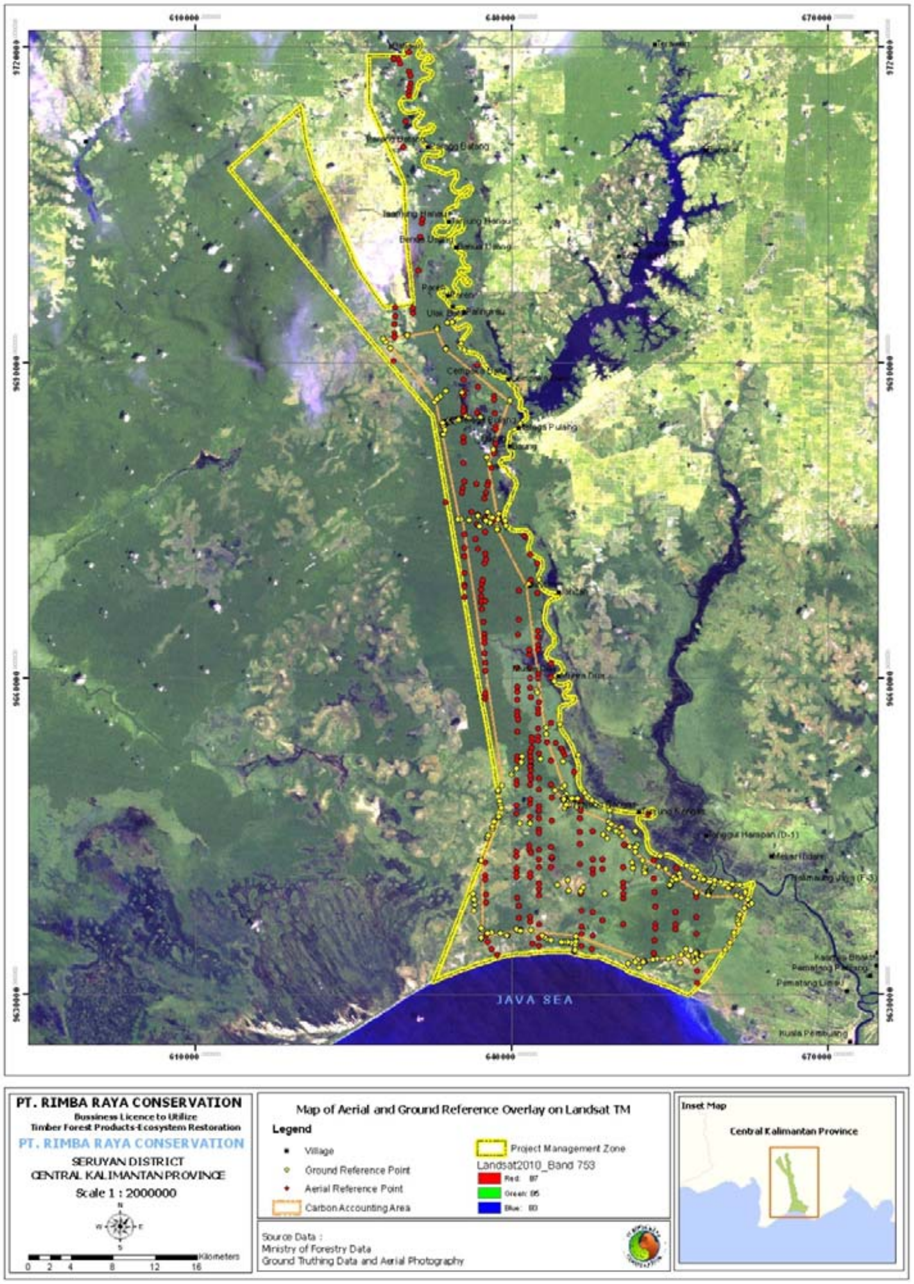
Rimba Raya Biodiversity Conservation Project

