# APRIL SALUMEI REDD PROJECT MONITORING REPORT

# 1ST PROJECT REPORTING PERIOD

Document Prepared By Environmental Accounting Services

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|---|---|
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# 1 PROJECT DETAILS

## 1.1 Summary description of the Project

The April Salumei REDD Project ('the Project') is a pilot project located in the Wosera Gawi and Ambunti Drekiker Districts in East Sepik Province of Papua New Guinea. The Sepik River area has been identified as one of the least developed areas within Papua New Guinea (WWF, undated). The area is rich in traditional culture and possesses extraordinary levels of biodiversity. The Project is located approximately 122 kilometers (km) from the provincial town of Wewak within north-western Papua New Guinea. The location of the Project Area is shown in Figure 1.

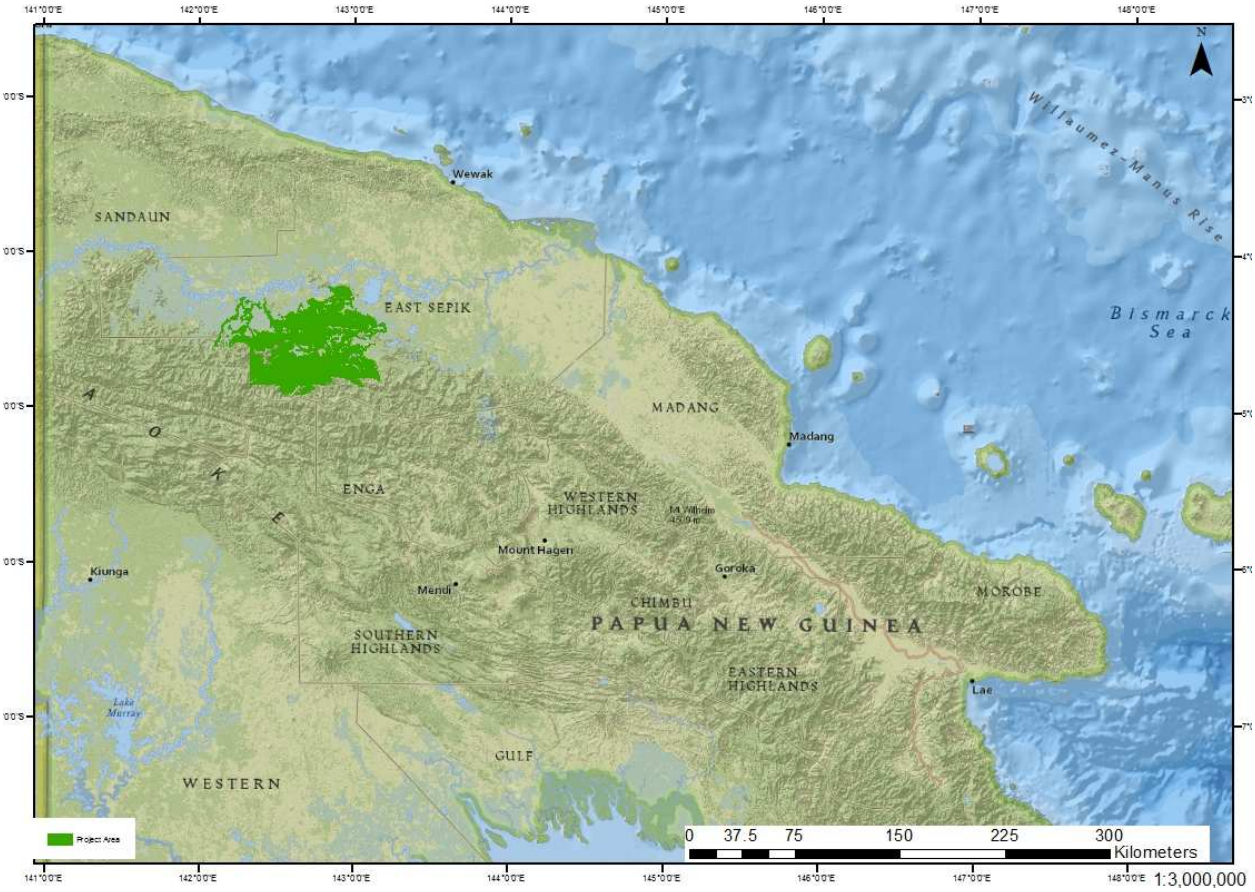



**Figure 1: Location of the Project in relation to Papua New Guinea**

Source: EAS for Rainforest Project Management, 2012.

The Project Area is defined by the area of forested land on mineral soils within the boundaries of two Forestry Management Agreements (FMA) namely; April Salumei (530,868 ha) and April River (75,313 ha) with a combined area of 606,181 hectares (ha)[1]. An FMA is a legal agreement between the landowners and the Government (issued via the Papua New Guinea Forest Authority). Under the terms of the FMA, the landowners have authorised the issuance of a 50-year timber concession license, allowing harvesting of timber in the FMA. This normally involves the approval of a timber harvest plan for the first rotation (between 30 and 40 years), and then on approval by the Forest Authority, the FMA is extended for a second rotation.

[1] The variation in total area between the FMA boundaries and the Project area boundaries have resulted due to the discovery of peat soils in the FMA. Areas of peat were mapped and excluded in accordance with the selected VCS methodologies.

The Project Area fits into two different VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Categories[2] depending on whether the forest is converted during the baseline crediting period. These categories are Reduced Emissions from Deforestation and Forest Degradation – Avoided Planned (Sanctioned) Deforestation (REDD-APD), and Improved Forest Management – Logged to Protected Forest (IFM – LtPF), as shown in Figure 2 below. For the remainder of this document, the boundaries of the two different Project categories are collectively referred to as the 'Project Area'.

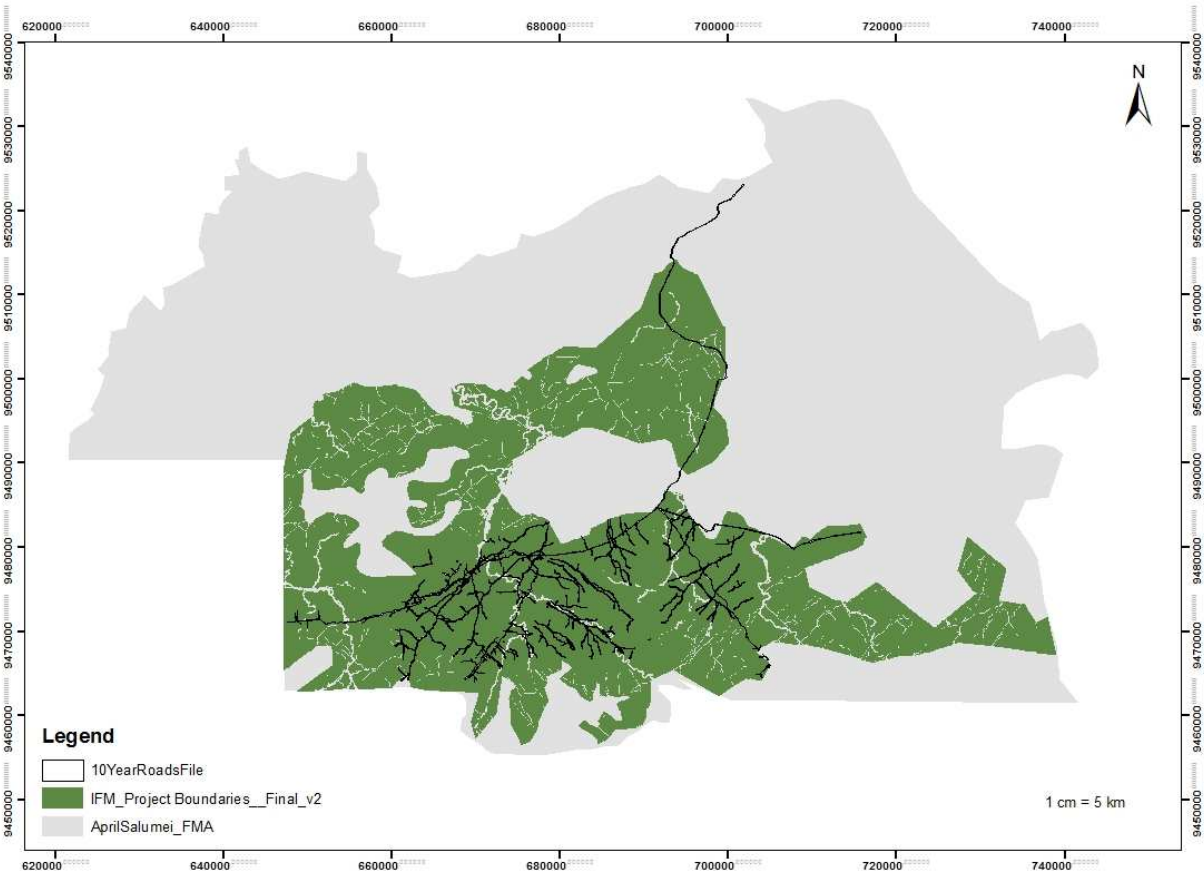



**Figure 2: Project Boundaries for the two VCS Project Categories (APD & IFM)**

Source: EAS for Rainforest Project Management, 2012

[2] VCS AFOLU Guidelines V3.3, Section 3.1.8 states that "Projects may include multiple project activities where the methodology applied to the project allows more than one project activity and/or where projects apply more than one methodology, as set out in the VCS Standard. Such projects shall comply with the respective project requirements of each included AFOLU category. For each activity covered by a different methodology, the geographic extent of the area to which the methodology is applied shall be clearly delineated.

The key project attributes for the two categories of the Project are summarised in Table 1 below.

**Table 1: Summary of the key attributes of the Project**

| | REDD-APD | IFM - LtPF |
|---|---|---|
| **Project Area (ha)** | 7,640 | 196,703 |
| **Geographical Position** | Centroid: 4°33'31"S and 142°41'20"E | |
| **Forest Type** | Moist Tropical Rainforest - Low Altitude Forest | |
| **Soil Type** | Hydraquents and fluvaquents in wetlands and river banks. Humitropepets and dystropepts in higher elevations[3] | |
| **Baseline sequence of activities leading to deforestation or degradation** | 1. Construction of roads that are sanctioned and developed to allow timber extraction.<br>2. Planned road development was modeled as specified in the Forest Management and Development Proposal (FMDP), however road development regularly exceeds the code requirements and leads to more extensive and rapid road development. | 1. Legal timber harvesting as permitted under a Forestry Management Agreement (FMA) in accordance with a valid and verifiable Forest Management and Development Proposal (FMDP)<br>2. Timber extraction rates were modeled to occur in accordance with the FMDP. In reality, extraction rates often exceed those in the plan. |
| **Legal Land Use Classification** | Primary intact forest | |
| **Selected Methodology** | REDD Methodology Modules, v1.3. VM0007 | Methodology for Improved Forest Management: Conversion from Logged to Protected Forest, v1.2 VM0010[4] |

The aim of this Project is to protect the forest and biodiversity of the Project Area whilst providing important source of income for the impoverished landowners that reside within it. The Project also aims to improve wellbeing of local communities in the Project Area through the development of viable sustainable agriculture opportunities; as well as by improving access to healthcare, education and infrastructure; while preserving the local communities' rich cultural traditions and customs.

[3] Source: Development Option Study for April Salumei, 1996
[4] As this methodology was on-hold at the time of writing, the updated but yet-to-approved version (v1.2) was used to prepare this PD and the associated calculations

### 1.2 Sectoral scope and project type

The April Salumei REDD Project falls under the 'AFOLU' sectoral scope of the VCS. Table 2 shows the Project scope, category, activity and grouping classification.

**Table 2: VCS sectoral scope, project category, activity and grouping classification**

| Scope | Category | Activity | Grouped or Multiple Project |
|---|---|---|---|
| 14 – Agriculture, Forestry and Other Land Use | Avoided (Sanctioned) Planned Deforestation | Protection without logging, fuel wood collection or charcoal production | Multiple |
| 14 – Agriculture, Forestry and Other Land Use | Improved Forest Management | Conversion from Logged to Protected Forest | Multiple |

### 1.3 Project Proponent

The Project Proponent is Rainforest Project Management Limited. Rainforest Project Management was granted the rights to develop and manage the project by the landowners and the Papua New Guinea National Government. Contact details for the Project Proponent are summarised in Table 3 below.

**Table 3: Project Proponent details**

| Project Proponent | Address | Contact Person | Contact Details |
|---|---|---|---|
| Rainforest Project Management Limited (Company No 1-72274) | Po Box 3319, Boroko, NCD, Papua New Guinea | Stephen Hooper | Phone: +61 (0) 488 088 321<br>Email: shooper@p-f-a.org |

### 1.4 Other entities involved in the Project

Rainforest Project Management has partnered with a number of organisations to assist with the design, development and operation of the April Salumei REDD Project, as described in Table 4 below.

**Table 4 Summary of other entities involved in the Project**

| Name of project partner/stakeholder | Role in the project | Roles & responsibilities |
|---|---|---|
| Incorporated Land Groups (ILGs) | Land owners | Owners of the land. Project staff. Chairman of the ILGs has a seat on the April Salumei Group. |
| Pacific Forest Alliance | Implementation partner | Specifically established to manage the project. For more information see: http://www.pacificforestalliance.org |
| April Salumei Working Group | Implementation partner | Responsible for development of the Project Management Plan. Consists of members and representatives of the landowners within the Project Area |
| Environmental Accounting Services (EAS) | Lead technical & VCS consultant | Technical design and development of the carbon project elements including fieldwork, remote sensing analysis, and historical land use change analysis and technical project development. Also responsible for development of documentation and systems to achieve validation and verification against the VCS. |
| University of Papua New Guinea, School of Natural and Physical Sciences: | Technical support | Provision of expert advice on forestry, climate change, natural resources, geology, mining, GIS, geography, sustainable development, hydrology, biodiversity, community livelihoods, law and policy. Assisted with the collection of field inventory data |
| Papua New Guinea Forest Research Institute | Technical and implementation support | Provided expert advice in tropical forestry and REDD management in Papua New Guinea. Assisted with the collection of field inventory data. Conducted Government liaison for the Project. |
| Papua New Guinea Forest Authority | Government authorisation | Responsible for: official Government approval of the project; provision of forest inventory data and provincial land use planning; advice on REDD project implementation |
| Prime Minister and Office of Climate Change and Development | Policy support | Advice on REDD policy and implementation |
| Partners with Melanesia | Community development | Not for Profit (NGO) focused on conservation and community development programmes in Papua New Guinea |

### 1.5 Project start date

The project start date is May 22, 2009. This is the date that the first agreement was signed between the Landowner Companies and a Project Developer to develop the April Salumei FMA into a Carbon Project.

The start and end dates for the historical reference period, fixed baseline period and the monitoring period are provided in Table 5 below.

**Table 5: Temporal boundaries of the Project**

| Temporal boundary | Start Date | End Date |
|---|---|---|
| Fixed baseline period | 22 May 2009 | 21 May 2019 |
| First Monitoring period | 22 May 2009 | 31 December 2012 |

### 1.6 Project crediting period

The crediting period for the project is 38 years (i.e. approved timber harvest plan is for 40 years) as shown in Table 6 below.

**Table 6: Project crediting period**

| Time Period | Start Date | End Date | No of years |
|---|---|---|---|
| Project crediting period | 22 May 2009 | 21 May 2047 | 38 |

### 1.7 Project scale and estimated GHG emission reductions or removals

Table 7 shows the GHG emissions reductions that are expected to be achieved by the Project over its first crediting period.

**Table 7: Estimated GHG emission reductions from the project over the first ten years of the crediting period**

| Year ending | Estimated GHG emission reductions REDD-APD ($tCO_2e$) | Estimated GHG emission reductions IFM-LtP ($tCO_2e$) | Total Estimated GHG emission reductions ($tCO_2e$) |
|---|---|---|---|
| May 2010 | 96,001 | 117,295 | 213,296 |
| May 2011 | 98,684 | 144,627 | 243,311 |
| May 2012 | 101,367 | 171,959 | 273,326 |
| May 2013 | 113,441 | 199,291 | 312,732 |
| May 2014 | 106,733 | 226,622 | 333,355 |
| May 2015 | 109,416 | 253,954 | 363,370 |
| May 2016 | 112,099 | 281,286 | 393,385 |
| May 2017 | 114,782 | 308,618 | 423,400 |
| May 2018 | 117,465 | 335,950 | 453,415 |
| May 2019 | 120,148 | 363,282 | 483,430 |
| **Total estimated ERs** | **1,090,136** | **2,402,884** | **3,493,020** |
| Total number of crediting years | 10 | 10 | 10 |
| **Average annual ERs** | **109,013.6** | **240,288** | **349,302.00** |

This demonstrates that the April Salumei REDD Project qualifies as a 'Large-Project' as shown in Table 8.

**Table 8: Classification of Project scale**

| **Project** | |
|---|---|
| **Large project** | X |

### 1.8 Project Location

The Project Area is located within the Wosera Gawi and Ambunti Drekiker Districts in the East Sepik province of Papua New Guinea. A map of this location in relation to Papua New Guinea can be seen in Figure 1, while Figure 2 shows a more detailed image of Project Area. The Geographic boundaries of the Project Area are described in more detail in Table 9 below.

**Table 9: Geographic boundaries of Project Area**

| Requirement | VM0007 Evidence | VM0010 Evidence |
|---|---|---|
| Project Area Name | Logging roads | Timber Area |
| Maps (digital) of the area | Figure 2 | Figure 2 |
| Geographic co-ordinates of each polygon vertex and documentation of their accuracy | Boundary of deforested area defined by series of vectors representing modelled roads occurring across the entire extent of the FMA. | Coordinates define the project area:<br>Northern most point: 142°49”13.837” E; 4°28’51.249”S<br>Western most point: 142°19”32.34” E; 4°43’57.781”S<br>Southern most point: 142°33”39.457” E; 4°55’30.221”S<br>Eastern most point: 143°8”41.874” E; 4°51’0.353”S |
| Total land area (ha) | 7,640 | 196,703 |
| Forest land right and user rights | Subject to a FMA | |
| Project Area and Proxy Areas | A shapefile & KML file of the project boundaries provided as supporting documentation. File name: April Salumei_Project Boundaries_VM0007_Roads (KML file), Project Boundaries_Roads_Dec 14_2012 (ArcGIS file). | A shapefile & KML file of the project boundaries provided in supporting documentation. File name: IFM_TotalHarvestableArea_March27_final (ArcGIS file). |

### 1.9 Title and Reference of Methodology

As described previously, the Project Area is divided into two different VCS Project Categories with stratification of the Project Area used to delineate the spatial boundaries of each VCS Project Category for accounting purposes. These are:

- VM0007, ‘REDD Methodology Modules Version 1.3’ for areas of planned deforestation
- VM0010, ‘Methodology for Improved Forest Management: Conversion from Logged to Protected Forest Version 1.2’ for areas of logging in the baseline

# 2 IMPLEMENTATION STATUS

## 2.1 Implementation Status of the Project Activity

The Project has been in the development stage since 2009 and is now in the early stages of activity implementation. During the monitoring period 2009 -2012 the main activities undertaken by the Project have focused on the community and developing implementation plans through an on-going Participatory Rural Appraisal Approach.
The focus of this process has been to design operational objectives, frameworks and procedures combined with activity and development plans. These plans focus on how financial benefits from the Project will be distributed and the types of activities that are important to the communities who live within the Project Area. These activities were designed to mitigate deforestation and by default mitigate leakage and uphold project permanence.

