 95% confidence interval of the regression model (Figure 4.4.2).

Only RRD subset 2 contributes to overall uncertainty. RRD subset 1, Huimbayoc, has a baseline rate of zero, thus its contribution to total uncertainty is zero. Calculations are detailed in Table 4.4.2 that follows the figures.

Figure 4.4: Standing dead wood plotted against live tree biomass, demonstrating apparent inverse correlation between live tree biomass and maximum standing dead wood.



Source: 2009 PNCAZ forest inventory (n=64)

Figure 4.5: The 95% confidence interval (dashed lines) of predicted deforestation rate

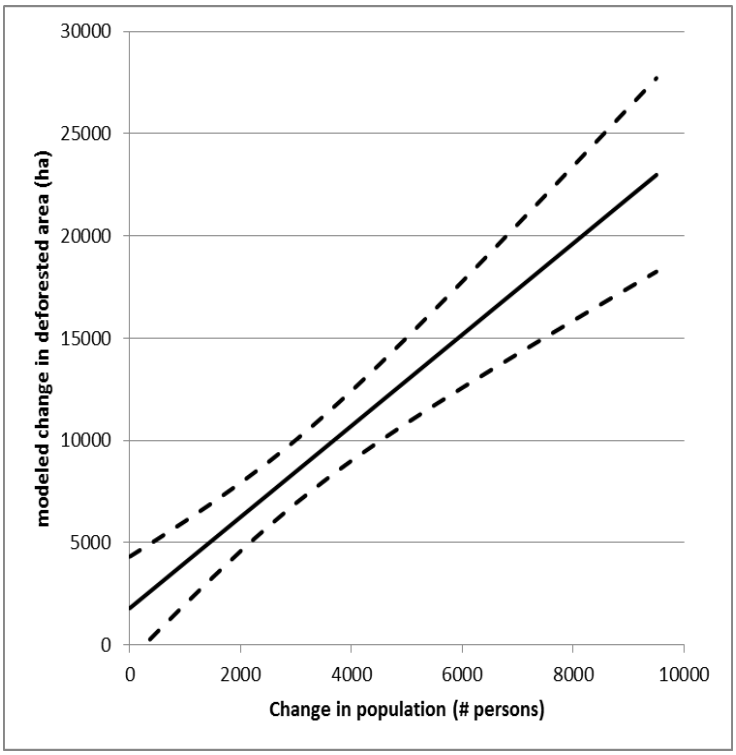


Table 4.4.2: Summary of uncertainty calculations

X-UNC eq #	5	Derived in PD Section 3	Regression model	1	3	6	10	11
Year	*Uncertainty* $_{BSL,SS}$	Total population change	Modeled deforestation (ha)	*Uncertainty* $_{BSL,RATE,t}$	*Uncertainty* $_{BSL,RATE,t^*}$	*Uncertainty* $_{BSL,t^*}$	C_{REDD_ERROR,t^*}	*Adjustment factor applied to* C_{REDD,t^*}
2015	7.5%	22694	52412	26%	10%	12%	12%	100%

The final adjustment factor in Table 4.4.2 above is applied to parameter $C_{REDD,t}$, cumulative total net GHG emission reductions at time *t*, to produce parameter $Adjusted\_C_{REDD,t}$, cumulative total net GHG emission reductions at time *t* adjusted to account for uncertainty.

Summary of net emission reduction calculations

Estimates of GHG credits eligible for issuance as VCU's are found in the table 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)

Table 4.4.3: Table of estimated net GHG emission reductions or removals during this monitoring period (8 August 2014 to 7 August 2015)

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)	Risk buffer (%)	Deductions for AFOLU pooled buffer account	Available VCUs (tCO2e))
Total 2015	3,396,760	22,511	0	3,374,248	10%	337,424	3,036,823

APPENDIX 1: INTERPRETATION AND CLASSIFICATION OF IMAGERY

Landsat imagery

The Landsat program has provided the longest temporal archive of moderate resolution satellite imagery available, and as of 2008 USGS made all of this data freely available to all users. The combination of frequent data capture, moderate resolution (30m) and accessibility have made Landsat data the most widely used satellite platform for land cover change analysis.

On May 31, 2003 the Scan Line Corrector (SLC) in the ETM+ instrument failed on Landsat 7. The SLC consists of a pair of small mirrors that rotate about an axis in tandem with the motion of the main ETM+ scan mirror. The purpose of the SLC is to compensate for the forward motion (along-track) of the spacecraft so that the resulting scans are aligned parallel to each other. Without the effects of the SLC, the instrument images the Earth in a "zig-zag" fashion, resulting in some areas that are imaged twice and others that are not imaged at all. The net effect is that approximately one-fourth of the data in a Landsat 7 scene is missing when acquired without a functional SLC. Therefore all Landsat 7 imagery after 2003 first has significant data gaps.