Monitoring Plan



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1. Introduction

1.1 Background

The Rimba Raya Biodiversity Reserve Project, an initiative by InfiniteEARTH, aims to reduce Indonesia's emissions by preserving 91,215 hectares of tropical peat swamp forest in its Project Management Zone. Situated next to Tanjung Puting National Park in the Seruyan River watershed, Rimba Raya is rich in biodiversity including the endangered Bornean orangutan. The project area was slated by the Provincial government to be converted into four palm oil estates. These planned estates now comprise the 47,237 hectare Rimba Raya Carbon Accounting Area, which is monitored for the life of the project to protect and account for Rimba Raya carbon stores. The Rimba Raya project follows the framework of Reducing Emissions from Deforestation and Degradation (REDD) through Avoided Planned Deforestation (APD).

1.2 Purpose

The purpose of monitoring for carbon accounting is to ensure that the estimates of GHG removals presented in the VCS Project Document are being met, and to identify and account for any unplanned reductions in project carbon stocks, increase in project emissions or possible leakage outside the project boundary. Additionally, monitoring the project implementation will enable project proponents to objectively assess project components, identify gaps and deficiencies and use this information to improve both monitoring and management. This adaptive management approach is a key feature of the Rimba Raya program.

2. Project Location

2.1 Project Location and Boundaries

Rimba Raya is located in the Seruyan Regency, in the province of Central Kalimantan, Indonesia (right). The 91,215 hectare Project Management Zone, lies between 112°01'12 "-112°28'12" east longitude and 02°31'48"- 03°21'00" south latitude and is bounded by Tanjung Puting National Park in the west, the Java Sea in the south, the Seruyan River in the east, and a palm oil concession in the north (Figure 1). (Note that this palm oil concession, formerly leased by KUCC is now managed by WSSL.) The Project Management Zone surrounds and protects the 47,237 ha Carbon Accounting Area (CAA), which defines the boundary for carbon monitoring and accounting.

2.2 Monitoring Areas

The entire Project Management Zone (PMZ) is managed to protect forests and peat through a slate of forest conservation and community development programs described in the Climate Community and Biodiversity (CCB) Project Design Description. The project implementation is monitored annually, including the project boundary and the area inside the project boundary (Carbon Accounting Area), which are protected from land use change activities that reduce carbon stocks or increase peat emissions.

In the northern part of the Project Management Zone, 3 to 20 km from the Carbon Accounting Area, a physical buffer around the WSSL palm oil plantation protects the forests of Tanjung Puting National Park (**Palm Oil Buffer West)** and the Seruyan River Watershed (**Palm Oil Buffer East)**. Carbon Accounting Area buffers include **North Buffer**, which provides a physical barrier and hydrologic buffer 3 km from the WSSL plantation, **Seruyan Buffer** that protects the east side of the CAA and **Java Sea Buffer** that protects the south and Tanjung Puting

National Park which protects the CAA on the West. The Total Project Management Area and the CAA itself form a buffer for Tanjung Puting National Park.

The Carbon Accounting Area (CAA) is divided into four monitoring regions. **Carbon-North** is accessed by the Baung River and the Seruyan River from Palingkau village south to Baung village. This area includes permanent biomass transects T1, T2 and T7 and Post Setiung. **Carbon-Central** is accessed by the Sigintung River and the Seruyan River in the vicinity of Jahitan and Muara Dua villages and includes permanent biomass transects T8, T3 and T4 and Post Sigintung. **Carbon-South-Seruyan** is accessed by the Seruyan River in the vicinity of Tanjung Rengas village and includes permanent biomass transects T5 and T6.**Carbon-South-Sea** is accessed by the Java Sea coast and does not include permanent biomass transects.