This process has identified three primary development aims for the Project Area, categorised according to climate, community or biodiversity outcomes. These aims are:

- Climate: To avoid greenhouse gas emissions related to planned deforestation and timber harvest in the Project Area
- Community: To result in a net increase in the wellbeing of communities in the Project Area, via improved health standards, education, transportation, employment opportunities, community support for conservation, and equitable distribution of project benefits
- Biodiversity: To maximise biodiversity value of the Project Area by preventing habitat and therefore species loss

In order to achieve these objectives, the project has implemented (and will continue to implement) a number of activities as described below. It should be noted that project related activities do not lead to the clearance of any native ecosystems.

### *2.1.1 Climate related activities*

There are two main activities targeted towards reducing greenhouse gas emissions, as described below.

**Reclassification of the FMA as a REDD Project Area:**

The Project Area is defined by an FMA that permits the Papua New Guinea Forest Authority to award forest harvesting rights to a company for fifty (50) years. In agreements signed by the landowners with the Project Developer the landholders have agreed to terminate the FMA upon validation to the VCS[5]. This is possible under clause 16.1 (a) of the FMA agreement which states that the FMA can be terminated “by agreement at any time by all parties”. The National Government is the other Party to the FMA agreement through the Papua New Guinea Forest Authority. With the National Governments approval of the FMAs being the REDD pilot project through the NEC decision clearly demonstrates that both parties are in agreement to convert this area from an FMA to a REDD conservation project. Removal of the Project Area from the Papua New Guinea land registry will ensure that commercial logging concessions cannot be awarded in the future.

[5] This agreement can be made available on request to Third Party validators.

Pending cancellation of the FMA and its subsequent removal from the land registry, the Project Proponent has sought to protect the Project Area by formally delineating the area as a REDD pilot project. This was achieved on the 10th May 2012, when Papua New Guinea's authority for Climate Change, the National Executive Council (NEC) formally approved the project as a national level REDD pilot project. This is formally enshrined in a legally-binding National Decision (number 106/2012), which represents the highest level of a REDD Project approval possible in Papua New Guinea. A copy of this decision is available to the auditor in Annex 3.

**Monitoring of land use change within the Project Area:**

During the crediting period remote sensing was the primary activity undertaken to detect land use change in the Project Area.

Remote sensing will be combined with ground-based monitoring undertaken by project employees from the local area in future monitoring periods. These 'Community Rangers' will be given comprehensive training, including induction, communication skills, and computer training. In addition, 'Forest Stewards' will also be responsible for monitoring, observing and reporting of the forest at local level. They will be trained in measurement of key parameters like tree Diameter at Breast Height (DBH), tree height, tree count, classification of tree species, assessment of abnormalities (tree mortality, logging) and use of a GPS.

Forest Stewards will be required to report their observations on an immediate and/or annual basis, as outlined according to the schedule listed in Table 10 below. It is proposed that these field activities will commence the year following VCS validation.

**Table 10: Field based reporting schedule**

| Reporting frequency | Observed activity |
|---|---|
| Immediate | Illegal logging |
| | Fire |
| | Any other loss of resource |
| Annual (commencing the year following validation) | Third party validation of the resource area by a qualified forester with Papua New Guinea Forest Authority |
| | Investigation of any irregularities identified in aerial surveys or satellite imaging as they become available |
| | Survey of timber used for traditional purposes (e.g. clearance for making gardens, harvesting for building canoes or homes). |

### *2.1.2 Community related activities*

Supporting sustainable projects and livelihoods for the local community is considered crucial towards the success of the Project. Community development activities will be tailored towards the specific community needs as well as being consistent with Papua New Guinea's Vision 2050 Goals (Papua New Guinea Vision 2050, 2011), which aims to improve socio-economic conditions of its people.[6]

[6] Papua New Guinea Vision 2050 activities (and their respective numbers in the policy document) considered relevant to the project include: Education activities: 1.17.2.1 free education; 1.17.2.2 100% literacy for adult population over 15yrs; 1.17.2.17 establish a public-private partnership in delivery of education; 1.17.2.18 introduce environmental sustainability and climate change into the curriculum. Health activities include: 1.17.3.1 reduce HIV-AIDS to 0.1% of the population aged 15-49yrs;

Seven key community development strategies are being implemented under the Project, as described below.

**Strategy 1: Improved community infrastructure**

Housing, community centres and other infrastructure is generally very poor in the Project Area. Examples of activities that are planned to be implemented to improve community infrastructure include:

- Renovation of housing at Yambi and Ambunti, including the establishment of fully equipped offices in the District Headquarters in Yambi. These headquarters will serve as the base for the Project field operations, as well as a community centre for project controls, pending establishment of a community centre inside the Project Area.
- Establishment of regional resource centres in each of the jurisdictions of the land owner companies. These will be multi-purpose, and be a place for the storage, dissemination and exchange of data, knowledge, skills and technology. They will also serve as a communication hub for the landowners.

**Strategy 2: Improve community education quality and extent**

Literacy levels in the area are low. The Project aims at improving literacy and general education of children and youth in the Project Area. Examples of early implementation activities include:

- Analysis of the education needs of the respective areas and their current schools in terms of facilities, human resources, and equipment
- Provision of education materials to existing schools, as per needs assessment conducted above
- Provision of secondary and tertiary scholarships to encourage local youths to continue their education and become future leaders in the region

**Strategy 3: Improve healthcare quality and outreach**

There is currently little or no access to health care in the area, resulting in a high mortality biased toward small children, infants and mothers. Examples of early implementation activities to address this issue include:

- Comprehensive review of the communities' needs and development of a prioritised Project health plan
- Support for the establishment of community health buildings in strategic locations to improve health care accessibility, in accordance with the Project health plan

**Strategy 4: Improve mobility and transport**

The local communities suffer from a lack of mobility along rivers within the Project Area and also isolation from the rest of the region due to a lack of access to transport. This has flow-on implications for the ability of local people to access healthcare and education. Examples of early implementation activities to address this issue include:

1.17.3.2 Reduce tuberculosis to 10/100,000 of population; 1.17.3.3 Reduce malaria deaths to 10/100,000; 1.17.3.5 Establish one aid post per ward area; 1.17.3.6 establish two health workers per ward area; 1.17.3.7 establish one basic health service centre with two doctors and support personnel per district; 1.17.3.8 improve the terms and conditions of employment of health officers More details can be found in the Papua New Guinea Vision 2050 report (Papua New Guinea Vision 2050, 2011).

- The initial purchase of five large (23 foot) dinghies with 40 horsepower outboard motors to support the transport needs of the communities. The dinghies will also be used in the provision of project programs and for dissemination of information.

**Strategy 5: Improved communication networks**

Communication networks in the area are not effective, being either erratic or non-existent. Examples of early implementation activities to address this issue include:

- Auditing of existing radio communication and immediately repair or replace faulty radios or components
- Set up of satellite communication for the entire Project Area

**Strategy 6: Update the land owner database**

Traditional landowners change frequently due to births and deaths but the cost of updating the ILG database is often too great for landowners to bear. Examples of early implementation activities to address this issue include:

- Arranging for real-time update of all ILG's and mapping their boundaries that will be completed consistently with the new ILG Act. It is estimated that this process will take 3 to 4 years for completion. Mapping of traditional landowner boundaries will help resolve disputes, and will also assist in the fair and transparent distribution of Project benefits.

**Strategy 7: Generate employment opportunities**

Local employment opportunities will arise from the Project itself, as Forest Stewards and Community Rangers. The project will trial the development of community policing in the Project Area, whereby community leaders develop culturally appropriate but effective ways to promote public safety and enhance the quality of life in their neighbourhoods. In addition, the leakage management activities such as improved agricultural productivity in existing agricultural areas will not only increase food production for subsistence purposes, but it may also result in excess food production that can be sold in local markets.

### *2.1.3 Project technologies, products and services*

The April Salumei REDD Project is primarily a forest conservation project. The project design is focused on supporting activities that reduce the drivers of deforestation and forest degradation, focussing on proven technologies, products or services across three main areas; 1) forest conservation; 2) sustainable agriculture development; and 3) small enterprise development, as described below.

- Forest conservation – Activities primarily focused on supervision, monitoring, conservation research and other conservation based land management activities. These activities will be supported by technical experts in forest inventory and remote sensing where required.
- Sustainable agriculture development – The Project will employ agricultural experts to test and implement agricultural regimes that are culturally appropriate, but that will also improve productivity permitting excess production to be sold in markets. A broader range of agricultural products will also be produced, allowing the local people to generate produce across a broader range of seasons, while improving nutrition for the local communities.
- Small enterprise development – The Project aims to encourage and assist in the development of small enterprises to generate alternative sources of income and reduce the pressure on the forest

resource. These enterprises will be supported by the project and external expertise will be sought if and where required.

Progress towards the implementation of the proposed activities is presented in Table 11.

**Table 11: Implementation Status of Project Activities in the April Salumei Area**

| Project Activities for the April Salumei REDD Project | | | | |
|---|---|---|---|---|
| **Strategy** | **Tasks** | **Achievements so far** | **Planned activities for the next year** | **Comments** |
| 1: Improved community infrastructure | Renovation of housing at Yembi and Ambunti | Identification and Selection of Site, Review of work to be undertaken. | | Waiting for confirmation of land title from JDB&PPC. Confusion over ownership of land at Yembi so as a result of this we will concentrate on establishing resource at Ambunti. |
| | Establishment of offices in Ambuntii | Selected Site | | Waiting for confirmation of land title. Office and accommodation to be built in Ambunti. |
| | Establishment of the regional resource centres in each of the jurisdictions of the land owner companies | Discussions and agreement with Traditional owners. | | Pending funding. |
| 2: : Improve community education quality and extent | Analysis of education needs | PRA process identified education as a priority for the project. | | Landowner Chairman prioritised education as a key deliverable of the project. Preliminary survey indicates all communities have different development requirements. In some areas curriculum support materials are required and in others there may be no classroom or teacher. |
| | Provision of education materials to existing schools | Planned for 1st quarter 2013 | | To be coordinated with District education officers. The O'Neil Government has committed to free education so we are understanding how we will link into this initiative |
| | Provision of secondary and tertiary scholarships | Planned only | | It is evident the landowners want scholarship for the students to various institutions. These will be made available as budgets allow. |
| 3: Improve health care quality and outreach | Comprehensive review of community health needs | PRA process identified health as a key priority for the project. | Review planned for 2013 | Following the review of all Health Centres and facilities information sharing and planning will be undertaken with the District Health officer to ensure an alignment of our objectives. |
| | Development of a prioritised Project health plan | | Will be undertaken in 2013 | Integrated plan to be established in close consultation with the respective District health officers. |
| | Support the | Planned | | Work closely with the District |

| | | | | |
|---|---|---|---|---|
| | establishment of community health buildings in accordance with the Project health plan | | | Health Office to implement the activity. |
| 4: Improve mobility and transport | Purchase offive large (23 foot) dinghies with 40 horsepower outboard motors | Ordered, paid for and delivered to each project area. | Nil | Boats have been purchased and have been delivered. |
| 5: Improved communication networks | Auditing of existing radio communication to work in partnership with PIM. | LOC have been asked to advise requirements. | | All Landowner Chairman have been asked to provide a list of broken and or missing parts on all radios. The Project will then purchase the required parts to ensure an efficient radio service. It is planned for the radio service to allow broadcast of the project travel plans, objectives and activities. Also provide opportunity for each LO chairmen to communicate among themselves. |
| | Immediately repair or replace faulty radios or components | Access need and costing. | Completed | Assessed and should commence shortly. |
| | Set up of satellite communication for the entire Project Area | Access suppliers and cost implications. | | Communication was identified as important and LO chairmen want satellite V-Sat system established.<br>Quarter 3 will see a review of existing options. Mobile networks are being rolled out quickly in PNG and this may be a better option than satellite. |
| 6: Update the land owner database | Arranging for real-time update of all ILG's | 164 ILG agreements signed and 2 x LANCO incorporated, B'nomo & Niksek Investments. | Has commenced | All Incorporated Land groups have been recorded and updated by landowner Company Chairman. This process will be overseen by the project Manager Mr Philip Ugu and ILG updates made with the Dept. of Community Development and Lands. |
| | Mappingof their boundaries | Identified as a major project activity. | | This will follow the updating of all ILGs as it conforms to the revised ILG Act 2009. |
| 7: Generate employment opportunities | Development of community policing in the Project Area | Need to consult relevant agencies and support activity. | | In consultation with relevant agencies (police, youth, district services, law & justice sector) support community policing activities. |
| | Employment of ForestStewards and Community Rangers by the Project | A priority in the implementation of the project & M&E. | | Have employed the landowner Company Chairman to date. Community Stewards are planned to be employed as financial budgets allow. |

| | | | | |
|---|---|---|---|---|
| | Development of culturally appropriate but effective ways to promote public safety by the community leaders | | Completed. | Safety Policy has been developed and discussed with landowner Chairman. This has been discussed with all ILG Chairman at the village level. |
| | The Project aims to encourage and assist in the development of small enterprises to generate alternative sources of income | Discussions on going for chairmen to identify projects to be undertaken. | | Policy developed to outline how communities can apply for funding sustainable projects. We have not yet encouraged landowners to apply for the funding however we have identified priority projects at the Landowner Company Chairman's level during the PRA. |
| 8. Identify Training Needs to improve Chairmen performance. | Training planned and delivered to improve landowner chairmen decision making. | Training delivered on;<br>• What is a leader?<br>• Roles and responsibilities of leader.<br>• Needs Analysis & projects identification.<br>• Planning & Budgeting.<br>• Workshop conducted on project. | Several training is planned for the year. | The chairmen acknowledge the training as important and are embracing it and want more training and workshops that will improve their leadership skills, management capacity and decision making.<br>They acknowledge the importance of good governance, transparency and accountability in decision making. |
| 9. Impact projects to the delivered landowners. | Impact projects worth K100,000.00 has been identified by landowner chairmen is planned to be delivered. | In the process of delivery of the impact project in respective geo-project areas. | | Projects identified and nominated by landowner chairmen and their executives. Identified projects funded and to be delivered. |
| 10. Mobilisation Funds Delivered. | Mobilisation of K100,000.00 has been paid to the landowner companies. | Landowner company accounts activated.<br>Chairmen & their landowner executive have decided on where to spend the funds.<br>Acquittals have been made. | | Chairmen plan and budget for the expenditure of the funds on priority areas and acquittals submitted. |

| | | | | |
|---|---|---|---|---|
| 11. Stakeholder engagement with partners. | Work with stakeholders that have mutual interest in the development of the project. | Meetings held with LO chairmen's, JDP&BPC, District Administrator, Provincial Administration, ESPG, Central Agencies, NFA, Vision 2050, OCCD, PM&NEC, PWM etc. Also presentations made at various levels in meetings and workshops. | | Various consultation meetings have been held at the landowner, local level, district, provincial and national level and NGOs in the development of the project. |

## 2.2 Project Description Deviations

Not applicable.