As a result the older platform, Landsat 5, was used more frequently. Landsat 5 had a critical instrument error in November 2011 which resulted in the suspension of all imagery acquisition. From late 2011 until the launch of Landsat 8 in February 2013, the only available Landsat imagery was from the Landsat 7 sensor with the SLC-error. Therefore, to conduct a monitoring event for 2012 required a modification of the original classification procedures to compensate for the scan line error which was detailed in the previous monitoring report. Landsat 8 imagery became available in 2013 and therefore was used preferentially over Landsat 7 in this monitoring period. Due to cloud coverage in many areas, Landsat 7 was used in some scenes to help fill in gaps.

This combination of Landsat 7 and Landsat 8 is the same for this monitoring period as for the previous one, and does not constitute a change in platform since Landsat platforms are cross-calibrated. As stated in the module M-MON, if the same remotely sensed spatial data source used in baseline development is no longer available (e.g., due to satellites or sensors going out of service) an alternate source may be used. To ensure consistency with all previous monitoring events, the classification method employed followed the approach used for the previous monitoring events in 2014 and 2012. This method was used both to ensure continuity in the analysis and to overcome the problem of cloud cover. All methods are based on common good practice in the remote sensing field.

To overcome the cloud cover and shadow problems and maintain continuity with the previous monitoring, all available 2015 images from the reference region were combined through a post-classification concatenation procedure. For each Landsat path/ row in the reference region all images with useable (cloud free) data were obtained from USGS EarthExplorer. Figure 5.1 shows the location of each scene and Table 5.1 shows the collection of images that were used in the final classification.

Figure 5.1: Landsat path/row scene location

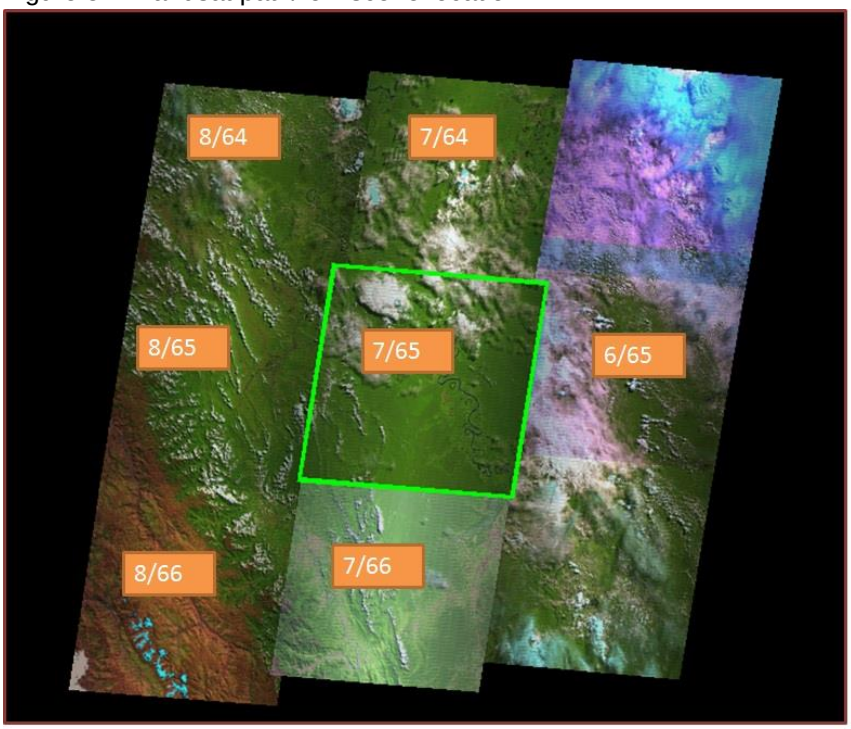


Table 5.1: Images that were used in the final classification

Path Row	Date	Image ID	cloud cover
path 7 row 66			
	4/23/2015	LC80070662015093LGN00	21.23
	8/25 /2015	LC80070662015237LGN00	8.57
	9/10/2015	LC80070662015253LGN00	8.18
	10/28/2015	LC80070662015301LGN00	18.78
L7	10/20/2015	LE70070662015293EDC01	14
L7	2/6/2015	LE70070662015037CUB00	41
L7	8/1/2015	LE70070662015213CUB00	7
path 6 row 65			
	5/18/2015	LC80060652015230LGN00	0.93
	10/21/2015	LC80060652015294LGN00	1.89
path 7 row 65			
	8/9/2015	LC80070652015221LGN00	3.27
	8/25 /2015	LC80070652015237LGN00	2.36
	9/10/2015	LC80070652015253LGN00	0.64
	11/13/2015	LC80070652015317LGN00	21.09