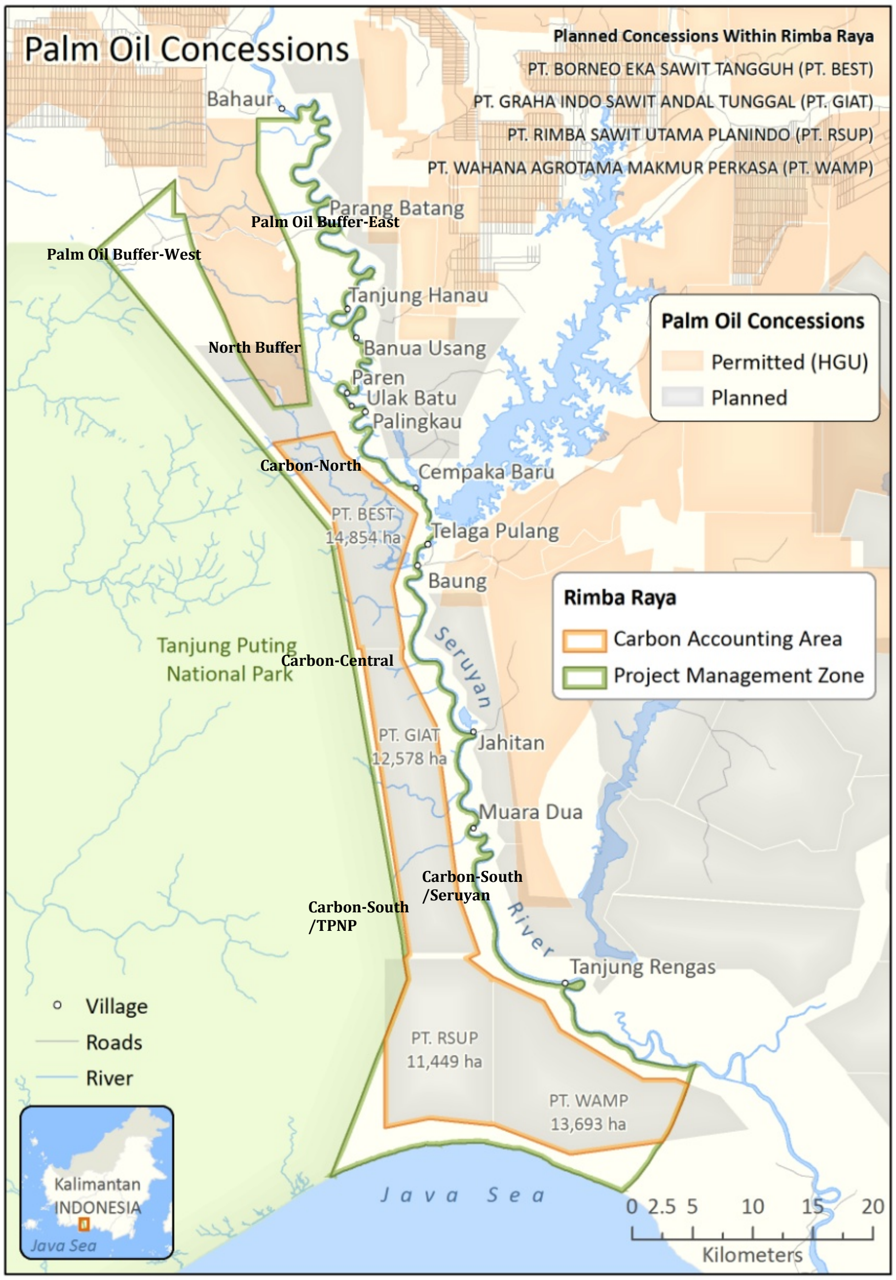


Figure 1. Map of Total Project Management Zone and Carbon Accounting Area, flanked by Palm Oil Estates to the north and east; bound by the Java Sea to the south and the Tanjung Puting National Park to the west.

3. Description of Monitoring

3.1 Approach

Annual monitoring activities consist of remote sensing and G.I.S. analysis, routine field patrols and directed field sampling in areas prioritized by systematic site assessments. The monitoring system takes a hierarchical approach starting with medium resolution (30-50m) satellite imagery, then high resolution satellite or aerial imagery (5-10m), and finally with ground patrols.