## 2.3 Grouped Project

Not applicable

# 3 DATA AND PARAMETERS

## 3.1 Data and Parameters Available at Validation

### *3.1.1 VM0007*

**Table 12: M-MON Data and Parameters not Monitored (default or measured one time)**

| | |
|---|---|
| Data / Parameter: | Project Forest Cover Benchmark Map |
| Data Unit: | |
| 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: | Remote sensing in combination with GPS data collected during ground trothing. |
| Justification of choice of data or description of measurement methods and procedures applied: | The minimum map accuracy must be 90% for the classification of forest/non forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy. |
| Any comment: | Where forest land contains more than one forest class, the map must be stratified into forest classes using module X-STR. |
| Used in equations: | M-MON 3 and M-MON-8 |

| | |
|---|---|
| Data / Parameter: | $A_i$ |
| Data Unit: | ha |
| Description: | Area of stratum, i |
| Source of data: | |
| Justification of choice of data or description of measurement methods and procedures applied: | Frequency: At a minimum every ten years prior to baseline renewal. |
| Any comment: | Ex-ante it shall be assumed that strata area will remain constant |
| Used in equations: | M-MON 19 |

**Table 13: BL-PL Data and Parameters not Monitored (default or measured one time)**

| | |
|---|---|
| Data / Parameter: | $D\%_{planned,i,t}$ |
| Data Unit: | $\%year^{-1}$ |
| Used in equations: | BL-PL 2,3 |
| Description: | Projected annual proportion of land that will be deforested in stratum i at year t |
| Source of data: | Analysis of land use land change remote sensing data within six proxy areas over a period of nine years. |
| Value applied: | Over the fixed baseline period 22nd May 2009 – 21st May 2019 Infrastructure related deforestation was found to be 0.181% as a percentage of the entire Project Area. |
| Justification of choice of data or description of measurement methods and procedures applied: | N/A |
| Any comment: | These figures will be revisited at the time of the baseline revision. |

| | |
|---|---|
| Data / Parameter: | L-D |
| Data Unit: | % |
| Used in equations: | BL-PL 3 |
| Description: | Likelihood of deforestation in stratum i |
| Source of data: | N/A |
| Value applied: | 1 |
| Justification of choice of data or description of measurement methods and procedures applied: | Areas subject to deforestation are not under Government control and are zoned for deforestation in accordance with classifying the area as a Forest Management Area (FMA). |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | PFc |
| Data Unit: | Dimensionless |
| Used in equations: | 7 |
| Description: | Proportion of available area for production of commodity c that is currently forested |
| Source of data: | |
| Value applied: | LK-ASP 7 |
| Justification of choice of data or description of measurement methods and procedures applied: | This value will be assumed to be 1 (i.e. displacement is to 100% forested areas), since displacement of logging activities dictates that the displacement area must be forested. |
| Any comment: | |

**Table 14: LK-ME Data and Parameters not Monitored (default or measured one time)**

| | |
|---|---|
| Data / Parameter: | CF |
| Data Unit: | t C t d.m.$^{-1}$ |
| Used in equations: | LK-ME 4 |
| Description: | Carbon Fraction of Dry Matter |
| Source of data: | IPCC Good Practice Guidance |
| Value applied: | Default value 0.47 t C t$^{-1}$ d.m. |
| Justification of choice of data or description of measurement methods and procedures applied: | No species specific values available nor national specific information. |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | $D_{mn}$ |
| Data Unit: | t d.m.m$^{-3}$ |
| Used in equations: | LK-ME 4 |
| Description: | Mean wood density of commercially harvested species |
| Source of data: | Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database.7 Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0.<br>Must use the same value in the CP-W module if this module is used. |
| Value applied: | 0.60 |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | Calculation is performed in Project calculation spreadsheet on tab labelled WdDensity. |

[7] http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm

| | |
|---|---|
| Data / Parameter: | LDF |
| Data Unit: | t C $m^{-3}$ |
| Used in equations: | LK-ME 4 |
| Description: | Factor for calculating the biomass of dead wood created during logging operations per cubic meter extracted |
| Source of data: | Measured by Winrock International from 774 logging gaps in Bolivia, Belize, the Republic of Congo, Brazil and Indonesia (Annex 1 LK-ME) |
| Value applied: | Default value for broadleaf and mixed forests of 0.53 t C $m^{-3}$ |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | This value will be updated if improved and/or locally specific data becomes available. This update may occur prior to the 10 year mandatory baseline revision. |

| | |
|---|---|
| Data / Parameter: | LIF |
| Data Unit: | t C $m^{-3}$ |
| Used in equations: | LK-ME 4 |
| Description: | Factor for calculating the emissions arising from the creation of logging infrastructure (roads, skid trails and decks) during logging operations per cubic meter extracted |
| Source of data: | Calculated from 1,839 hectares of logging concessions analysed by Winrock International in the Republic of Congo and Brazil, may be used for tropical broadleaf forests (Annex 1 LK-ME) |
| Value applied: | Conservative default value of 0.29 t $CO_2$-e $m^{-3}$ |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | This value will be updated if improved and/or locally specific data becomes available. This update may occur prior to the 10 year mandatory baseline revision. |

| | |
|---|---|
| Data / Parameter: | PMLFT |
| Data Unit: | % |
| Used in equations: | |
| Description: | Mean merchantable biomass (annual allowable cut) as a proportion of total FMA Area |
| Source of data: | Forest Trends analysis of FMA operations in Papua New Guinea (Forest Trends, 2011) |
| Value applied: | 0.46 |
| Justification of choice of data or description of measurement methods and procedures applied: | National relevant information |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | PMPFT |
| Data Unit: | % |
| Used in equations: | |
| Description: | Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries |
| Source of data: | Forest Trends analysis of FMA operations in Papua New Guinea (Forest Trends, 2011) |
| Value applied: | 0.30 |
| Justification of choice of data or description of measurement methods and procedures applied: | National relevant information |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | $V_{BSL,EX,i,t}$ |
| Data Unit: | $m^3$ |
| Used in equations: | LK-ME 4 |
| Description: | Volume of timber projected to be extracted from within the project boundary during the baseline in stratum i at time t |
| Source of data: | The Forest Development and Management Plan (FDMP) prepared by Road Timber Co combined with the April River Timber Harvest Plan. |
| Value applied: | 460,000$m^3$ $ha^{-1}$ $yr^{-1}$ |
| Justification of choice of data or description of measurement methods and procedures applied: | Site specific information |
| Any comment: | This value will not be updated, as the plan is considered the best estimate of the logging practices that would have occurred in the Project Area. |

**Table 15: CP-AB Data and Parameters not Monitored (default or measured one time)**

| | |
|---|---|
| Data / Parameter: | CF |
| Data Unit: | tC $t^{-1}$ d.m. |
| Used in equations: | CP-AB 1, 10 |
| Description: | Carbon fraction of dry matter |
| Source of data: | IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3 |
| Value applied: | Default value 0.47 tC $t^{-1}$ d.m. was used. |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | The default values should be used for all species. |

| | |
|---|---|
| Data / Parameter: | fj(X,Y) |
| Data Unit: | t d.m. $tree^{-1}$ |
| Used in equations: | 1,3 |
| 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: | In the absence of a National allometric equation specific to Papua New Guinea, an allometic was selected based on DBH and species specific wood density from Chave, J., C. Andalo, S. Brown, M. A. Cairns, J. Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.-P. Lescure, B. W. Nelson, H. Ogawa, H. Puig, B. Riera, T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145: 87-99.<br>The equation was developed from 416 trees (42 of which were from Papua New Guinea), and is based on a statistically significant regression with an $r^2$ = 0.99 |
| Value applied: | $f_j(DBH,\rho)_{ab} = \rho \times \exp(-1.239 + 1.98 \times \ln(DBH) + 0.207 \times (ln(DBH))^3$<br>Where:<br>$f_j(DBH,\rho)_{ab}$ = aboveground biomass kg d.m. $ha^{-1}$<br>$\rho$ = species specific wood density g $cm^{-3}$<br>$DBH$ = diameter at breast height (i.e. 1.3m) cm |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | Should allometrics for Papua New Guinea be available when the baseline is renewed, the Chave equation will be replaced by the locally developed equation. |

| | |
|---|---|
| Data / Parameter: | R |
| Data Unit: | t root d.m. $t^{-1}$shoot d.m. |
| Used in equations: | CP-AB 5, 13 |
| Description: | Root to shoot ratio appropriate to species or forest type/biome. The 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: | Table 4.4 of the IPCC Guidelines for AFOLU (2006). |
| Value applied: | A root:shoot ratio of 0.37 t root dm/t AGB was assumed, based on the value for tropical rainforest. |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | Global values from Table 4.4 of the AFOLU Guidelines were selected by choosing the climatic zone and forest type that most closely matches the April Salumei Project Area.<br>The mean values of default values selected from Table 4.4 of the AFOLU Guidelines are considered conservative. |

**Table 16: CP-L Data and Parameters not Monitored (default or measured one time)**

| | |
|---|---|
| Data / Parameter: | $CF_j$ |
| Data Unit: | tC $t^{-1}$ d.m. |
| Used in equations: | CP-L 1 |
| Description: | Carbon fraction of dry matter in litter |
| Source of data: | CP-L Module |
| Value applied: | Default value 0.37 tC $t^{-1}$ d.m. is used. |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | None |

**Table 17: CP- W Data and Parameters not Monitored (default or measured one time)**

| | |
|---|---|
| Data / Parameter: | $CF_j$ |
| Data Unit: | t C $t^{-1}$ d.m. |
| Used in equations: | CP-W 1 |
| Description: | Carbon fraction of dry matter in t C $t^{-1}$ d.m. for species j |
| Source of data: | Default value is used. |
| Value applied: | 0.47 |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | None |

| | |
|---|---|
| Data / Parameter: | $D_j$ |
| Data Unit: | t d.m.$m^{-3}$ |
| Used in equations: | LK-ME 4 |
| Description: | Mean wood density of commercially harvested species |
| Source of data: | Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database.8 Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0.<br>Must use the same value in the CP-W module if this module is used. |
| Value applied: | 0.60 |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | Calculation is performed in Project calculation spreadsheet on tab labelled WdDensity. |

[8] http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm

| | |
|---|---|
| Data / Parameter: | $SLF_{ty}$ |
| Data Unit: | dimensionless |
| Used in equations: | CP-W 2 |
| Description: | Fraction of wood products that will be emitted to the atmosphere within 3 years of production by class of wood product ty. |
| Source of data: | Winjum et al. 1998, updated to reflect changes to the VCS Standard version 3, which defines the medium term fraction as all wood products that decay between 3 – 100 years after harvest. |
| Value applied: | |

| **Wood Product Class** | **SLF** |
|---|---|
| Sawnwood | 0.12 |
| Woodbase Panel | 0.06 |
| Other industrial Roundwood | 0.18 |
| Paper and Paperboard | 0.24 |
| Other classes of wood products | 1.0 |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | Parameter values were updated in accordance with the new VCS Requirements for wood product accounting, as per the values reported in VCS Approved methodology, VM003 |

| | |
|---|---|
| Data / Parameter: | $WW_{ty}$ |
| Data Unit: | dimensionless |
| Used in equations: | CP-W 2 |
| Description: | Fraction of extracted biomass effectively emitted to the atmosphere during production by class of wood product ty. |
| Source of data: | Winjum et al. 1998 |
| Value applied: | WW is therefore equal to CXB,ty multiplied by 0.24 for developing countries. |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | Parameter values to be updated if new empirically based peer-reviewed findings become available. |

**Table 18: E-BB Data and Parameters not Monitored (default or measured one time)**

| | |
|---|---|
| Data / Parameter: | CF |
| Data Unit: | tC $t^{-1}$ d.m. |
| Used in equations: | E-BB 2 |
| Description: | Carbon fraction of dry matter |
| Source of data: | IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3 |
| Value applied: | Default value 0.47 tC $t^{-1}$ d.m. is used. |
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | None |

| | |
|---|---|
| Data / Parameter: | $COMF_i$ |
| Data Unit: | Dimensionless |
| Used in equations: | E-BB 1 |
| Description: | Combustion factor for stratum i (vegetation type) |
| Source of data: | Default values in Table 2.6 of IPCC, 2006 (Annex 2) |
| Value applied: | |

| Vegetation Type | Subcategory | Mean | SD |
|---|---|---|---|
| Primary Tropical Forest | Primary Tropical Forest | 0.32 | 0.12 |
| Secondary Tropical Forest (slash and burn) | Young Tropical Forest (3-5 years) | 0.46 | - |
| Secondary Tropical Forest (slash and burn) | Intermediate Tropical Forest (6-10 years) | 0.67 | 0.21 |
| Secondary Tropical Forest (slash and burn) | Advanced Tropical Forest (14-17 years) | 0.50 | 0.10 |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel load (i.e., a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (i.e., intensity and rate of spread).<br>Default values shall be updated whenever new guidelines are produced by the IPCC. |

| | |
|---|---|
| Data / Parameter: | $G_{gi}$ |
| Data Unit: | g $kg^{-1}$ dry matter burnt |
| Used in equations: | E-BB 1 |
| Description: | Emission factor for stratum i for gas g |
| Source of data: | Defaults sourced from Volume 4, Chapter 2 of the IPCC 2006 Inventory Guidelines, Table 2.5. |
| Value applied: | |

| Category | $CO_2$ | $CH_4$ | $N_2O$ |
|---|---|---|---|
| Tropical Forest | 1580 | 6.8 | 0.20 |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied: | In the absence of national specific data internationally recognised sources are acceptable. |
| Any comment: | Default values shall be updated whenever new guidelines are produced by the IPCC. |

**Table 19: X-UNC Data and Parameters not Monitored (default or measured one time)**

| | |
|---|---|
| Data / Parameter: | $C_{REDD,t}$ |
| Data Unit: | $tCO_2$-e |
| Used in equations: | X-UNC 11 |
| Description: | Net anthropogenic greenhouse emissions reductions at time t; |
| Module parameter originates in: | REDD-MF |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | $D\%_{pn}$ |
| Data Unit: | % |
| Used in equations: | Uncertainty in baseline rate |
| Description: | Percent of deforestation in land parcel *pn* etc of a proxy area as a result of planned deforestation as defined in this module |
| Module parameter originates in: | BL-PL |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | $Yrs_{pn}$ |
| Data Unit: | Years |
| Used in equations: | Uncertainty in baseline rate |
| Description: | Number of years over which deforestation occurred in land parcel *pn* in proxy area; |
| Module parameter originates in: | BL-PL |
| Any comment: | |

### *3.1.2 VM0010*

**Table 20: VM0010 Data and parameters not monitored (default values or measured one time)**

| | |
|---|---|
| Data / parameter: | $V_{l,j,i,sp}$ |
| Data unit: | $m^3$ |
| Used in equations: | VM0010 Equation 1 |
| Description: | Merchantable volume for tree *l* of species *j* in sample plot *sp* in stratum *i* |
| Source of data: | Merchantable volume for all trees in each plot was calculated using a volume equation specified in the PNG Forest Inventory Planning System database.[9] |
| Measurement procedures (if any): | Refer to Forest Carbon Stock report |
| Any comment: | Since our field inventory volume estimate was higher than the volume estimate as stated in the FDMP and April River Plan, the merchantable volume estimate from the FDMP and April River Logging Plan was used for the timber harvest schedule, as required under the Methodology (i.e.: 93.54 $m^3$ $ha^{-1}$ $yr^{-1}$, or 460,000 $m^3$ $yr^{-1}$). |

| | |
|---|---|
| Data / Parameter: | CFj |
| Data Unit: | tC $t^{-1}$ d.m. |
| Used in equations: | VM0010 Equation 3, 4 |
| Description: | Carbon fraction of dry matter |
| Source of data: | IPCC 2006 INV GLs AFOLU Chapter 4, Table 4.3 |
| Value applied: | Default value 0.47 tC $t^{-1}$ d.m. was used. |
| Measurement procedures (if any) | None |
| Any comment: | The default values should be used for all species. |

[9] The equation is: V ($m^3$ $ha^{-1}$) =1.116*0.00007854*($DBH^{2.4762}$)

| | |
|---|---|
| Data / Parameter: | $D_j$ |
| Data Unit: | t d.m.m$^{-3}$ |
| Used in equations: | VM0010 Equation 4 |
| Description: | Mean wood density of commercially harvested species |
| Source of data: | Weighted average wood density of commercial species listed in the FDMP as being targeted for timber production, Wood density values were derived from either Table 4.13 IPCC National Guidance for Greenhouse Gas Inventories AFOLU Section, or from the World Agroforestry Centre wood density database.[10] Nations. Rome, 1997. FAO Forestry Paper - 134. ISBN 92-5-103955-0. |
| Measurement procedures (if any): | None |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | $fj_{(X,Y...)}$ |
| Data Unit: | t d.m. tree$^{-1}$ |
| Used in equations: | VM0010, equation 17 |
| Description: | Allometric equation(s) for species *j* linking measured tree variable(s)<br>to aboveground biomass of living trees |
| Source of data: | |
| Measurement procedures (if any): | NA |
| Any comment: | |

[10] http://www.worldagroforestry.org/sea/products/afdbases/wd/Index.htm

| | |
|---|---|
| Data / parameter: | $PML_{FT}$ |
| Data unit: | % |
| Used in equations: | |
| Description: | Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type. |
| Source of data: | |
| Measurement procedures (if any): | |
| Any comment: | |

| | |
|---|---|
| Data / parameter: | VEX,j,i\|BSL |
| Data unit: | $m^3 \cdot ha^{-1}$ |
| Used in equations: | VM0010, equation 3, 4 and 22 |
| Description: | Mean volume of extracted timber per unit area for species *j* in stratum *i* |
| Source of data: | The timber harvest plan sets the allowable mean extracted volume from the merchantable volume of timber in the forest inventory (*Vj,i\|BSL),* based on legal limits. |
| Measurement procedures (if any): | NA |
| Any comment: | |

| | |
|---|---|
| Data / parameter: | THi,p |
| Data unit: | Years |
| Used in equations: | |
| Description: | Number of years since timber harvest in stratum *i* in land parcel *p* |
| Source of data: | The timber harvest schedule specifies the year (*1,2,3...)* timber harvest in each land parcel is scheduled to occur and the number of years each land parcel is in a post harvest state during the project crediting period. |
| Measurement procedures (if any): | |
| Any comment: | |

| | |
|---|---|
| Data / parameter: | A i,p |
| Data unit: | Ha |
| Used in equations: | VM0010, equation 20 |
| Description: | Area covered by stratum *i* over land parcel *p* |
| Source of data: | Geodetic coordinates and/or Remote Sensing data and/or legal parcel records |
| Measurement procedures (if any): | |
| Any comment: | It must be assumed ex-ante that land parcel boundaries and strata areas must not change through time |

| | |
|---|---|
| Data / parameter: | $A_{1,i,p}$ |
| Data unit: | Ha |
| Used in equations: | VM0010, equation 11 |
| Description: | The area of stratum *i* in land parcel *p* that was harvested 1 year ago |
| Source of data: | Geodetic coordinates, GIS Files or legal parcel records |
| Measurement procedures (if any): | |
| Any comment: | |

| | |
|---|---|
| Data / parameter: | $A_{2\text{-}10,i,p}$ |
| Data unit: | Ha |
| Used in equations: | VM0010, equation 12 |
| Description: | The area of stratum *i* in land parcel *p* that was harvested between 2 and 10 years ago |
| Source of data: | Geodetic coordinates, GIS Files or legal parcel records |
| Measurement procedures (if any): | |
| Any comment: | |

| | |
|---|---|
| Data / parameter: | $A_{11\text{-}20,i,p}$ |
| Data unit: | Ha |
| Used in equations: | VM0010, equation 13 |
| Description: | The area of stratum *i* in land parcel *p* that was harvested between 11 and 20 years ago |
| Source of data: | Geodetic coordinates, GIS Files or legal parcel records |
| Measurement procedures (if any): | |
| Any comment: | |

| | |
|---|---|
| Data / parameter: | $A_{t*}$ |
| Data unit: | Ha |
| Used in equations: | VM0010, equation 14 |
| Description: | Cumulative area harvested until time t* |
| Source of data: | Geodetic coordinates, GIS Files or legal parcel records |
| Measurement procedures (if any): | |
| Any comment: | |

| | |
|---|---|
| Data / parameter: | $A_{sp}$ |
| Data unit: | Ha |
| Used in equations: | VM0010, equation 2 and 19 |
| Description: | Area of sample plot *sp* |
| Source of data: | Recording and archiving of size of sample plots |
| Measurement procedures (if any): | Standard Operation Procedures for forest timber inventory is used. |