path 8 row 65			
	6/29/2015	LC80080652015180LGN00	27.42
	6/13/2015	LC80080652015164LGN00	22.3
	7/15/2015	LC80080652015196LGN00	31.71
	9/17/2015	LC80080652015260LGN00	21
L7	12/6/2015	LC80080652015340LGN00	33.25
L7	8/8/2015	LE70080652015220EDC00	22
L7	9/9/2015	LE70080652015252EDC00	16
L7	9/25 /2015	LE70080652015268EDC00	33.8
path 7 row 64			
	9/10/2015	LC80070642015253LGN00	0.18

Pre-processing

When using Lansat 8 data, imagery can be obtained from Earth Resource Observation Systems - EROS with multiple pre-processing steps completed. These processing steps are summarized below and more detail information can be found from NASA[4].

The 1G product available to users is both radiometrically and geometrically corrected. The correction algorithms employed model the spacecraft and sensor using data generated by onboard computers during imaging events and ground control points and a digital elevation model are also used to improve the overall geometric fidelity. The geometric correction process utilizes both ground control points (GCP) and digital elevation models (DEM) to attain absolute geodetic accuracy. The WGS84 ellipsoid is employed as the Earth model for the Universal Transverse Mercator (UTM) coordinate transformation. Associated with the UTM projection is a unique set of projection parameters that flow from the USGS General Cartographic Transformation Package. The end result is a geometrically rectified product free from distortions related to the sensor (*e.g.*, jitter, view angle effects), satellite (*e.g.,* attitude deviations from nominal), and Earth *(e.g.,* rotation, curvature, relief).

When using Level 1G-processed imagery, geometric accuracy should be confirmed, but extra geo-referencing steps are unnecessary.

Processing

Each image was processed using a hard classification technique. Using a clustering technique all useable data were identified. Through this process, pixels are grouped according to their spectral similarities and are then identified to land cover classes. Therefore pixels with no data due to clouds and shadow can be removed. For each image, the remaining data is processed to identify all forest and non-forest clusters. Using known areas of forest, these cluster groups are identified and clumped. The same process is conducted for non-forest clusters. Since the non-forest category also includes categories that can be difficult to separate, such as agroforestry,

[4] http://landsathandbook.gsfc.nasa.gov/level/

secondary forests, swamps and mountain areas that have illumination variability, a secondary classification step was used in cases when forest and non-forest could not be distinguished. Challenges were isolated for clusters in all classes that included potential confusion and separability. These areas were processed again through a secondary cluster analysis focused only on these categories, and resulted in further dividing confusion classes. Through careful inspection of these new finely distinguished clusters, areas of non-forest were distinguished. This secondary classification was done for the best images available for each area (path/row). All areas that were identified as non-forest through this process (agriculture & re-growth) were then aggregated. In a final processing step all forest and non-forest groups from each image are then combined.

Post-processing

After all areas of usable 2015 data were distinguished into forest and non-forest, a mode filtering procedure was used to align the classification as closely as possible with the Peruvian DNA forest definition. A 3 pixel x 3 pixel filter was used which increases the minimum mapping unit to 0.81 ha. (90m x 90m). In some cases where clouds, cloud shadows and terrain shadows caused classification errors, shadow effects were delineated and classified correctly.

The result of this classification procedure is shown in Figure 5.2. where 99% of the reference region is classified with less than 1% unclassifiable due to cloud coverage (Table 5.2).