A key feature of the Rimba Raya monitoring plan is to employ spatial data and tools to systematically monitor land cover change, forest degradation and carbon pools in the project area and project buffer. This is combined with ground-based surveys to investigate and record information on any activities that affect project carbon stocks and peat emissions (e.g. fire, logging). Such an approach improves the efficiency and effectiveness of directed field visits, which is essential for reliably monitoring the Rimba Raya project boundary in extensive and inaccessible peat swamplands.

This type of approach to field monitoring has been employed by project partner, Orangutan Foundation International, in the project area since 2004. Rimba Raya monitoring builds on the existing field reconnaissance, forest survey and G.I.S. team training, protocols and monitoring systems already in place for many years.

3.2 Methodology

The VCS methodology (including monitoring requirements) employed by this project is the **Approved VCS Methodology VM0004 Version 1.0 Methodology for Conservation Projects that Avoid Planned Land Use Conversion in Peat Swamp Forests, Sectoral Scope 14**, which has been validated under the VCS double-approval process. This methodology was developed by Winrock International for the Mawas Peat Swamp Conservation project, and is relevant for planned conversion of peat swamps throughout Southeast Asia. The methodology is particularly applicable to the Rimba Raya Project because it is also located in peat swamp, less than 150km from Mawas, and is categorized as an Avoided Planned Deforestation (APD) project type.

The methodology outlines methods for monitoring land use change, forest degradation and carbon pools and forms the basis for implementing the monitoring plan. This methodology provides a reference for monitoring, reporting, and verification required for evaluating project performance and supports the accurate determination of carbon offsets by project activities.

The methodology was designed so that all necessary field measurements (including measurements of baseline carbon stocks) could, if desired, be performed up front - prior to project implementation thus limiting monitoring activities over the crediting period to monitoring new activities and area changes only. This monitoring section uses various formulae presented in the methodology and the reader should access that report for their full listing and their justification for use in monitoring.

3.3 Monitoring Plan and Adaptive Management Framework

The Monitoring Plan was developed as part of the VCS Project Document. This plan is necessarily general with the aim of 1) defining a monitoring approach, 2) framing general repeatable methods consistent with the VCS methodology, and 3) providing flexibility to test and improve specific monitoring methods in response to project-based learning, advances in science, and improvements in data and access to information. The Year 1 monitoring report will include an assessment of methods, gaps and needs for each monitoring component, which will be incorporated into the Year-2 monitoring plan. Specific monitoring methods, protocols and procedures will be refined during Years 1-3 so that after Year 3, monitoring will consist of implementing a standard detailed methodology.

3.4 Monitoring Components

There are eight major components of monitoring: three that are focused on project conditions and forest protection (Table 1) and five that are focused on annual land change assessment for carbon accounting (Table 2).

Table 1. Monitoring Components: Project Conditions and Forest Protection

Monitoring Component (pg ref in Meth)	Activity and Years	Times and periods	Detection frequency	Remote sensing data, resolution, coverage and years	Field survey frequency	Reporting frequency
Boundary (p.67)	Mark in field [Yr1 temp stakes on boundary with palm oil, Yr2& Yr3 permanent stakes in other high risk areas – replace as needed]	Year-end	Non-specific	n/a	1 field survey annually	Annually
	Patrol Yr1-Yr30		Annually	ALOS 50m or Landsat 30m + high res aerial or satellite imagery (1-5m) every 2 years starting Yr2		
Stratification (p. 68)	Land cover classification (Yr1 develop model, Yr2-3 refine model, Yr 4-30 apply standard model)	Year-end	Annually	ALOS 50m or Landsat 30m + field data + sample high res aerial or satellite imagery (1-5m) for accuracy assessment in Yr 1,3,5 etc. Full coverage high res aerial or satellite imagery (1-5m) + field data in Yr 2,4,6 etc.	1 field survey annually	Annually
Forest Protection (p. 68)	Routine patrols and as-needed intervention (expanding coverage and intensity of intervention Yr-1 to Yr-3 in conjunction with community and stakeholder involvement)	Year-round	Quarterly	ALOS 50m or Landsat 30m + SPOT and high resolution imagery collected for boundary and strata monitoring	1 patrol quarterly and as-needed	Quarterly