| | |
|---|---|
| Data / parameter: | $BCEF_R$ |
| Data unit: | t.d.m $m^{-3}$ |
| Used in equations: | VM0010 Equation 3, 18 |
| Description: | Biomass conversion and expansion factor applicable to wood removals in the project area |
| Source of data: | In the absence of country specific data a BCEF of 1.67 t $dm^{-1}$ $m^3$ was applied from the IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.5) |
| Measurement procedures (if any): | None |
| Any comment: | When selecting a $BCEF_R$ the minimum DBH must be compatible with the minimum DBH specified in the timber harvest plan.<br><br>Default values shall be updated whenever new guidelines are produced by the IPCC |

| | |
|---|---|
| Data / parameter: | *OF,SLF,WW* |
| Data unit: | kg $kg^{-1}$ |
| Used in equations: | VM0010 Equation 7, 8, 9 |
| Description: | *OF* = Fraction of wood products that will be emitted to the atmosphere between 3 and 100 years after production;<br><br>*SLF* = Fraction of wood products that will be emitted to the atmosphere within 3 years of production; and<br><br>*WW* = Fraction of extracted biomass effectively emitted to the atmosphere during production<br><br>Wood waste fraction (WW):<br><br>Winjum et al 1998 indicate that the proportion of extracted biomass that is oxidized (burning or decaying) from the production of commodities to be equal to 19% for developed countries, 24% for developing countries.<br><br>Short-lived fraction (SLF)<br><br>Winjum et al 1998 give the following proportions for wood products with short-term (<5 yr) uses (applicable internationally):<br><br>Sawnwood 0.12 Woodbase panels 0.06 Other industrial roundwood 0.18 Paper and Paperboard 0.24<br><br>Additional oxidized fraction (OF)<br><br>Winjum et al 1998 gives annual oxidation fractions for each class of wood products split by forest region (boreal, temperate and tropical).<br><br>This methodology projects these fractions over 95 years to give the additional proportion that is oxidized between the 3rd and 100th years after initial harvest: |

| Wood Product Class | *OF* | | |
|---|---|---|---|
| | Boreal | Temperate | Tropical |
| Sawnwood | 0.39 | 0.62 | 0.86 |
| Woodbase panels | 0.62 | 0.86 | 0.98 |
| Other industrial roundwood | 0.86 | 0.98 | 0.99 |
| Paper and paperboard | 0.39 | 0.62 | 0.99 |

| | |
|---|---|
| Source of data: | The source of data is the published paper of Winjum et al. 1998 |
| Measurement procedures (if any): | None |
| Any comment: | Parameters were updated in accordance with the requirements of the VCS Standard version 3. |

| | |
|---|---|
| Data / parameter: | $RGR_i$ |
| Data unit: | $tC.ha^{-1}.yr^{-1}$ |
| Used in equations: | VM0010 Equation 9, 14 |
| Description: | Forest regrowth rate post timber harvest for stratum i |
| Source of data: | Fox et al (2011), value for Southern Highlands |
| Measurement procedures (if any): | None |
| Any comment: | |

| | |
|---|---|
| Data / parameter: | $COMF_i$ |
| Data unit: | Dimensionless |
| Used in equations: | VM0010 Equation 21 |
| Description: | Combustion factor for stratum *i* (vegetation type) |
| Source of data: | Default values in Table 2.6 of IPCC, 2006 |
| Measurement procedures (if any): | None |
| Any comment: | The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel load (i.e., a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (i.e., intensity and rate of spread).<br><br>Default values shall be updated whenever new guidelines are produced by the IPCC |

| | |
|---|---|
| Data / parameter: | $G_{gi}$ |
| Data unit: | $g\ kg^{-1}$ dry matter burnt |
| Used in equations: | VM0010 Equation 21 |
| Description: | Emission factor for stratum *i* for gas *g* |
| Source of data: | Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5 |
| Measurement procedures (if any): | None |
| Any comment: | Default values shall be updated whenever new guidelines are produced by the IPCC |

| | |
|---|---|
| Data / parameter: | *PML, PMP* |
| Data unit: | % |
| Used in equations: | STEP 5 - Leakage, Box 2. |
| Description: | Sustainable AAC as recommended by the Forest Trends review team, relative to total FMA area. |
| Source of data: | Forest Trends (2001). Available from http://www.forest-trends.org/documents/files/doc_161.pdf |
| Measurement procedures (if any): | None |
| Any comment: | |

## 3.2 Data and Parameters Monitored

### *3.2.1 VM0007*

**REDD Methodology Framework (REDD-MF)**

| | |
|---|---|
| Data / Parameter: | Project Forest Cover Monitoring Map |
| Data Unit: | N/A |
| Used in equations: | 3 |
| Description: | Map showing the location of forest land within the project area at the beginning of each monitoring period. If some land is cleared within the Project Area, the benchmark map must show the deforested areas at each monitoring event. |
| Value applied | Ha |
| Source of data: | For the first monitoring period; remote sensing<br><br>For subsequent monitoring periods: remote sensing in combination with GPS data collected during ground truthing.<br><br>The minimum map accuracy must be 90% for the classification of forest/non-forest in the remote sensing imagery. If the classification accuracy is less than 90% then the map is not acceptable for further analysis. More remote sensing data and ground truthing data will be needed to produce a product that reaches the 90% minimum mapping accuracy.<br><br>Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event. |
| Justification of choice of data or description of measurement methods and procedures applied: | Spatial data selected for the development of the Forest Cover Monitoring Map shall be sourced from the LandSAT data files. Images shall be selected to minimize cloud cover issues. |
| QA/QC procedures to be applied: | |
| Any comment: | Where forest land contains more than one forest class, the map must be stratified into forest classes using module X-STR. |

| | |
|---|---|
| Data / Parameter: | Degradation PRA Results |
| Data Unit: | N/A verbal responses |
| Used in equations: | Section 5.2.2.1 |
| Description: | Participatory Rural Appraisal |
| Value applied | N/A |
| Source of data: | Rapid Rural Appraisal documents and Questionnaires |
| Justification of choice of data or description of measurement methods and procedures applied: | The PRA shall consist of semi-structured interviews / questionnaires.<br><br>The PRA evaluates the extent of the following activities within the project area:<br><br>- Illegal commercial harvesting<br>- harvesting of fuel wood<br>- harvesting of wood for charcoal production<br>- timber harvest<br>-<br>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.<br><br>An additional output of the PRA shall be a depth of penetration of degradation pressure. A maximum distance shall be recorded for penetration into the forest from access points (such as roads, rivers, already cleared areas) for the purpose of harvesting fuel wood, charcoal and/or timber. It is likely that differing distances shall exist for each degradation pressure. If multiple pressures exist in the same stratum the deepest depth of penetration shall be used to define $A_{deg,i}$.<br><br>Frequency: every two years |
| QA/QC procedures to be applied: | The person leading the PRA process shall be experienced/trained in conducting PRAs and all communications will be documented and stored. |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | Result of Limited Degradation Survey |
| Data Unit: | |
| Used in equations: | Section 5.2.2.1 |
| Description: | |
| Value applied | |
| Source of data: | |
| Justification of choice of data or description of measurement methods and procedures applied: | Sampled by surveying several transects of known length and width across the access-buffer area (equal in area to at least 1% of $A_{Deg,i}$) to check whether new tree stumps are evident or not.<br><br>Frequency: Must be repeated each time the PRA indicates a potential for degradation |
| QA/QC procedures to be applied: | |
| Any comment: | Ex-ante, an estimation shall be made of degradation in the with project case. If the belief is that zero degradation will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent deforestation. |

| | |
|---|---|
| Data / Parameter: | $A_{DefPA,i,u,t}$ |
| Data Unit: | ha |
| Used in equations: | 3 |
| Description: | Area of recorded deforestation in the project area in stratum i converted to land use u at time t |
| Value applied | |
| Source of data: | Remote sensing imagery |
| Justification of choice of data or description of measurement methods and procedures applied: | Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event |
| QA/QC procedures to be applied: | |
| Any comment: | Ex-ante, an estimation shall be made of deforestation in the with project case. If the belief is that zero deforestation will occur within the project boundaries then this parameter may be set to zero. |

| | |
|---|---|
| Data / Parameter: | $A_{DegW,i}$ |
| Data Unit: | ha |
| Used in equations: | 8 |
| Description: | Area potentially impacted by degradation processes in stratum i |
| Source of data: | GIS delineation and ground truthing |
| Justification of choice of data or description of measurement methods and procedures applied: | $A_{DegW,I}$ shall be composed of a buffer from all access points (access buffer), such as roads and rivers or previously cleared areas. The width of the buffer shall be determined by the depth of degradation penetration as defined as a PRA output.<br>Frequency: Must to be repeated each time the PRA indicates a potential for degradation. |
| Any comment: | Ex-ante, a limited survey can be used to determine a likely depth of degradation penetration |

| | |
|---|---|
| Data / Parameter: | $A_{DistPA,q,I,t}$ |
| Data Unit: | ha |
| Used in equations: | 20 |
| Description: | Area impacted by natural disturbance in the project stratum I converted to natural disturbance stratum q at time t; ha |
| Source of data: | Remote Sensing imagery combined with ground verification or GPS coordinates |
| Justification of choice of data or description of measurement methods and procedures applied: | Minimum monitoring unit shall be equal to a minimum of 11 Landsat pixels or one hectare.<br>Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event |
| Any comment: | Ex-ante, estimations of emissions from natural disturbances shall be based on historic incidence of such event in the Project region |

| | |
|---|---|
| Data / Parameter: | $AP_i$ |
| Data Unit: | ha |
| Used in equations: | 8 |
| Description: | Total area of degradation sample plots in stratum i |
| Source of data: | Ground measurement |
| Justification of choice of data or description of measurement methods and procedures applied: | The sampling plan must be designed using plots systematically placed over the buffer zone so that they sample at least 3% of the area of the buffer zone.<br>Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event |
| Any comment: | Ex-ante an estimation must be made of area of plots. This must be set to exactly 3% of the buffer zone $A_{Deg,i}$ |

| | |
|---|---|
| Data / Parameter: | $C_{DegW,i,t}$ |
| Data Unit: | t $CO_2$-e |
| Used in equations: | 8 |
| Description: | Biomass carbon of trees cut and removed through illegal logging and fuelwood and charcoal extraction degradation process from plots measured in stratum i at time t |
| Source of data: | Field Measurement |
| Justification of choice of data or description of measurement methods and procedures applied: | The diameter of all tree stumps is the designated plots will be measured and conservatively assumed to be the same as the DBH. If the stump is a large buttress, identify several individuals of the same species nearby and determine a ratio of the diameter at DBH to the diameter of buttress at the same height above ground as the measured stumps. This ratio will be applied to the measured stumps to estimate the likely DBH of the cut tree. The above and below ground carbon stock of each harvested tree must be estimated using the same allometric regression equation and root to shoot ratio used in the module for estimating the carbon pool in trees (CP-AB) in the baseline scenario. See detailed guidance in CP-AB for aboveground biomass estimation.<br>Frequency: Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event |
| Any comment: | Ex-ante an estimation shall be made of likely degradation in the with-project case. Such an estimation shall be based on rates of degradation in surrounding areas and the degree of protection that will be in place (e.g. forest guards) in the with-project case. |

**Baseline Carbon Stock Changes and Greenhouse Gas Emissions from Planned Deforestation (BL-UP)**

See parameters under CP-AB, E-BB, CP-LI

**Carbon Stocks in the above-and belowground biomass of live trees and non-tree pools (CP-AB)**

| | |
|---|---|
| Data / Parameter: | $A_{sp}$ |
| Data Unit: | ha |
| Used in equations: | CP-AB 2,6,14 |
| Description: | Area of sample plots in ha |
| Monitoring Frequency: | Monitoring must occur at least every ten years for baseline renewal.<br>Where carbon stock enhancement is included monitoring shall occur at least every five years |
| Source of data: | Recording and archiving of number and size of sample plots |
| Measurement procedures (if any): | See Carbon Field Inventory Manual |
| Monitoring frequency: | Monitoring must occur at least every ten years for baseline renewal. |
| QA/QC procedures to be applied: | See Carbon Field Inventory Manual |
| Any comment: | Where carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante.<br><br>This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description. |

| | |
|---|---|
| Data / Parameter: | N |
| Data Unit: | Dimensionless |
| Used in equations: | CP-AB 4 |
| Description: | Number of sample points |
| Value applied: | 18 |
| Source of data: | Recording and archiving of number of sample points |
| Measurement procedures (if any): | See Carbon Field Inventory Manual |
| Monitoring frequency: | Monitoring must occur at least every ten years for baseline renewal. |
| QA/QC procedures to be applied: | See Carbon Field Inventory Manual |
| Any comment: | As carbon stock estimation occurs only for the determination of the baseline this parameter is known as *ex-ante*.<br>This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description. |

| | |
|---|---|
| Data / Parameter: | DBH |
| Data Unit: | cm |
| Used in equations: | CP-AB 1 |
| Description: | Diameter at breast height of a tree in cm |
| Value applied: | |
| Source of data: | Field measurements in sample plots |
| Measurement procedures (if any): | Measured 1.3m aboveground. Measure all trees above minimum DBH of 10cm in the sample plots. Minimum DBH employed in inventories is held constant for the duration of the project. |
| Monitoring frequency: | Monitoring must occur at least every ten years for baseline renewal. |
| QA/QC procedures to be applied: | Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. |
| Any comment: | Carbon stock estimation occurs only for determination of the baseline this parameter shall be known ex-ante.<br><br>This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description. |

| | |
|---|---|
| Data / Parameter: | $A_{sf}$ |
| Data Unit: | $m^{-2}$ |
| Used in equations: | CP-AB 10 |
| Description: | Area of one sampling frame |
| Value applied: | 400 |
| Source of data: | Recording and archiving size of sampling frame plot |
| Measurement procedures (if any): | |
| Monitoring frequency: | Monitoring must occur at least every ten years for baseline renewal. |
| QA/QC procedures to be applied: | |
| Any comment: | Shall be known *ex-ante*.<br><br>This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description. |

**Greenhouse Gas Emissions from Biomass Burning (E-BB)**

| | |
|---|---|
| Data / Parameter: | $A_{burn,i,t}$ |
| Data Unit: | Ha |
| Used in equations: | E-BB 1 |
| Description: | Area burnt in stratum i at time t |
| Value applied: | |
| Source of data: | |
| Measurement procedures (if any): | |
| Monitoring frequency: | |
| QA/QC procedures to be applied: | |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | $C_{AB,tree,i}$ |
| Data Unit: | t $CO_2$-e $ha^{-1}$ |
| Used in equations: | E-BB 2 |
| Description: | Carbon stock in aboveground biomass in trees in stratum, i |
| Value applied: | |
| Source of data: | |
| Measurement procedures (if any): | |
| Monitoring frequency: | |
| QA/QC procedures to be applied: | |
| Any comment: | |

| | |
|---|---|
| Data / Parameter: | $C_{LI,i}$ |
| Data Unit: | t $CO_2$-e $ha^{-1}$ |
| Used in equations: | E-BB 2 |
| Description: | Carbon stock in aboveground biomass in trees in stratum i |
| Value applied: | |
| Source of data: | |
| Measurement procedures (if any): | |
| Monitoring frequency: | |
| QA/QC procedures to be applied: | |

| | |
|---|---|
| Any comment: | |

**Carbon Stocks in the Long Term Wood Products Pool (CP-W)**

| | |
|---|---|
| Data / Parameter: | $A_i$ |
| Data Unit: | ha. |
| Used in equations: | CP-W 1 |
| Description: | Total area of stratum i |
| Source of data: | Direct forest inventory of the project area, distinguishing commercially viable stocks on the basis of species and tree size, referencing local expert knowledge or a participatory rural assessment (PRA) of harvest practices and markets. |
| Measurement procedures (if any) | This parameter is updated at baseline renewal when aboveground biomass is re-inventoried as per module CP-AB (at least every 10 years). |
| Monitoring frequency: | Monitoring must occur at least every ten years for baseline renewal. |
| QA/QC procedures: | |
| Any comment: | Ex-ante it is assumed that the strata remains constant during the baseline period<br>This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description. |

| | |
|---|---|
| Data / Parameter: | $V_{ex,i}$ |
| Data Unit: | $m^3$ |
| Used in equations: | CP-W 1 |
| Description: | The volume of timber in $m^3$ extracted from within the stratum (does not include slash left onsite), reported by wood product class and preferably species. |
| Source of data: | Timber harvest records and/or estimates derived from field measurements or remote assessments with aerial photography or satellite imagery. |
| Measurement procedures (if any) | |
| Monitoring frequency: | Monitoring must occur at least every ten years for baseline renewal. |
| QA/QC procedures: | |
| Any comment: | Note that this volume does not include logging slash left onsite. Data compilers must also make sure that extracted volumes reported are gross volumes removed (i.e. reported volume does not already discount for estimated wood waste, as is often the practice in harvest records). Assignment of volume extracted to wood product class(es), be substantiated on the basis of participatory rural appraisal (PRA) findings (also used to assess potential for degradation in module M-MON) or records of timber sales.<br>Assignment of volume extracted to species, must be substantiated on the basis of either PRA findings, harvest records, or a commercial inventory.<br>Baseline removals will be known ex-ante. With project removals are classed as project emissions and where expected shall be detailed ex-ante alongside evidence on expected harvested volumes.<br><br>This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description. |

**Estimation of Market-Effects (LK-ME)**

| | |
|---|---|
| Data / Parameter: | $PML_{FT}$ |
| Data Unit: | % |
| Used in equations: | Not used directly in any equations, but input factor for LF, used in equation LK-ME 2. |
| Description: | Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type |
| Source of data: | Ex ante estimate based on field inventory of all biomass. Merchantable biomass is assumed to be all biomass above 50cm DBH. |
| Measurement procedures: | |
| Monitoring frequency: | Must be monitored at least every 5 years or if verification occurs on a frequency of less than every 5 years, examination must occur prior to any verification event. |
| Any comment: | |