Figure 5.2: 2015 Classification for full reference region

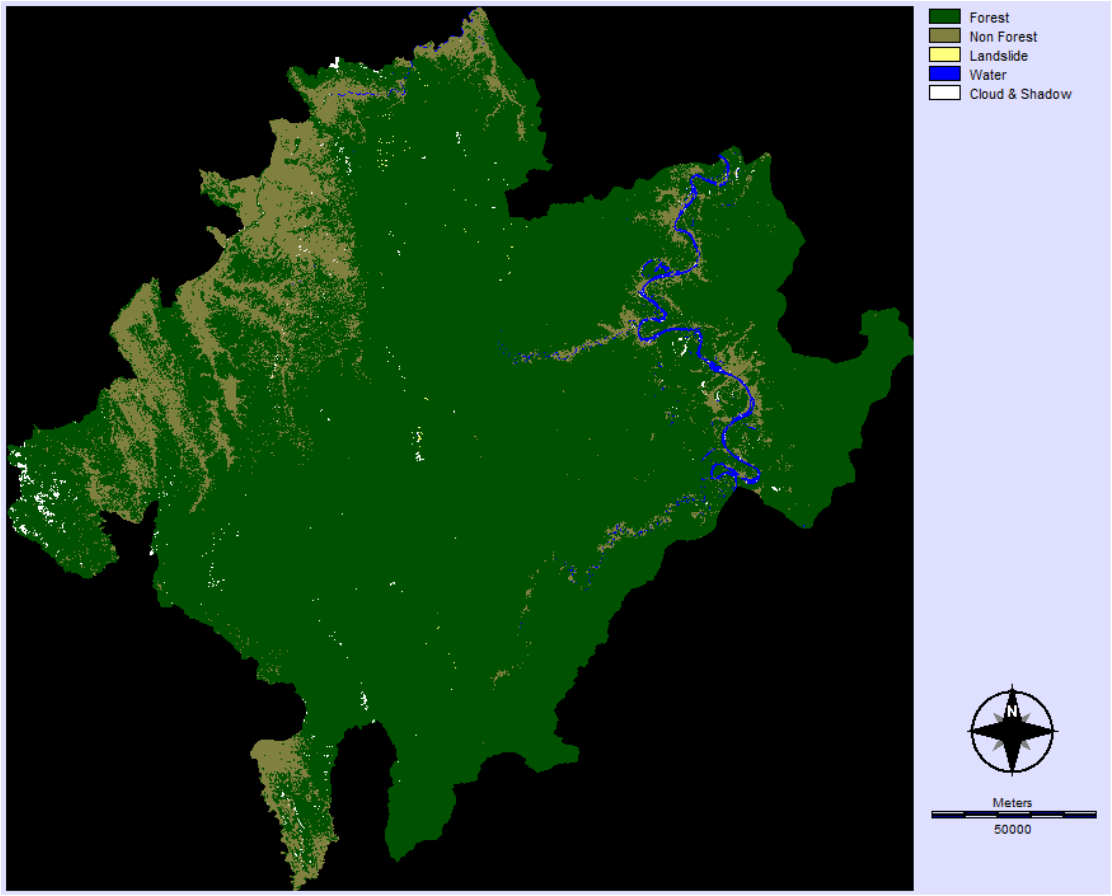


Table 5.2: Classification area

Category	Hectares
Forest	3,435,650.82
Non-Forest	129,258.18
Cloud & shadow	**14,069.16**
Total area classified	3,607,419.24
% cloud	0.39%

Analysis of the total cloud cover in the year 2014 and 2015 show that less than 10% of the region is obscured by clouds for both years combined (Table 5.3).

Table 5.3: Cloud obscured total area

CLOUD COVER ANALYSIS	ha	% of area
Area that is clouded in 2014 & 2015	6,100.1	
Area this is only clouded in either 2014 or 2015	205,413.9	
Cloud cover total for both dates	211,514	5.86%

Quality Assurance/Quality Control

To ensure consistency and quality results, all data sources and analytical procedures are documented and archived (detailed under data archiving above).

Accuracy of the classification was assessed by comparing the classification with ground truth points and samples of high resolution imagery (Quickbird imagery/ Astirum ~5m resolution available on Google Earth). All data collected from ground-truth points are recorded (including GPS coordinates and identified land-use class) and archived. Any sample points of high resolution imagery used to assess classification accuracy are also archived. Samples used to assess classification accuracy are well-distributed throughout the classification area (as far as is possible considering availability of high resolution imagery), with a minimum sampling intensity of 50 points each for the forest and non-forest classes. Distribution of all points is shown in Figure 5.3.