Table 2. Monitoring Components: Land Change Assessment for Carbon Accounting

Monitoring Component (page reference in Methodology)	Activity and Years	Times and periods	Detection frequency	Remote sensing data, resolution, coverage and years	Field survey frequency	Reporting frequency
Land change (p. 70, 83)	Detection and area calculation of land change caused by agents other than logging or fire (e.g. mechanical clearing)	Year-round	Semi-annually	Landsat 30m for detection plus targeted high resolution imagery (aerial or satellite with 1-5m resolution) as needed to support analysis and field surveys	2-3 field surveys annually	Annually
Logging (p. 71)	Detection and area calculation of deforestation caused by logging	Year-round with increased activity during wet season	Semi-annually	high resolution imagery (aerial or satellite with 1-5m resolution) as needed for logging gap analysis	2-3 field surveys annually	Annually
	Detection and survey of transport canal-building associated with logging			high resolution imagery (aerial or satellite with 1-5m resolution) and ground data		
Fire (p.78)	Detection of fire ignitions, calculation of burn areas (deforestation associated with fire)	Year-round with increased activity during dry season	Monthly, weekly, daily	MODIS imagery (1 km thermal band detects fires as small as 100m2 and imagery is collected and posted daily)	2-3 field surveys annually	Annually
Biomass plot surveys (not required)	Survey of above ground biomass originally conducted for the baseline carbon assessment	End of year	None	linked to high resolution aerial imagery (1-5m)	1 field survey every five years	10-year baseline reports
Leakage (p.40)	new permit activity	Year-round (first five years of project 2009-2014)	Quarterly	n/a	n/a	Annually
	Spatial analysis of new palm oil in areas of possible leakage	End of year (first five years of project 2009-2014)	Annually	Landsat 30m for palm oil boundary interpretation and delineation	none	Annually