**Estimation of Emissions from activity shifting (LK-ASP)**

| | |
|---|---|
| Data / Parameter: | ALK-peat,i |
| Data Unit: | Ha |
| Used in equations: | 8 |
| Description: | Area of leakage to peatland at time t |
| Source of data: | GPS coordinates and/or Remote Sensing data and/or legal parcel records |
| Measurement procedures (if any) | NA |
| Monitoring frequency: | Must be examined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event |
| Quality Assurance / Quality Control: | |
| Any comment: | ALK-peat is equal to the increase in deforestation of peatland by the specific agent relative to business-asusual. So if historic data shows X hectares of peatland deforestation by the focal agent each year over the past five years than any deforestation in excess of those X hectares each year after project implementation shall be counted as leakage. Ex-ante evidence shall be presented to justify a projection of zero leakage to peatland. Such evidence can include contracts with the displaced agent of deforestation or evidence of the unsuitability of peatland for the projected land use. |

| | |
|---|---|
| Data / Parameter: | $A_{planned,i}$ |
| Data Unit: | Ha |
| Used in equations: | 4 |
| Description: | Total area of planned deforestation over the entire project lifetime for stratum i |
| Source of data: | GPS coordinates and/or Remote Sensing data and/or legal parcel records |
| Measurement procedures (if any) | NA |
| Monitoring frequency: | Must be examined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event. |
| Quality Assurance / Quality Control: | |
| Any comment: | Ex-ante, Aplanned,i shall be determined as described in BL-PL |

| | |
|---|---|
| Data / Parameter: | $A_{defLK,i,t}$ |
| Data Unit: | Ha |
| Used in equations: | 5 |
| Description: | The total area of deforestation by the baseline agent or class of agent of the planned deforestation in stratum i at time t |
| Source of data: | Analysis of Remote Sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent |
| Measurement procedures (if any) | This parameter is updated at baseline renewal when aboveground biomass is re-inventoried as per module CP-AB (at least every 10 years). |
| Monitoring frequency: | Must be reexamined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event. |
| Quality Assurance / Quality Control: | |
| Any comment: | Legal records will include government permits to deforest including concession licenses Ex-ante, project proponents shall determine and justify the likelihood of leakage based on characteristics of the baseline agent or class of agent |

**Uncertainty for REDD Project Activities (X-UNC)**

| | |
|---|---|
| Data / Parameter: | $EB_{SL\ SS,i,\ pool\#}$ |
| Data Unit: | t $CO_2$-e |
| Used in equations: | 4, 5 |
| Description: | Carbon stock or GHG sources (e.g. trees, dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the baseline case |
| Source of data: | The terms denoting significant carbon stocks, GHG sources or leakage emissions from baseline modules (BL-DFW, BL-PL, BL-UP) used to calculate net emission reductions. |
| Measurement procedures (if any) | |
| Monitoring frequency: | Monitored at least once every ten years (or when the baseline is revisited) |
| Quality Assurance / Quality Control: | |
| Any comment: | Baseline stocks and sources are estimated ex-ante for each baseline period.<br><br>This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description. |

| | |
|---|---|
| Data / Parameter: | $EP_{,SS,i,\ Pool\#}$ |
| Data Unit: | t $CO_2$-e |
| Used in equations: | 7, 8 |
| Description: | Carbon stock or GHG sources (e.g. trees, down dead wood, soil organic carbon, emission from fertilizer addition, emission from biomass burning etc.) in the with-project case |
| Source of data: | The terms denoting significant carbon stocks, GHG sources or leakage emissions used in calculating net emission reductions from the following relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA. |
| Measurement procedures (if any) | |
| Monitoring frequency: | Monitored at least once every five years. Reported in the Project Monitoring report. |
| Quality Assurance / Quality Control: | |
| Any comment: | The *ex-ante* estimation shall be derived directly from the estimations originating in the relevant modules: CP-AB, CP-D, CP-L, CP-S, CP-W, E-BB, E-FFC, E-NA. |

| | |
|---|---|
| Data / Parameter: | $U_{BSL,SS,i,pool\#}$ |
| Data Unit: | % |
| Used in equations: | 4, 5 |

| | |
|---|---|
| Description: | Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the baseline case (1,2…n represent different carbon pools and/or GHG sources) |
| Source of data: | Calculations arising from field measurement data |
| Measurement procedures (if any) | Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level.<br>For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest.<br>For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero. |
| Monitoring frequency: | Monitored at least once every ten years (or when the baseline is revisited) |
| Quality Assurance / Quality Control: | |
| Any comment: | Baseline stocks and sources are estimated ex-ante for each baseline period.<br>This parameter was not monitored ex-post and is therefore excluded from this monitoring period in accordance with the validated Project Description. |

| | |
|---|---|
| Data / Parameter: | $U_{P,SS,i,pool\#}$ |
| Data Unit: | % |
| Used in equations: | 7 |
| Description: | Percentage uncertainty (expressed as 95% confidence interval as a percentage of the mean where appropriate) for carbon stocks and greenhouse gas sources in the with-project case (1,2…n represent different carbon pools and/or GHG sources) . |
| Source of data: | Calculations arising from field measurement data |
| Measurement procedures (if any) | Uncertainty in pools derived from field measurement with 95% confidence interval calculated as the standard error of the averaged plot measurements in each stratum multiplied by the t value for the 95% confidence level.<br>For wood products the uncertainty should be the confidence interval around the volume of timber extracted from the forest.<br>For emission sources conservative parameters should be used sufficient to allow the uncertainty to be set as zero. |
| Monitoring frequency: | Monitored at least once every five years |
| Quality Assurance / Quality Control: | |
| Any comment: | *Ex-ante* the uncertainty in the with-project carbon stocks and sources shall be equal to the calculated baseline uncertainty. |

### *3.2.2 VM0010*

| | |
|---|---|
| Data / Parameter: | Illegal Logging PRA results |
| Data Unit: | |
| Used in equations: | VM0010 Step 4 |
| Description: | |
| Source of data: | PRA |
| Measurement procedures (if any) | The PRA shall evaluate whether timber harvest may be occurring in the project area and shall consist of semi-structured interviews / questionnaires.<br>If ≥ 10% of those interviewed/surveyed believe that illegal logging may be occurring within the project boundary then the limited on-the-ground illegal logging survey shall be triggered.<br>An additional output of the PRA shall be a depth of penetration of illegal logging pressure. A maximum distance shall be recorded for penetration into the forest from access points (such as roads, rivers, already cleared areas) for the purpose of harvesting timber. |
| Monitoring frequency: | Every two years from the first verification. |
| Quality Assurance / Quality Control: | |
| Any comment: | Ex ante estimation shall be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent illegal logging. |

| | |
|---|---|
| Data / Parameter: | Result of Limited Illegal Logging Survey |
| Data Unit: | |
| Used in equations: | VM0010 Step 4 |
| Description: | |
| Source of data: | Limited on-the-ground illegal logging survey |
| Measurement procedures (if any) | Sampled by surveying multiple transects of known length and width across the access-buffer area to check whether new tree stumps are evident or not. The access-buffer area shall be equal in area to at least 1% of $A_{DIST_IL,i}$ |
| Monitoring frequency: | Must to be repeated each time the PRA indicates a potential for illegal logging. |
| Quality Assurance / Quality Control: | |
| Any comment: | Ex ante an estimation shall be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero. |

| | |
|---|---|
| Data / Parameter: | $A_{burn,i,t}$ |
| Data Unit: | Hectares |
| Used in equations: | VM0010 Equation 17 |
| Description: | Area burnt in stratum i at time t |
| Source of data: | GPS coordinates and/or Remote Sensing data |
| Measurement procedures (if any) | N/A |
| Monitoring frequency: | Areas disturbed shall be monitored at in accordance with the monitoring and reporting schedule. |
| Quality Assurance / Quality Control: | Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended. |
| Any comment: | Ex ante estimations of areas burned shall be based on historic incidence of fire in the Project region. Analysis of satellite imagery over a historical reference period of 2000-2009 presented no evidence of fire scars in the Project Area. |

| | |
|---|---|
| Data / Parameter: | $A_{dist,i,t}$ |
| Data Unit: | hectares |
| Used in equations: | VM0010 Equation 17 |
| Description: | Area disturbed in stratum i at time t |
| Source of data: | GPS coordinates and/or Remote Sensing data |
| Measurement procedures (if any) | N/A |
| Monitoring frequency: | Areas disturbed shall be monitored at in accordance with the monitoring and reporting schedule. |
| Quality Assurance / Quality Control: | Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended. |
| Any comment: | Ex ante estimations of areas disturbed shall be based on historic incidence of natural disturbance in the Project region. Analysis of satellite imagery over a historical reference period of 2000-2009 presented no evidence of natural disturbance in the Project Area. |

| | |
|---|---|
| Data / Parameter: | $A_{DIST_IL,i}$ |
| Data Unit: | hectares |
| Used in equations: | VM0010 Equation 19 |
| Description: | Area potentially impacted by illegal logging in stratum i |
| Source of data: | GIS delineation and ground truthing |
| Measurement procedures (if any) | $A_{DIST_IL,i}$ shall be composed of a buffer from all access points (access buffer), such as roads and rivers or previously cleared areas. The width of the buffer shall be determined by the depth of degradation penetration as defined as a PRA output. |
| Monitoring frequency: | Repeated each time the PRA indicates a potential for degradation |
| Quality Assurance / Quality Control: | |
| Any comment: | *Ex ante* a limited survey can be used to determine a likely depth of degradation penetration. |

| | |
|---|---|
| Data / Parameter: | $C_{DIST_IL,i,t\|PRJ}$ |
| Data Unit: | $tCO_2$-e |
| Used in equations: | VM0010 Equation 20 |
| Description: | biomass carbon of trees cut and removed through illegal logging in stratum *i* at time *t* |
| Source of data: | Field measurements in sample plots |
| Measurement procedures (if any) | The sampling plan must be designed using plots systematically placed over the buffer zone so that they sample at least 3% of the area of the buffer zone ($A_{DIST_IL,i}$). The diameter of all tree stumps will be measured and conservatively assumed to be the same as the DBH. Where the stump is a large buttress, several individuals of the same species nearby shall be located and a ratio of the diameter at DBH to the diameter of buttress at the same height above ground as the measured stumps shall be determined. This ratio will be applied to the measured stumps to estimate the likely DBH of the cut tree.<br>The aboveground carbon stock of each harvested tree will be estimated using the allometric regression equations chosen for forest growth in the project scenario. The mean aboveground carbon stock of the harvested trees is conservatively estimated to be the total emissions and to all enter the atmosphere. |
| Monitoring frequency: | Repeated each time limited sampling of $A_{DIST_IL}$, indicates illegal logging. |
| Quality Assurance / Quality Control: | Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the *IPCC GPG LULUCF 2003*, is recommended. |
| Any comment: | If species-specific equations are used and species cannot be identified from stumps then it shall be assumed that the harvested species is the species most commonly harvested. A PRA shall be used to determine the most commonly harvested species. |

| | |
|---|---|
| Data / Parameter: | $A_{Pi}$ |
| Data Unit: | hectares |
| Used in equations: | VM0010 Equation 19 |
| Description: | Total area of illegal logging sample plots in stratum i |
| Source of data: | Ground measurement |
| Measurement procedures (if any) | A sampling plan must be designed using multiple sample plots systematically placed across the buffer zone so that they sample at least 3% of the area of the buffer zone. |
| Monitoring frequency: | Not more than five years |
| Quality Assurance / Quality Control: | Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the *IPCC GPG LULUCF 2003*, is recommended. |
| Any comment: | *Ex ante* estimation should be made of area of plots. This should be set to exactly 3% of the buffer zone *ADIST_IL,i* |

| | |
|---|---|
| Data / Parameter: | $PMP_i$ |
| Data Unit: | % |
| Used in equations: | VM0010 STEP 5 - Leakage, Box 4. |
| Description: | Merchantable biomass as a proportion of total aboveground tree biomass for stratum *i* within the project boundaries |
| Source of data: | Within each stratum divide the summed merchantable biomass (defined as total gross biomass of a tree 15cm DBH or larger) by the summed total of aboveground tree biomass. |
| Measurement procedures (if any) | |
| Monitoring frequency: | Not more than five years |
| Quality Assurance / Quality Control: | Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the *IPCC GPG LULUCF 2003*, is recommended. |
| Any comment: | *Ex-ante* a time zero measurement shall be made of this factor.<br>The timber harvest plan sets the allowable mean extracted volume from the merchantable volume of timber in the forest inventory ($V_{j,i\|BSL}$), based on legal limits. |

| | |
|---|---|
| Data / Parameter: | $A_{i,}$ |
| Data Unit: | hectares |
| Used in equations: | VM0010 Equation 16 |
| Description: | Area covered by stratum *i* |
| Source of data: | GPS coordinates and/or Remote Sensing data and/or legal parcel records |
| Measurement procedures (if any) | |
| Monitoring frequency: | |
| Quality Assurance / Quality Control: | |
| Any comment: | In the baseline scenario strata areas shall not change through time. In the project scenario it shall be assumed *ex-ante* that stand boundaries and strata areas shall not change through time. *Ex post* adjustments of the project scenario strata may be needed if unexpected disturbances occur during the project crediting period, severely affecting different parts of an originally homogenous stratum. This disturbance will be delineated as a separate stratum for the purpose of monitoring the carbon stock changes. |

### 3.3 Description of the Monitoring Plan

The primary objective of the monitoring plan is to provide the information necessary to:

- Undertake periodic verification of the project against the VCS; and
- Revisit the baseline at the conclusion of each fixed baseline period (i.e. every 10 years).

The scope of the monitoring plan is to collect data for reporting on[11]:

- The area of forest land converted to non-forest land and associated changes in carbon stocks within the Project Area.
- Confirmation of the project activity
- The area of forest land undergoing loss in carbon stock from degradation activities and associated changes in carbon stocks;
- The greenhouse gas emissions associated with project implementation.
- The area of forest land undergoing loss in carbon stocks resulting from natural disturbances and illegal logging and any associated changes in carbon stocks.

#### *3.3.1 Required Information*

Information required for verification of the Project includes:

- Actual carbon stock changes and GHG emissions within the Project Area;
- Net anthropogenic GHG emission reduction.

Information required for revisiting the baseline projections includes:

- Information on agents, drivers and underlying causes of deforestation;
- The area and location of baseline deforestation;
- Improved data on the carbon component of the baseline, if available.

Additionally, the monitoring activities will be used to collect and analyze information necessary to:

- Assess the success of the project scenario;
- Determine any variation between ex-ante and ex-post estimations of GHG emissions or carbon stocks; and
- Calculate and report net GHG reductions attributed to the project in accordance with the methodology requirements.

#### *3.3.2 Overview of the Monitoring Process*

The Monitoring Plan employs direct field monitoring patrols as well as indirect satellite images and analysis tools to systematically monitor land cover change in the Project Area. Any detection of change from direct or indirect monitoring will trigger a land use change assessment and increased patrols in identified vulnerable areas. Increased patrols would be aimed at reducing future impact on identified 'at risk areas' for more intense patrols. Figure 3 shows an overview of the Project monitoring and reporting process.

[11] Note that as there is no harvesting in the project scenario, there is no unsustainable firewood collection or charcoal production and regrowth of deforested/degraded lands is conservatively omitted.

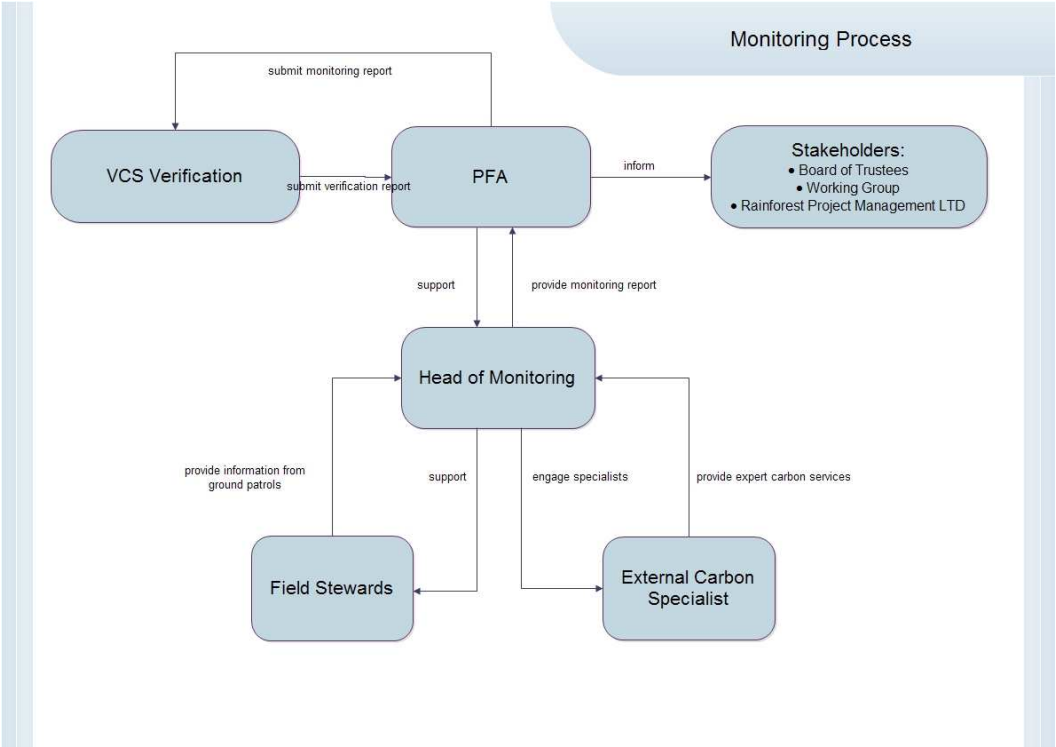



**Figure 3: Overview of monitoring process**

The monitoring reports developed by the Head of Monitoring will be used to identify project risks and non-conformances which will in turn trigger a corrective action plan (CAPs), if required, which is created between the Head of Monitoring and the Field Stewards. These CAPs inform of any necessary revision of the field standard operating procedures (SOPs), or additional training requirements, thereby enabling a process of continuous improvement through an adaptive management processes as illustrated in Figure 4