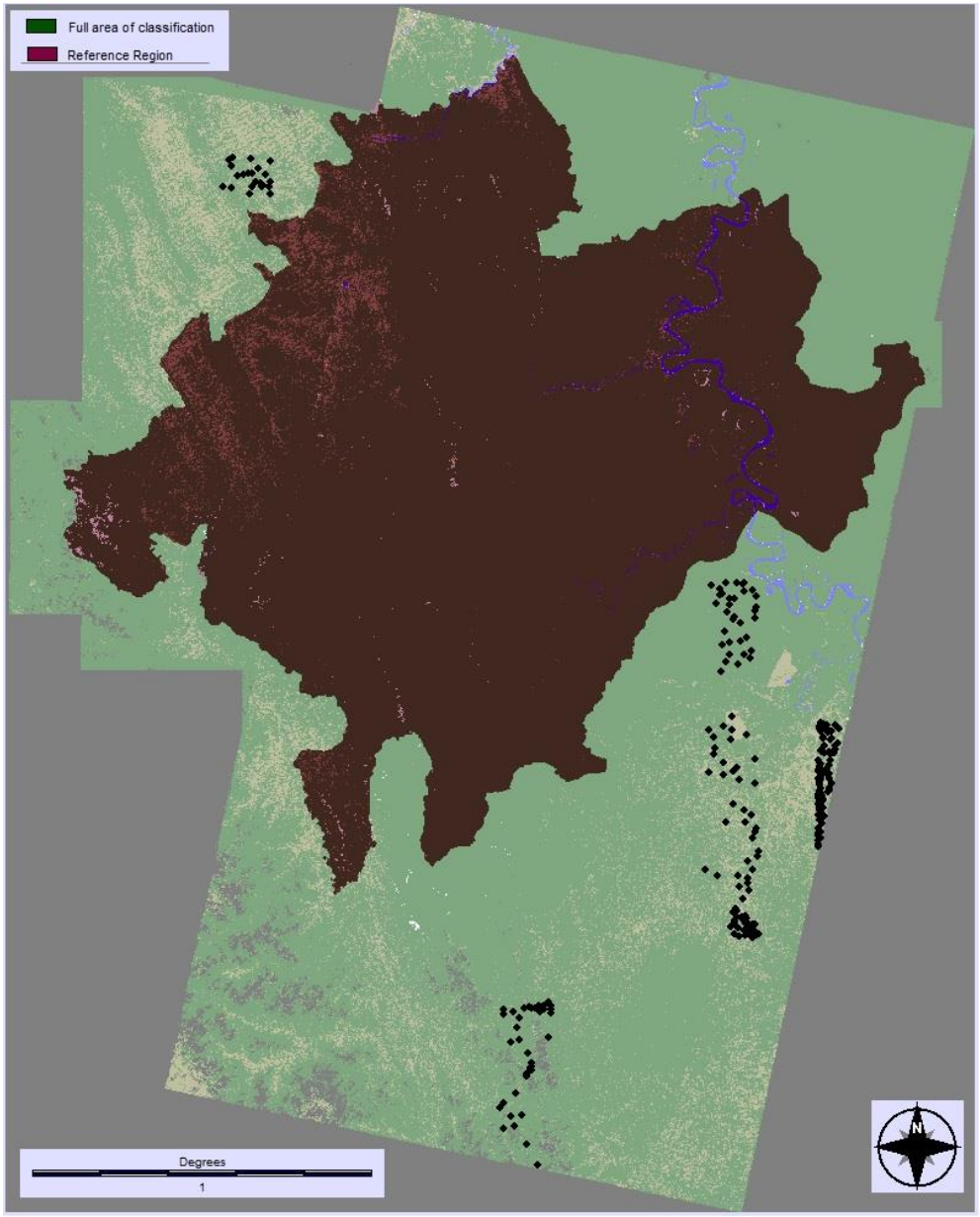
All available 2015 imagery was used in this accuracy assessment, but no points fell within the project areas. The map below shows the distribution of points in the fullclassifiaction area. When classification is conducted the full landsat scenes are used which covers an area much greater than the reference region alone. The accuracy assessment point all fall within the classification area, but outside of the reference region. This is a conservative approach since the landscape surrounding the reference region represents very challenging herterogenous mixtures of forest and non-forest.

Overall classification accuracy was 95.5% Results of the accuracy assessment are in Table 5.4.

Table 5.4 Classification accuracy assessment 2015

Classification	**Land-use class as determined from ground-truth points**		**Total**	**Accuracy (%)**	**Error of Commission (%)**
				User's accuracy	
	Forest	**Non-forest**		***(# correct/ row total)***	
Forest	119	9	128	93.0%	7.0%
Non-forest	2	115	117	98.3%	1.7%
Total	121	124	245		
Accuracy (%) ***Producer's accuracy*** ***(# correct/ column total)***	98.3%	92.7%		Overall Accuracy	
Error of Omission (%)	1.7%	7.3%		95.5%	

Figure 5.3: Accuracy assessment points



New benchmark maps were created for 2015 for the project area (Figure 5.4) and leakage belt (Figure 5.5)

Figure 5.4: Project Forest Cover Benchmark Map 2015

Figure 5.5: Leakage Belt Forest Cover Monitoring Map 2015