4. Adaptive Management

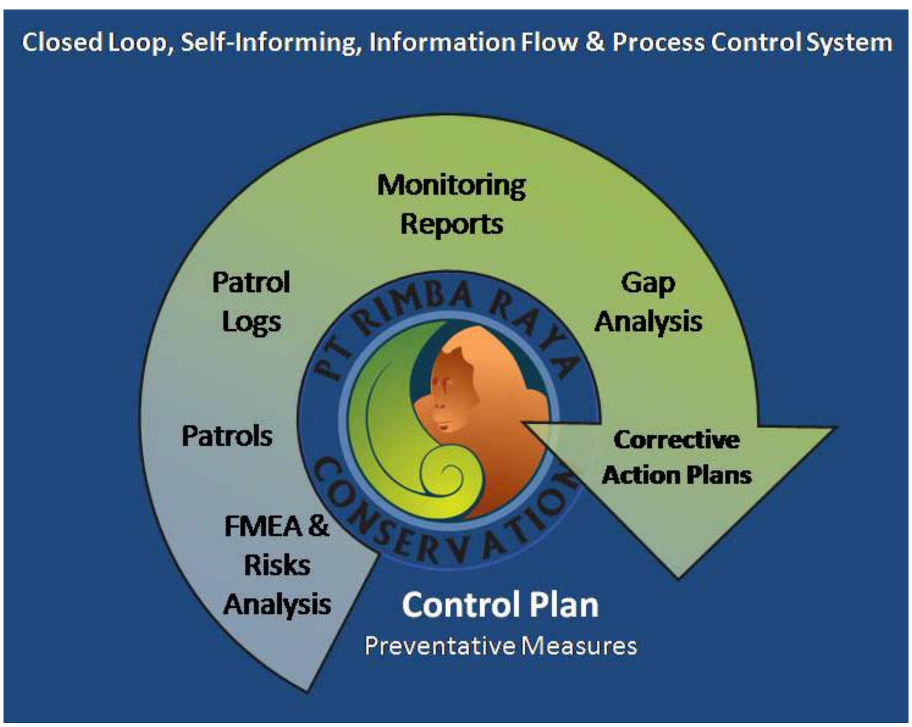
4.1 Adaptive Management Context

Given the pioneering status of the project, the fact that the industry, the science, the standards and protocols are all in a nascent state, project proponents have adopted an "adaptive management" approach, in particular with regard to monitoring. The variety and complexity of field conditions amongst projects and within the same project from one area to another and from one year to another vary widely. Therefore no fixed template can be imposed or adopted in Year 1 without the expectation of making changes and improvements to such in reaction to ground realities. As such, project proponents intend to "learn by doing" and commit to creating an environment of "continuous improvement" through this adaptive management process.

The proposed three year ramp-up and roll-out plan for monitoring activities is part of this adaptive management strategy. Given the extent of the area, the intensity of proposed monitoring activities and the required infrastructure, it is simply unrealistic to expect a complete, effective, project-specific monitoring system in less than three years. Additionally, years one and two are being used to inform necessary changes to the monitoring plan before final roll-out. Lastly, the related science and technology is developing quickly and project proponents expect to be able to deploy new technologies and REDD-specific datasets by year three (e.g. ALOS data for biomass assessment and LIDAR systems for forest degradation and hydrologic analysis).

4.2 Adaptive Management Framework – FMEA & Control Plan

The framework for this Adaptive Management strategy is a "Closed Loop, Self-Informing Information Flow & Process Control System", depicted below.



In this system, Monitoring activities are organized into two classes: Major Threats to Carbon Stocks (Land Cover Change) and Threats to Biodiversity with minimal or moderate threats to carbon stocks (Degradation). A Failure Modes & Effects Analysis is conducted and a resulting Risk Assessment Index is assigned to each possible "Failure

Mode" (Fire, Logging, Agriculture, etc). Control Plans are created to address possible modes of failure from which Field SOPs are then devised. Patrols generate Patrol Logs, which inform Monitoring Reports. Management then assesses summary monitoring reports and performs a Gap Analysis from which Corrective Action Plans are developed. These then inform and update the Control Plan, thereby closing the loop and ensuring a system of continuous improvement through a "learn by doing" adaptive management process. This framework and its implementation are more fully described in section 7 of this report (See Annex 1 - FMEA &Control Plan).

5. Boundary

5.1 Boundary Monitoring Plan

The project implementation is monitored annually, including the project boundary and the area inside the project boundary, which are protected from land use change activities that reduce carbon stocks or increase peat emissions. Since the project boundary is not a functionally discrete hydrologic unit, a 3km buffer zone surrounding the project boundary is also monitored to ensure that no drainage activities have occurred within a project year that could potentially impact peat emissions inside the project boundary as required by the methodology. Both the project boundary and the 3km buffer zone are monitored for new drainage activities over the life of the project.

The Carbon Accounting Area was moved south during project design so that the project boundary is situated >3km from the southern boundary of WSSL oil palm plantation. The "North Buffer" area is monitored to ensure no new drainage activities occur within 3 km of the CAA boundary. Additionally, the project extends monitoring and management to a Project Management Zone (PMZ) that covers 91,215 ha including the 47,237 Carbon Accounting Area (CAA), providing a substantial additional buffer to project carbon stocks.

5.2 Legal boundary and GIS delineation

The 47,237 ha Carbon Accounting Area boundaries are coincident with the boundaries of four planned palm oil concessions, adjusted to exclude a hydrologic buffer 3 km south of the existing WSSL palm oil plantation. GIS data delineating government-approved plantation concessions "ijin lokasi", were used to define the CAA boundary. The GIS boundary and project area are considered final with no expected changes in Rimba Raya's final license.