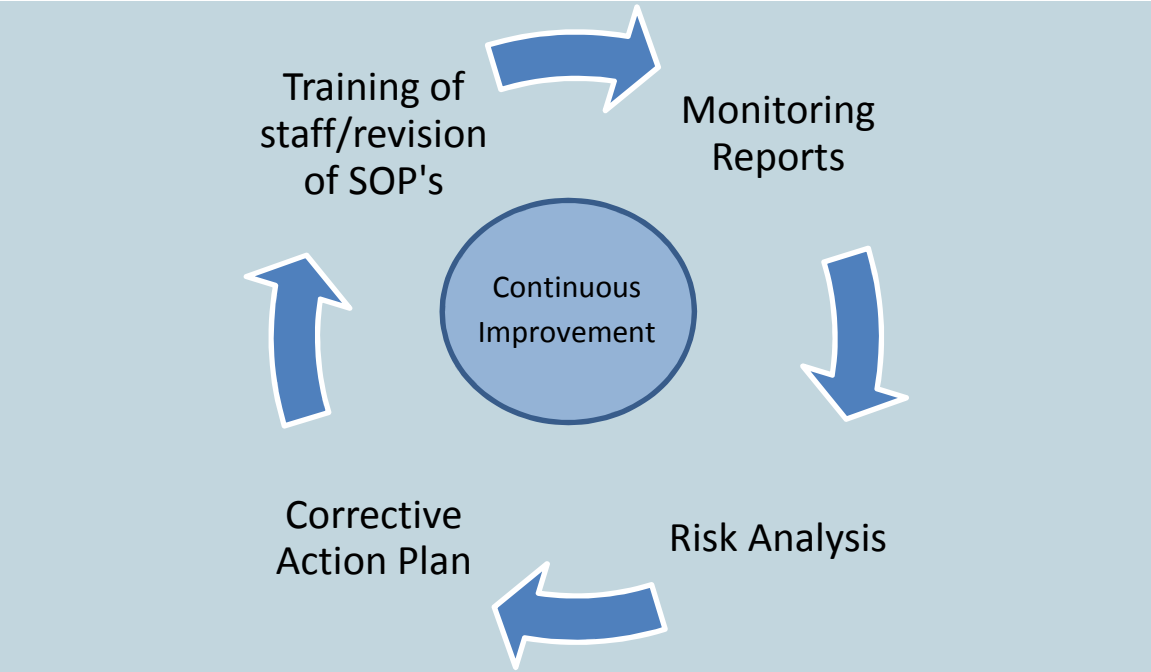
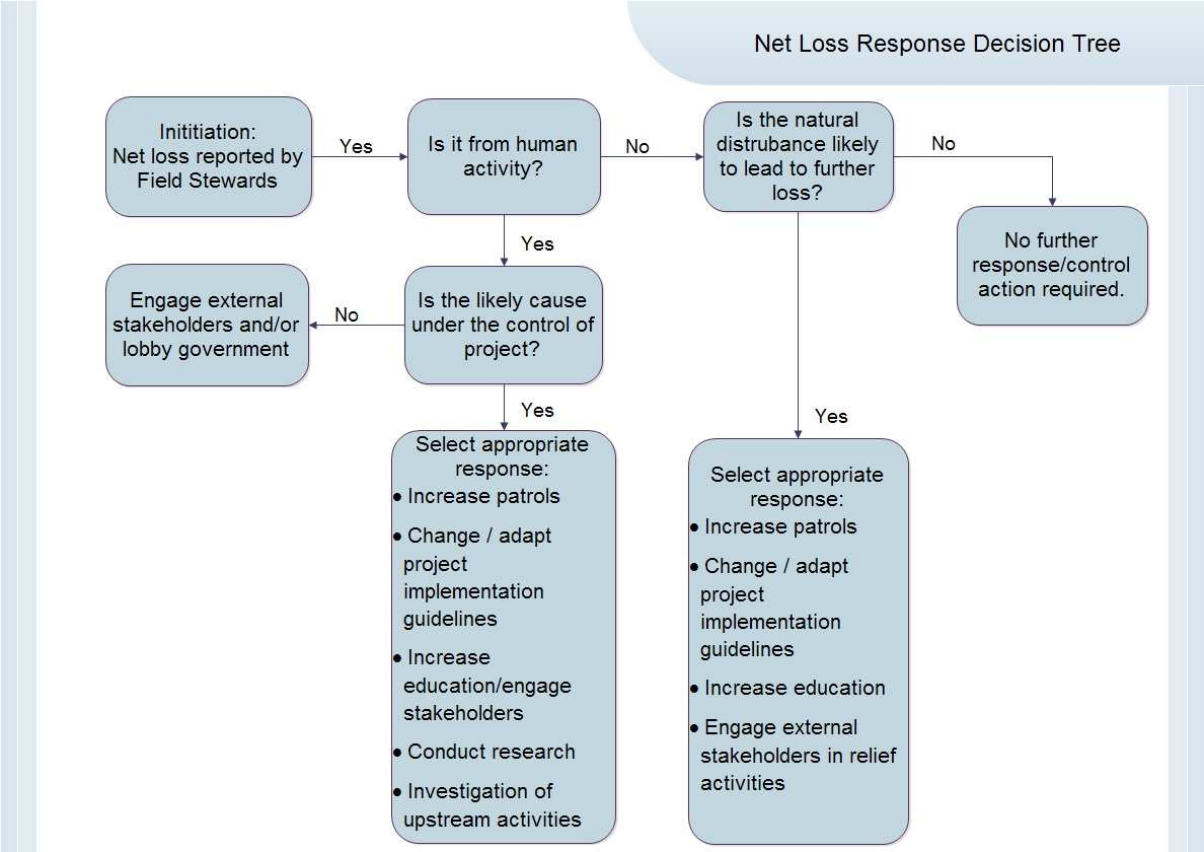



**Figure 4: Continuous Improvement of monitoring process**

If the monitoring and reporting process identifies disturbance which results in a net loss in the Project Area, then the decision tree in Figure 5 is used to guide responses to the issue.

**Figure 5: Net Loss Response Decision Tree**




### *3.3.3 Ground Surveys*

Ground surveys will be conducted to gather information from the Project Area. Ground surveys may fall under the following categories:

- Routine Field Patrol
- Incident Based Non-Routine Patrol

Each field patrol requires completion of a field sheet or survey. The information required to be collected from the routine field patrols is detailed against each parameter listed in Section 3.2.

Routine field patrols will be conducted by the Field Stewards and reported to the Head of Monitoring. Incident based non-routine patrols will also be completed by the Field Stewards and reported to the Head of Monitoring; however the reporting of non-routine patrols will instigate the adaptive management procedures as seen in Figure 5.

### *3.3.4 Remote Sensing*

Remote sensing techniques will be employed to assess deforestation in the Project Area. Both low and high resolution images may be assessed to detect changes in the project region related to indicators such as infrastructure development, clearing for gardening, fires and other natural disturbances. Changes at this scale are most likely detectable over a longer (12 month) temporal scale and as such this analysis will take place to coincide with the VCS reporting and verification events detailed in Table 23. The results will be collated into a monitoring report suitable for third party verification. A summary of identified monitoring components can be found in Table 21 below.

**Table 21: Monitoring Activities**

| Monitoring Component | | Activity | Monitoring Frequency | Method | Resources |
|---|---|---|---|---|---|
| 1 | Boundary | Detect integrity of Project Boundary | Annually | Remote Sensing | ALOS 50m or Landsat 30m |
| 2 | Stratification | Land Cover classification | Annually | Remote Sensing | ALOS 50m or Landsat 30m + field data |
| 3 | Land change | Detection and area calculation of deforestation | Annually | Remote Sensing | Landsat 30m for detection plus targeted high resolution imagery (aerial or satellite with 1-5m resolution) as needed to support analysis and field surveys |
| 4 | Logging | Detection and area calculation of degradation from illegal logging | Continual | Fieldwork<br><br>Remote Sensing | High Resolution Imagery (5m satellite)<br><br>Results of 2 yearly PRA process. |
| 5 | Fire | Detection of fire ignitions, calculation of burn areas (deforestation associated with fire) | Continual | Fieldwork<br><br>Remote Sensing | MODIS imagery (1 km thermal band detects fires as small as $100m^2$ and imagery is collected and posted daily) |
| 6 | Forest Carbon Stock | Field measurement of biomass indicators (i.e. species, height, DBH) | 10 yearly | Fieldwork | Project Field Inventory Guide and Data Sheets |
| 7 | Leakage | New logging or land conversion permit activity within region of project | Annually | Fieldwork<br><br>Remote Sensing<br>National Records | Landsat 30m for detection plus targeted high resolution imagery (aerial or satellite with 1-5m resolution) |

### *3.3.5 Data Archiving*

All data collected as part of the monitoring program will be archived electronically and kept at least for two years after the end of the project crediting period. All measurements will be conducted according to relevant standards as described in the parameter tables.

Data archiving shall take both electronic and paper forms, and copies of all data shall be provided to relevant project participants/stakeholders. All electronic data and reports shall also be copied on durable media such as CDs and copies of the CDs are to be stored in multiple locations. One copy to be stored in the office of Head of Monitoring and one copy stored in the head office of PFA.

The archives will include:

- copies of all original field measurement data and data analysis spreadsheets;
- estimates of the carbon stock changes in all pools and non-$CO_2$ GHG and corresponding calculation spreadsheets;
- GIS products; and
- copies of the monitoring reports.

### *3.3.6 Organisation and Responsibilities*

**Table 22: Responsibilities of monitoring staff**

| Staff | Responsibilities |
|---|---|
| Pacific Forest Alliance | Third Party review process of monitoring report |
| | Managing the VCS verification process |
| | Maintaining and storage of records |
| | Reporting to project stakeholders |
| Project Manager/Head of Monitoring | Manage monitoring process |
| | Plan and coordinated field data collection |
| | Prepare reports |
| | Identify Issues |
| | Implement continual improvement processes |
| | Supervision of field stewards |
| | Identify training requirements |
| | Drafting of Standard Operating Procedures |
| | Procurement of required support from specialists |
| Field Steward | Field data collection |
| | Instrument calibration and maintenance |
| | Data uploading |
| | Communication of issues to Head of Monitoring |
| External Consultants | Delivery of required support as specified by the Head of Monitoring (largely remote sensing related activities). |

### *3.3.7 Monitoring Frequency*

The monitoring of parameters required for VM0007 and VM0010 will culminate in the development of a monitoring report for third party verification. This report will be produced annually up until 2015 and bi-annually after 2015 as reported in

Table 23 and consistent with the validated Project Description.

Should there be any loss identified in the Project Area the Net Loss Response procedure (Figure 5) will initiate immediate reporting to the Superintendent and an appropriate response to limit further loss.

The monitoring of parameters for the baseline renewal will culminate in the development of a revision of the baseline estimation of carbon stocks every 10 years. This is scheduled for 2019 (see

Table 23).

**Table 23: Frequency of Monitoring and Reporting for VCS verification**

| Period | Activities | Duration (yrs) | Baseline status |
|---|---|---|---|
| 22 May 2009 – 31 December 2012 | First monitoring period | 3.5 | First baseline period |
| 1st January 2013 – 31 December 2014 | Second monitoring period | 1 | |
| 1st January 2014 – 31 December 2015 | Third monitoring period | 1 | |
| 1st January 2015 – 31 December 2016 | Fourth monitoring period | 1 | |
| 1st January 2016 – 31 December 2018 | Fifth monitoring period | 2 | |
| 1st January 2018 – 21 May 2019 | Sixth monitoring period | 1.5 | |
| 21 May 2019 | Baseline Revision | NA | Revised baseline |

### 3.3.8 Quality Assurance and Quality Control (QA/QC)

Monitoring related QA/QC requirements are documented in a series of Standard Operating Procedures (SOPs) which are summarised in Table 24.

**Table 24: Standard Operating Procedures Relevant to VCS Monitoring and Reporting**

| QA/QC | Description |
|---|---|
| Data Collection SOP | The remote sensing data, will be verified by the field stewards through ground-truthing if required.<br><br>QA/QC procedures for specific parameters are described in Section 3.2. |
| Data Capture and Storage SOP | The DCS SOP defines the data capture, storage (hard copy and digital format) and data retrieval framework. |
| Report Development and Release | Technical review or pre-verification of the data, SOP and monitoring report will be conducted by an independent 3rd party, such as the University of Papua New Guinea using a checklist specially developed for this purpose. This report will then be signed off by Pacific Forest Alliance prior to the commencement of the VCS verification process. |
| Continual Improvement Process | This process will be applied to ensure continuous improvement in all processes involved. |
| Information and Communication Systems (ICS) SOP | The ICS SOP defines communication methods including communication responsibilities, timing of communication, reporting requirements, events response and the flow in which the communication process should occur. |

## 3.4 Monitoring and Reporting Tasks

Monitoring and reporting tasks are designed to collect and report the information required for periodic verification of the Project, and recalculation of the baseline at the end of the fixed baseline period.

Technical descriptions of monitoring tasks, data collection procedures, and QA/QC procedures are listed for each parameter in the tables presented in Section 3.

The monitoring plan is divided into two tasks:

- Task 1 – Monitoring and reporting of carbon stock changes and GHG emissions in areas defined as planned deforestation (VM0007)
- Task 2 - Monitoring and reporting for areas defined as conversion of logged to protected forest (VM0010)

### 3.4.1 Task 1 – Monitoring and reporting of carbon stock changes and GHG emissions in areas defined as planned deforestation (VM0007)

In accordance with VM0007 (M-MON) monitoring of the following parameters is required:

**Table 25: Parameters produced from VM0007 monitoring**

| Parameter | SI Unit | Source | Description |
|---|---|---|---|
| $\Delta C_P$ | t $CO_2$-e | Calculated | Net greenhouse gas emissions within the project area under the project scenario |
| $A_{DefPA,i,t}$ | ha | Satellite Images | Area of recorded deforestation in the project area in the project case in stratum i at time t |
| $A_{burn,i,t}$ | ha | Satellite Images | Area burnt in stratum i at time t |
| $A_{DistPA,i,t}$ | ha | Satellite Images | Area impacted by natural disturbance in stratum i at time t |

For the Project Area, the net greenhouse gas emissions in the Project case is equal to the sum of stock changes due to deforestation and natural disturbance plus the total greenhouse gas emissions. Degradation is not applicable and regrowth is conservatively omitted.

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

Where:

$\Delta CP$ Net greenhouse gas emissions within the project area under the project scenario; t CO2-e

$\Delta CP,DefPA,i,t$ Net carbon stock change as a result of deforestation in the project area in the project case in stratum *i* at time *t*; t CO2-e

$\Delta CP,Deg,i,t$ Net carbon stock change as a result of degradation in the project area in the project case in stratum *i* at time *t*; t CO2-e

$\Delta CP,DistPA,i,t$ Net carbon stock change as a result of natural disturbance in the project area in the project case in stratum *i* at time *t*; t CO2-e

$GHGP\text{-}E,i,t$ Greenhouse gas emissions as a result of deforestation and degradation activities within the project area in the project case in stratum *i* in year *t*; t CO2-e

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

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

The basis of the calculations requires quantification of the area parameters:

| | | | |
|---|---|---|---|
| $A_{DefPA,i,t}$ | ha | Satellite Images | Area of recorded deforestation in the Project Area in the project case in stratum i at time t |
| $A_{burn,i,t}$ | ha | Satellite Images | Area burnt in stratum i at time t |
| $A_{DistPA,i,t}$ | ha | Satellite Images | Area impacted by natural disturbance in stratum i at time t |

Quantification of these area parameters using remote sensing requires completion of the following four steps:

**Step 1: Selection and analyses of sources of land-use and land-cover (LU/LC) change data**

A land cover / land use change analysis for the years 2009 and 2012 was conducted based on Landsat-5 TM and Landsat-7 ETM+ satellite imagery, these images have a resolution of 30 meters and consist of 5 spectral bands. The Landsat images were acquired in Level 1T preprocessing format, which means that a very accurate geometric correction, including terrain correction has already been applied by the data provider (USGS). The images were checked for geometric alignment, and it was concluded that the geometric matching was very accurate, and no further correction required. The images were delivered in the UTM (Universal Transverse Mercator) projection, Zone 54 S.

The pixel information in the Landsat Level 1T imagery contains the at-sensor radiance, i.e. the radiation reflected from the earth surface at top of the atmosphere. This at-sensor-radiance contains atmospheric disturbances due to illumination, aerosols, water vapour etc. during image acquisition. In order to correct these disturbances, an atmospheric correction procedure has been applied, which removes these effects and converts the data into surface reflectance. The software ATCOR-2 has been used for this task, which makes use of the MODTRAN atmospheric transfer code. The atmospheric correction facilitates that differences between the images due to atmospheric disturbances are removed.

Additional preprocessing steps included spectral enhancement of the data by calculating the NDVI (Normalized Difference Vegetation Index) (Lillesand et al. 2004), and applying a MNF Transformation (Minimum Noise Fraction) (Green et al. 1988) in order to generate additional input bands for classification.

The preprocessing was conducted in the software package ENVI / IDL (ExelisVis) and the ATCOR-2 software (Green, 1988).

Table 26 lists the images used in this analysis and Table 27 provides a list of datasets delivered.

**Table 26: Images used in analysis**

| Satellite | Path/ Row | Acquisition date |
|---|---|---|
| **2009** | | |
| Landsat-5 | 099/063 | 2008-10-13 |
| Landsat-7 | 099/063 | 2009-03-06 |
| Landsat-5 | 099/063 | 2009-03-30 |
| Landsat-5 | 099/063 | 2009-05-09 |
| Landsat-5 | 099/063 | 2009-05-25 |
| Landsat-5 | 099/063 | 2009-06-10 |
| Landsat-5 | 099/063 | 2009-06-26 |
| Landsat-5 | 099/063 | 2009-08-29 |
| Landsat-5 | 099/063 | 2009-11-01 |
| Landsat-5 | 099/063 | 2009-11-17 |
| **2012** | | |
| Landsat-7 | 099/063 | 2011-02-16 |
| Landsat-7 | 099/063 | 2011-05-23 |
| Landsat-7 | 099/063 | 2011-08-27 |
| Landsat-7 | 099/063 | 2012-02-03 |
| Landsat-7 | 099/063 | 2012-03-06 |
| Landsat-7 | 099/063 | 2012-04-23 |
| Landsat-7 | 099/063 | 2012-05-09 |
| Landsat-7 | 099/063 | 2012-10-16 |
| Landsat-7 | 099/063 | 2013-01-20 |

The Landsat imagery was procured in Level 1 T preprocessing format. This means that a very accurate ortho-correction has already been applied by the data provider (USGS). All used imagery was thoroughly checked for geometric matching, and it was found that no additional geometric correction was necessary.

**Table 27: Datasets delivered:**

| Information | File name (s) | Comment |
|---|---|---|
| forest/non-forest cover shapefiles | Land_Cover_2009_final.shp | 2009 Land Cover Classifcation |
| | Land_Cover_2012_final.shp | 2012 Land Cover Classifcation |
| | Land_Cover_2009_final_CompleteNoData.shp | 2009 Land Cover Classifcation with accumulate No Data areas from 2009 and 2012 |
| | Land_Cover_2012_final_CompleteNoData.shp | 2012 Land Cover Classifcation with accumulate No Data areas from 2009 and 2012 |
| LULC change/deforestation shapefiles | Change_2009_2012_final.shp | Land Cover Change 2009 - 2012 |
| | Change_2009_2012_final_CompleteNoData.shp | Land Cover Change 2009 – 2012, calculated based on the LC datasets with accumulate NoData |
| shapefiles of cloud obscured areas | Included in the respective LC shapefiles | |
| and a shapefile of points used for validation and their corresponding classification by an analyst | Validation_points_2009.shp | Points used for the validation of the classification; Attributes are:<br><br>CID: Class code of the classification<br><br>Valid: Class code assigned by the interpreter<br><br>True: Are CID and Valid identical<br><br>Random: Random number used for sorting the validation points |

| | | |
|---|---|---|
| | | during interpretation |

All images were checked for geometric accuracy, in particular image to image matching. It was found that there was no mismatch between any of the images, so no further geometric correction was necessary.

**Step 2: Processing LU/LC Change Data**

The first step in the image preparation was the atmospheric correction, i.e. the removal of atmospheric distortions in the imagery due to differences in aerosols, water vapor, haze and illumination effects. This was done with the ATCOR-2 software. The output data was converted into surface reflectance.

The second step was the removal of clouds and cloud shadows. This was done by a semi-automated object-based image classification routine, developed by RSS, and executed in the Trimble eCognition software package. The clouds are detected based on the blue and thermal bands in the Landsat images, while cloud shadows are detected based on a brightness threshold in the Near Infrared and adjacency to clouds. The detected clouds and shadows were then masked out.

The next step of image preprocessing was the creation of a multi-image mosaic for each of the two observation times 2009 and 2012. Therefore, the images were ordered by quality (i.e. the ones with the lowest cloud cover on top) and mosaicked together by the ENVI mosaic tool. Gaps in one image were filled up by data from the images underneath. The mosaicking was conducted as a step-by-step procedure in order to facilitate an accurate color balancing between the individual images.

**Land cover classification**

The image mosaics were then classified into the following land cover classes listed by an object-based semi-automated processing routine in eCognition:

- Forest
- Non-Forest
- Water

The first step of the processes is the image segmentation, which accumulates spatially adjacent pixels with similar spectral properties into image objects.

A threshold-based classification rule-set was then used to assign the land cover classes to the image objects. . The rule-set follows a decision tree structure, assigning land cover classes to the image objects in a hierarchical manner. The workflow of the rule-set, including the decision rules and thresholds used is shown in Figure 6:

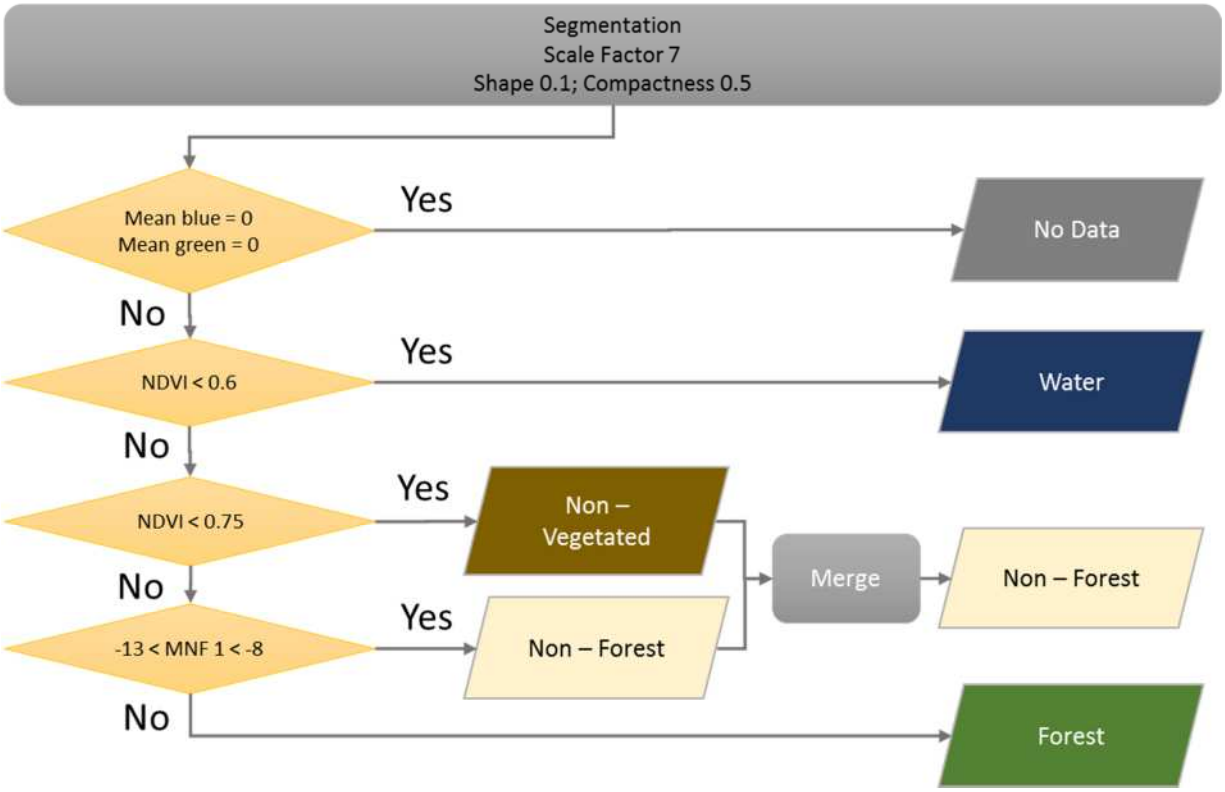



**Figure 6:Threshold based classification rule set**

Eventually, a visual screening of the classification results was conducted in order to reduce mis-classifications and improve classification accuracy.

No ground truth data was collected for training purposes in land cover classification.

**Change detection**

Based on the classification results of the two observation times, a post classification change detection was applied. The two classifications were overlaid in the GIS, and the change vectors (from-to change) were determined. The different change vectors were then grouped into meaningful change classes, such as “Deforestation”, “Regeneration” or “Flooding”.

**Step 3: Post-processing and accuracy assessment**

An accuracy assessment was conducted for the two land cover maps based on confusion matrices. Reference land cover samples were generated based on a stratified random sampling scheme. An independent interpreter then assigned the land cover category to the samples based on interpretation of the satellite images.

A confusion matrix was then established comparing the classification result with the reference samples, and the overall classification accuracy, as well as the accuracy of the individual classes (producer’s and user’s accuracy) were calculated.

No ground truth data was collected for the accuracy assessment.

**Estimating land-use and land-cover (LU/LC) change data in cloud-obscured areas**

The land cover classifications of both observation times were overlaid and a common no data mask was generated in order to exclude areas from the change analysis which were cloud-obscured in one of the classifications. All land-cover change statistics, in particular the deforestation rate, were calculated exclusively on areas which contain data at both observation times. The deforestation rate was then calculated in percent per year.

**Step 4: Calculation Approach**

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

Where:

| | |
|---|---|
| $\Delta C_{P,DefPA,i,t}$ | Net carbon stock change as a result of deforestation in the project case in the project area in stratum *i* at time *t*; t $CO_2$-e |
| $A_{DefPA,u,i,t}$ | Area of recorded deforestation in the project area stratum *i* converted to land use *u* at time *t*; ha |
| $\Delta C_{pools,Def,u,i,t}$ | 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 $ha^{-1}$ |
| *u* | *1,2,3,...U* post-deforestation land uses |
| *i* | 1, 2, 3 ...*M* strata |
| *t* | 1, 2, 3, ... *t** years elapsed since the start of the REDD project activity |

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

Where:

| | |
|---|---|
| $\Delta C_{pools,Def,u,i,t}$ | Net carbon stock changes in all pools as a result of deforestation in the project case in land use *u* in stratum *i* at time *t*; t CO2-e $ha^{-1}$ |
| $C_{BSL,i}$ | Carbon stock in all pools in the baseline case in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{post,u,i}$ | Carbon stock in all pools in post-deforestation land use *u* in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{WP,i}$ | Carbon stock sequestered in wood products from harvests in stratum *i*; t CO2-e $ha^{-1}$ |
| *u* | *1,2,3,...U* post-deforestation land uses |
| *i* | 1, 2, 3 ...*M* strata |
| *t* | 1, 2, 3, ... *t** years elapsed since the start of the REDD project activity |

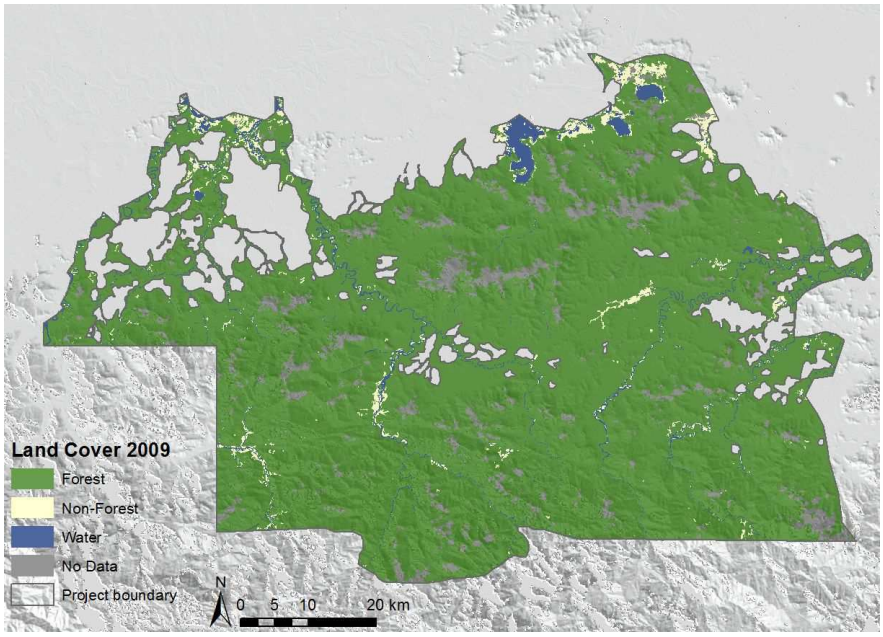
$$C_{post,u,i} = C_{AB_tree,i} + C_{BB_tree,i} + C_{AB_non-tree,i} + C_{BB_non-tree,i} + C_{LI,i}$$ Equation (M-MON 6)

Where:

| | |
|---|---|
| $C_{post,u,i}$ | Carbon stock in all pools in post-deforestation land use *u* in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{AB\ tree,i}$ | Carbon stock in aboveground tree biomass in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{BB\ tree,i}$ | Carbon stock in belowground tree biomass in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{AB\ non-tree,i}$ | Carbon stock in aboveground non-tree vegetation in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{BB\ non-tree,i}$ | Carbon stock in belowground non-tree vegetation in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{LI,i}$ | Carbon stock in litter in stratum *i*; t CO2-e $ha^{-1}$ |
| *u* | *1,2,3,...U* post-deforestation land uses |
| *i* | *1, 2, 3 ...M strata in the in the project case* |

**Area of recorded deforestation ($A_{DefPA,i,t}$), Area burnt ($A_{burn,i,t}$) and Area impacted by natural disturbance ($A_{DistPA,i,t}$).**

Figure 7 shows the land cover maps of the Forest Management Area (excluding peat areas) for the two observation times 2009 and 2012 and Table 28 shows quantitative change from these maps.



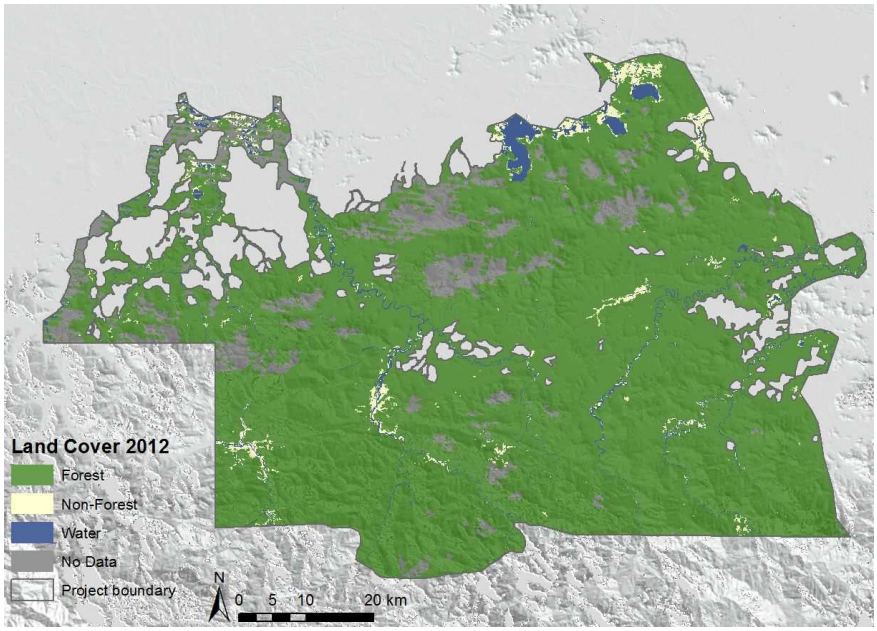




**Figure 7: Land cover map of the study area 2009 and 2012.**

**Table 28: Change table for 2009 and 2012**

| Class Name | Full area | | | |
|---|---|---|---|---|
| | 2009 | 2012 | 2009 | 2012 |
| | Area [ha] | | % | |
| Forest | 476,337 | 461,940 | 89% | 86% |
| Non-Forest | 12,249 | 11,948 | 2% | 2% |
| Water | 15,056 | 14,289 | 3% | 3% |
| No Data | 30,764 | 46,229 | **6%** | **9%** |
| **Total** | **534,406** | **534,406** | **100%** | **100%** |

## Accuracy assessment

An accuracy assessment was conducted for the two land cover maps based on confusion matrices.

Reference land cover samples were generated based on a stratified random sampling scheme, which uses the land cover classification as stratification. 50 sample points were created for each class.

An independent image interpreter then assigned the land cover category to the samples based on interpretation of the satellite images.

A confusion matrix was then established comparing the classification result with the reference samples, and the overall classification accuracy, as well as the accuracy of the individual classes (producer's and user's accuracy) were calculated. Details about the procedures can be found in Congalton and Green 1999 [12]

**Table 29: Confusion matrix of the 2009 Land Cover Classification**

| | Validation | | | |
|---|---|---|---|---|
| **Classification** | **Forest** | **Non-Forest** | **Water** | **Total** |
| Forest | **49** | 4 | 1 | **54** |
| Non-Forest | 1 | **46** | 4 | **51** |
| Water | | | **45** | **45** |
| **Total** | **50** | **50** | **50** | **150** |

[12] R.G. Congalton and K. Green, "Assessing the accuracy of remotely sensed data: principles and practices", Boca Raton, FL (1999).

**Table 30: Confusion matrix of the 2012 Land Cover Classification.**

| | **Validation** | | | |
|---|---|---|---|---|
| **Classification** | **Forest** | **Non-Forest** | **Water** | **Total** |
| Forest | **49** | 2 | 2 | **53** |
| Non-Forest | 1 | **45** | 4 | **50** |
| Water | | 3 | **44** | **47** |
| **Total** | **50** | **50** | **50** | **150** |

**Table 31: Results of the accuracy assessment of the two land cover classifications.**

| | **2009** | | **2012** | |
|---|---|---|---|---|
| **Overall accuracy** | **93.3%** | | **92.0%** | |
| **Class-wise accuracy** | **Producer's accuracy** | **User's accuracy** | **Producer's accuracy** | **User's accuracy** |
| Forest | 98.0% | 90.7% | 98.0% | 92.5% |
| Non-Forest | 92.0% | 90.2% | 90.0% | 90.0% |
| Water | 90.0% | 100.0% | 88.0% | 93.6% |

## Land Cover Change

Figure 8 shows the land cover change map of the study area for the time period 2009 – 2012 and Table 32 shows the Land Cover Change Matrix.

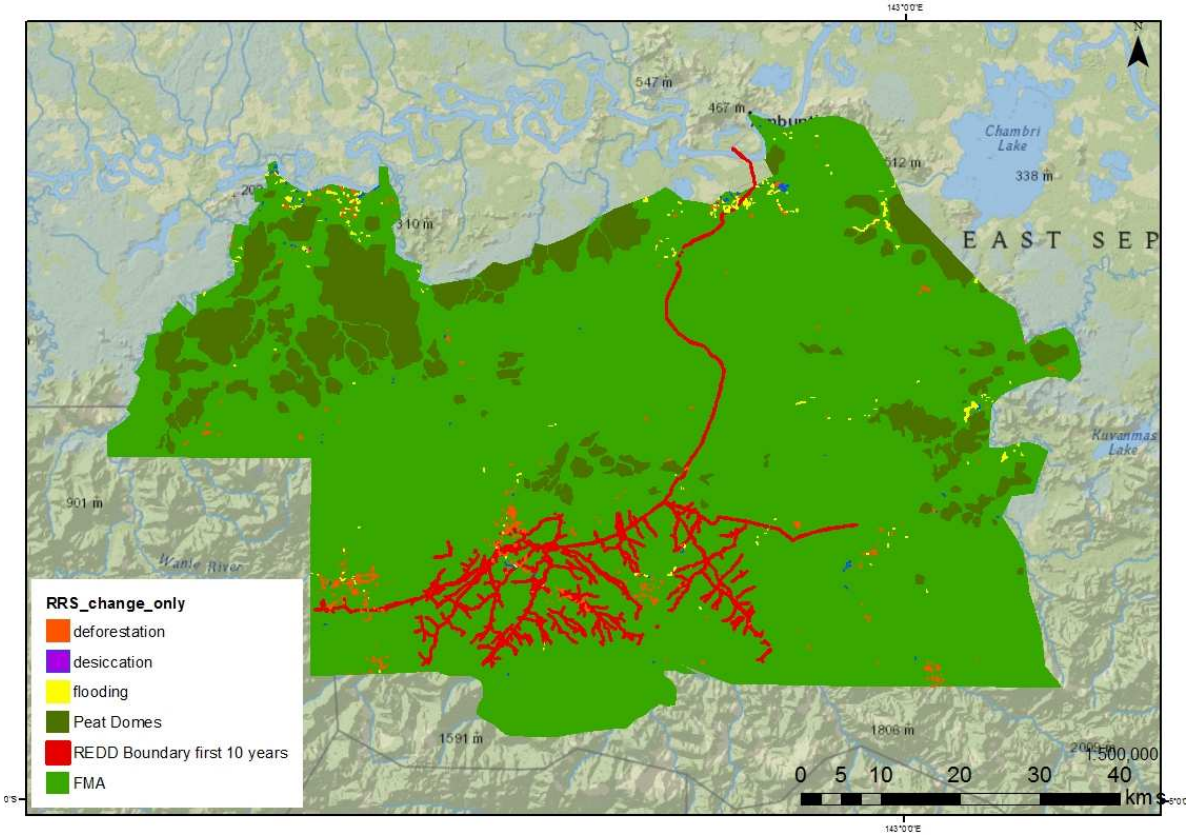



**Figure 8: Land cover change map for the observation period 2009 – 2012.**

**Table 32: Land Cover Change Matrix**

| | Land Cover T2 | | | | |
|---|---|---|---|---|---|
| Land Cover T1 | Forest | Non-Forest | Water | No Data | Total |
| Forest | 440741 | 1613 | 153 | | 442508 |
| Non-Forest | 771 | 9699 | 574 | | 11044 |
| Water | 17 | 190 | 13475 | | 13682 |
| No Data | | | | 67172 | 67172 |
| Total | 441529 | 11502 | 14203 | 67172 | 534406 |

**Table 33: Land cover change statistics for the different land cover classes in VM0007 boundary**

| Change type | Change | | |
|---|---|---|---|
| | 2009 - 2012 | | |
| | Area [ha] | % | ha $yr^{-1}$ |
| Deforestation | 16.8 | 0.7 | 4.8 |
| Desiccation | 0.9 | 0.0 | |
| Flood | 4.7 | 0.2 | |
| No change | 2346.8 | 92.0 | |
| No data | 179.8 | 7.0 | |
| Regrowth | 2.4 | 0.1 | |
| **Total** | **2551.3** | | |

**Table 34: Land cover change statistics for the different land cover classes in VM0010 boundary**

| Change type | Change | | |
|---|---|---|---|
| | 2009 - 2012 | | |
| | Area [ha] | % | ha $yr^{-1}$ |
| Deforestation | 526 | 0.3 | 150.3 |
| Desiccation | 8.2 | 0.0 | |
| No change | 174300.3 | 88.6 | |
| No data | 21726.1 | 11.0 | |
| Regrowth | 161.6 | 0.1 | |
| **Total** | **196722.2** | | |

**Area of recorded deforestation in the leakage belt ($A_{DefLB,i,t}$)**

Not Applicable.

**Monitoring degradation**

The Project has policies and procedures that require approvals for commercial activities to be established in the Project Area. These approaches require approval from the landowner companies. In addition there will be forest stewards who will be engaged to patrol the Project Area to educate the villagers in the Project operational procedures and to monitor and report any degradation activities.

The Project Area is extensive and remote and the population within the Project is very low. Subsistence activities such as building canoes, collecting firewood from the forest floor and building houses has not lead to degradation in the Project Area to date. Project monitoring will pick up any increases in disturbance and education programs will inform people and discourage them from degradation activities.

**Monitoring areas undergoing natural disturbance**

Natural disturbance in the Project Area relate primarily to loss of forest cover from shifting rivers, landslide and fire. Buffering of rivers was conducted as a means of minimizing disturbance from shifting rivers.

In accordance with the methodology emissions resulting from natural disturbances may be omitted if they are deemed *de minimis* through the use of the module T-SIG[13].

This Tool states that 'GHG emissions by sources are considered insignificant if there sum is lower than 5% of the of net anthropogenic removals by sinks when calculated according to

$$RC_{Ei} = \frac{E_i}{\sum_{i=1}^{I} E_i}$$

Where:

$RC_{Ei}$ Relative contribution of each source I to the sum of project and leakage GHG emissions

$E_i$ GHG emissions by sources pr project and possible decreases in carbon pools and leakage emissions

i = Index of individual sources of project and leakage GHG emissions (I = total number of sources considered.

All areas defined ex-post as a disturbance event in the Project Area were delineated to enable future tracking (Figure 8).

Equation M-MON 20 was used to determine the Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum I at time t.

$$\Delta C_{P,DistPA,i,t} = \sum_{q=1}^{Q} (A_{DisPA,q,i,t} \times \Delta\, C_{P,Dist,q,i,t}$$ Equation (M-MON 20)

Where:

$\Delta C_{P,DistPA,i,t}$ Net carbon stock change as a result of natural disturbance in the project case in the project area in stratum i at time t; t $CO_2$-e $ha^{-1}$

$A_{DustPA,q,I,t}$ Area impacted by natural disturbance in post natural disturbance stratum q in stratum i; at time t; t $CO_2$-e $ha^{-1}$

$\Delta C_{P,Dist,q,,ti}$ Net carbon stock changes in pools as a result of natural disturbance in post-natural disturbance stratum q in stratum i at time t; $CO_2$-e $ha^{-1}$

*q* *1,2,3,...Q* post-natural disturbance strata

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

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

[13] EB31 - Tool for testing significance of GHG emissions in A/R CDM project activities. V01. Available at: http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-04-v1.pdf

The land use change analysis detected deforestation from shifting rivers. There was no deforestation detected from fire or landslide during the monitoring period. Only deforestation from shifting rivers was detected in the REDD project boundary.

As there was no deforestation from fire during the monitoring period Equations M-MON 21 and M-MON 22 were not applied.

Equation M-MON 23 was then applied to quantify net carbon stock changes in pools as a result of natural disturbance in the project case during the monitoring period.

$$\Delta C_{P,Dist,q,i,t} = C_{BSL,i} - C_{P,Dist,q,i} - C_{WP,q,i}$$ Equation (M-MON 23)

Where:

| | |
|---|---|
| $\Delta C_{P,Dist,q,i,t}$ | Net carbon stock changes in pools as a result of natural disturbance in the project case in post-natural disturbance stratum *q* in stratum *i* at time *t*; t CO2-e $ha^{-1}$ |
| $C_{BSL,i}$ | Carbon stock in all pools in the baseline case in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{P,Dist,q,i}$ | Carbon stock in pools in post-natural disturbance strata *q* in stratum *i*; t CO2-e $ha^{-1}$ |
| $C_{Dist,WP,q,i}$ | Carbon stock sequestered in wood products from harvests following natural disturbance in post-natural disturbance stratum *q*, in stratum *i*; t CO2-e $ha^{-1}$ |
| *q* | *1,2,3,...Q* post-natural disturbance strata |
| *i* | 1, 2, 3 ...*M* strata |
| *t* | 1, 2, 3, ... *t** years elapsed since the start of the REDD project activity |

M-MON 24 was not applied, as it was conservatively assumed that the post-natural disturbance of the live and dead vegetation pool is zero.

**Monitoring areas undergoing carbon stock enhancement**

Not Applicable

**Monitoring project emissions**

The remote sensing indicated 0 hectares of burning within the IFM and REDD project boundaries. Therefore module E_BB was not applied.

**Monitoring requirements specific to baseline revision**

Not required in this monitoring report.

*Task 2 - Monitoring and reporting for areas defined as conversion of logged to protected forest (VM0010)*

Monitoring and reporting activities shall cover the following aspects:

- project implementation;

- actual carbon stock changes from project activity; and
- estimation of ex-post net carbon stock changes from disturbance and illegal logging.

Parameters listed in Table 35 are monitored in accordance with VM0010:

**Table 35: Parameters produced from VM0010 monitoring**

| Parameter | SI Unit | Description |
|---|---|---|
| Results of limited illegal logging survey | NA | PRA related to illegal logging activity |
| $A_{burn,i,t}$ | Ha | Area burnt in stratum i at time t |
| $A_{DIST_IL,\ i}$ | Ha | Area potentially impacted by illegal logging in stratum i |
| $A_{Pi}$ | Ha | Total area of illegal logging sample plots in stratum i |
| $PMP_i$ | | Annual Allowable Cut as a proportion of total FMA area |
| $A_i$ | Ha | Area covered by stratum i |
| DBH | Cm | Diameter at breast height of tree |

These parameters are required at each verification and are used in equations 16, 17, 19 of VM0010.

$$\Delta C_{WP100,i,p|BSL} = A_{i,p} * (C_{EX,i|BSL} - C_{WP100,i|BSL})$$ Equation (VM0010 - 16)

Where:

$\Delta C_{WP100,i,p|BSL}$ change in carbon stock resulting from wood product conversion and retirement from stratum i in land parcel p, tC;

$A_{i,p}$ the area of stratum i in land parcel p, ha;

$C_{EX,i|BSL}$ mean carbon stock of extracted timber per unit area in stratum i, tC $ha^{-1}$;

$C_{WP100,i|BSL}$ carbon stock sequestered in wood products in stratum i as a result of planned timber harvest in the baseline scenario, in tC $ha^{-1}$;

i 1, 2, 3 …M strata; and

p 1, 2, 3 ...P land parcels.

$$\Delta C_{RG,i,p|BSL} = A_{i,p} * (RGR_i * TH_{i,p})$$ Equation (VM0010 - 17)

Where:

| | |
|---|---|
| $\Delta C_{RG,i,p|BSL}$ | carbon sequestration resulting from forest regrowth after timber harvest in stratum i in land parcel p, tC; |
| $A_{i,p}$ | the area of stratum i in land parcel p, ha; |
| $R_{GRi}$ | regrowth rate of forest post timber harvest for stratum i, tC $ha^{-1}$ $yr^{-1}$; |
| $TH_{i,p}$ | number of years since timber harvest in stratum i in land parcel p, years; |
| i | 1, 2, 3 …M strata; and |
| p | 1, 2, 3 ...P land parcels. |

$$\Delta C_{NET|BSL} = \frac{\left(\sum_{p=1}^{P} \Delta C_{NET,p|BSL}\right)}{IFM_{CP}} * t^*$$ Equation (VM0010 - 19)

Where:

| | |
|---|---|
| $\Delta C_{NET|BSL}$ | net change in carbon stock across all parcels in the baseline scenario since the start of the project activity, in tC; |
| $\Delta C_{NET,p|BSL}$ | net change in carbon stock in the baseline scenario in parcel p, in tC; |
| IFMCP | project crediting period for the IFM project, in years; |
| t* | time elapsed since the start of the project, in years; and |
| p | 1, 2, 3 ...P land parcels harvested within the crediting period. |

**Monitoring of Disturbance**

Illegal PRA

The PRA conducted in the baseline assessment was completed in 2012. This PRA determined there was **no illegal logging occurring within the IFM Boundary**. This was consistent with patrols and remote sensing conducted between 2009 and 2012. The PRA will be repeated in 2014 as required by the methodology.

Area burnt ($A_{burn,i,t}$)

Remote sensing in the IFM boundary between 2009-2012 indicated that that there was no areas burnt. Therefore **$A_{burn,2009-2012}$ = 0 hectares**.

Area potentially impacted by illegal logging ($A_{DIST_IL,i}$)

The PRA indicated **no likely disturbance from illegal logging**. Remote sensing detected only areas deforested and these have been quantified and deducted from the net GHG emissions. No evidence of illegal logging was detected with the remote sensing.

Total area of illegal logging ($A_{Pi}$)

As there was **no illegal logging** this parameter is equivalent to 0.

Annual Allowable Cut as a proportion of total FMA area ($PMP_i$)

This is to be assessed at 5 yearly intervals. As this was part of the 2012 Project Documentation PMP will be re-assessed in 2017 and incorporated in the relevant Monitoring Report.

**Monitoring of actual carbon stock changes**

Diameter at breast height of tree (DBH)

Not Applicable. The forest is Primary forest and is assumed to be in steady state. No monitoring or claim for forest growth will be included in this Project.

# 4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

## 4.1 Baseline Emissions

Baseline emissions for the current monitoring period were calculated in accordance with the Projects VM0010 and VM0007 validated Calculator. This approach assumed a linear deforestation and which resulted in cumulative gross and net emission reductions (20 May 1, 2009 to December 31, 2012) by year as listed in Table 36.

**Table 36: Baseline Emissions for Monitoring Period M1**

| MON Period | Units<br>Year | | $\Delta C_{BSL,VM0007,t}$<br>t $CO_2$-e | $\Delta C_{BSL,VM0010,t}$<br>t $CO_2$-e | $\Delta C_{BSL,Total,t}$<br>t $CO_2$-e | $\Delta C_{BSL,Total,cumulative}$<br>t $CO_2$-e |
|---|---|---|---|---|---|---|
| M1 | | May-10 | 96,001 | 146,619 | 242,620 | 242,620 |
| | | May-11 | 98,684 | 180,782 | 279,466 | 522,086 |
| | | May-12 | 101,367 | 214,948 | 316,315 | 838,401 |
| | | Dec-12 | 56,050 | 124,555 | 180,605 | 1,019,006 |
| | | May-13 | 57,361 | 124,556 | 181,917 | 1,200,923 |
| | | May-14 | 106,733 | 283,278 | 390,011 | 1,590,934 |
| | | May-15 | 109,733 | 317,443 | 427,176 | 2,018,110 |
| | | May-16 | 112,099 | 351,608 | 463,707 | 2,481,817 |
| | | May-17 | 114,782 | 385,773 | 500,555 | 2,982,372 |
| | | May-18 | 117,465 | 419,938 | 537,403 | 3,519,775 |
| | | May-19 | 120,148 | 454,102 | 574,250 | 4,094,025 |

Figures for $\Delta C_{BSL,VM0007,t}$ taken from tab VM0007-REDD-MF of the calculation tool.

Figures for $\Delta C_{BSL,VM0010,t}$ taken from tab VM0010-8.1.4-5 of the calculation tool.

The first monitoring period is for 3.5 years. Availability of remote sensing data restricted the full 4$^{th}$ year to be included.

The gross baseline emissions covered by this Monitoring Periods (M1) are equivalent to **1,019,006 $tCO_2e$**.

## 4.2 Project Emissions

The Project Emissions were calculated in the VCS_7_10_Calculator_PNG-M1.xlsx calculator. As a result the Project Emissions were determined to be **203,286 $tCO_2e$** (Table 37).

**Table 37: Project Emissions from VM0007 and VM0010 areas**

| | | | $\Delta C_{P,VM0007,t}$ | $\Delta C_{P,VM0010,t}$ | $\Delta C_{P,Total,t}$ | $\Delta C_{P,Total,cumulative}$ |
|---|---|---|---|---|---|---|
| **MON Period** | **Units** | | **t $CO_2$-e** | **t $CO_2$-e** | **t $CO_2$-e** | **t $CO_2$-e** |
| | **Year** | | | | | |
| M1 | 1 | May-10 | 2,624 | 55,453 | 58,077 | 58,077 |
| | 2 | May-11 | 2,624 | 55,453 | 58,077 | 116,154 |
| | 3 | May-12 | 2,624 | 55,453 | 58,077 | 174,231 |
| | 4a | Dec-12 | 1,312 | 27,743 | 29,055 | 203,286 |

## 4.3 Leakage

As the project has taken the leakage factor deductions no leakage monitoring is required by either methodology. The Leakage deductions based on the default leakage factors and have already been incorporated into the baseline calculations.

### 4.4 Summary of GHG Emission Reductions and Removals (M1)

**Table 38: Summary of net GHG emissions from VM0007 for M1 period**

| Units Year (ending) | $C_{REDD,t}$ t CO2-e | $\Delta C_{BSL}$ t CO2-e | $\Delta C_P$ t CO2-e | $\Delta C_{LK}$ t CO2-e | $Buffer_{PLANNED}$ t CO2-e | $Buffer_{TOTAL}$ t CO2-e | $C_{REDD,t}$ t CO2-e cumultive | Adjusted_$C_{REDDt}$ t CO2-e cumultive | $VCU_t$ t CO2-e |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 93,376 | 96,001 | 2,624 | - | 9,338 | 9,338 | 93,376 | 93,376 | 84,039 |
| 2 | 96,059 | 98,684 | 2,624 | - | 9,606 | 9,606 | 189,435 | 189,435 | 86,453 |
| 3 | 98,742 | 101,367 | 2,624 | - | 9,874 | 9,874 | 288,178 | 288,178 | 88,868 |
| 4a | 54,737 | 56,050 | 1,312 | - | 5,474 | 5,474 | 342,915 | 342,915 | 49,264 |

The net GHG emission reductions and removals covered by this Monitoring Periods (M1) by VM0007 is equivalent to **308,624 $tCO_2e$ VCUs (**Table 38**)**.

**Table 39: Summary of net GHG emissions from VM0010 for M1 period**

| | Total Credits | Total No. Buffer credits withheld | Total VCUs |
|---|---|---|---|
| **Project Year (ending)** | | | |
| 1 | 61,842 | 6,184 | 55,658 |
| 2 | 89,174 | 8,917 | 80,256 |
| 3 | 116,506 | 11,651 | 104,855 |
| 4a | 71,902 | 7,190 | 64,712 |

The net GHG emission reductions and removals covered by this Monitoring Periods (M1) by VM0010 is equivalent to **305,481 $tCO_2e$ VCUs (**Table 39**)**.

The combine net GHG emission reductions and removals from the entire Project Area covered by this Monitoring Periods (M1) is equivalent to **614,105 $tCO_2e$ VCUs (**Table 40**)**.

**Table 40: Total combined net GHG emissions from period M1**

| | | | $VCU_{VM0007,t}$ | $VCU_{VM0010,t}$ | $VCU_{Total,t}$ | $VCU_{Total,cumulative}$ |
|---|---|---|---|---|---|---|
| **MON Period** | **Units** | | **t $CO_2$-e** | **t $CO_2$-e** | **t $CO_2$-e** | **t $CO_2$-e** |
| | **Year** | | | | | |
| M1 | 1 | 2009/2010 | 84,039 | 55,658 | 139,696 | 139,696 |
| | 2 | 2010/2011 | 86,453 | 80,256 | 166,710 | 306,406 |
| | 3 | 2011/2012 | 88,868 | 104,855 | 193,723 | 500,129 |
| | 4a | 2012 | 49,264 | 64,712 | 113,976 | 614,105 |

## 4.5 Additional Information

NA

**REFERENCES:**

Green, A. A., Berman, M., Switzer, P., and Craig, M. D., 1988, A transformation for ordering multispectral data in terms of image quality with implications for noise removal: *IEEE Transactions on Geoscience and Remote Sensing*, v. 26, no. 1, p. 65-74.

T.M. Lillesand, R.W. Kiefer, J.W. Chipman, “Remote Sensing and Image Interpretation”, 5th edition, New York (2004).