GIS data were also obtained for the Project Management Zone, defined by the Ministry of Forestry's Area Verification for the project. These GIS data obtained from government sources and matching the Area Verification map, bound an area of 91,215 ha. This boundary is currently undergoing final adjustment and approval. Any changes to this area will not affect the Carbon Accounting Area boundary.

5.3 CAA Boundary Marking and Field Survey

PMZ and CAA boundaries have been uploaded to GPS units for boundary marking, field reconnaissance and monitoring. The area inside the PMZ is monitored as part of ongoing forest protection and management activities conducted by RRC, OFI and other stakeholders. The geo-referenced boundary for the PMZ was used to identify the limits of project management and monitoring in the field. Signs marking Rimba Raya have been posted in key areas of potential land use conflict. Sign postings will be expanded during monitoring years 2 and 3 and maintained for the life of the project. Monitoring survey and patrol activities in the PMZ during project start up and Year-1 monitoring will include directed field surveys, expedition patrols and regular patrols by RRC, OFI and stakeholder field teams.

The CAA will be directly monitored for any land use or land cover change, and boundaries will be marked in the field by navigating to locations defining turning points uploaded to GPS receivers from GIS boundary data, in accordance with the methodology. Each location will be marked in the field with a tall wooden stake and a GPS point will be collected at the actual marker location. Land condition and human activities will be assessed and recorded at each boundary marker and photos taken in cardinal directions at each point. GPS and photo data will be permanently stored in the Rimba Raya database. CAA boundary and area monitoring will include protection patrols and surveys of land condition, fire hotspots and logging areas, which are described in Sections 6, 7, 8 and 9 of this monitoring plan.

6. Stratification

6.1 Stratification Monitoring Plan

Land cover classification will be used to stratify the Rimba Raya Carbon Accounting Area and Project Management Zone. Stratification of the project area will be monitored periodically because new data may become available to refine strata boundaries and/or classification. Additionally, as suggested in the methodology, two different strata may become similar enough over time to justify their merging. The ex post stratification will be used to verify the applicability of the ex ante stratification and refine procedures that facilitate cost-effective, consistent and accurate monitoring of carbon stock changes of the project during the crediting period.

6.2 Landcover Classification 2009

Comprehensive land cover classification and mapping was conducted based on 2008 Landsat imagery prior to the start of Year-1 monitoring. Methods combined automated pixel-based classification with manual delineation of landcover class boundaries informed by high resolution aerial photography and ground survey data in order to optimize accuracy, efficiency and consistency in land cover mapping. Preliminary carbon accounting for the baseline scenario was conducted based on this land cover assessment, after grouping classes to better reflect significant variation in above-ground carbon.

In preparation for Year 1 monitoring, the classification scheme was further improved (Table 3) to better reflect ground conditions in Rimba Raya while remaining relevant to regional and national land cover classification schemes. Using the revised classification scheme, land cover mapping was updated to 2009 Landsat imagery (February 2009 ETM+ path/row 119/062) and is described in the Landcover Assessment report (see Figure 2). Mapping was conducted using ArcGIS software to interpret raw and classified imagery, delineate and assign land cover classes. The Minimum Mapping Unit (MMU) was set to 2 ha and the view frame scale set to 1:24,000 fixed in ArcMap in order to ensure consistency in mapping detail across the project area. The 2009 land cover classification is the stratification upon which the final baseline carbon accounting was conducted.

The current Rimba Raya land cover classification scheme aims to balance specificity in defining classes with important variation in biomass and generality that produces annual consistency in classification and subsequent robustness in change analysis. It should be noted that class descriptions, while substantially refined in Year 1 monitoring, remain qualitative. Quantitative vegetation analysis based on directed field surveys will be conducted in Year 2, linked to the classification scheme and to remote sensing data and used to improve the robustness of the land cover classification.

Table 3. Rimba Raya Land Use / Land Cover Classes

Class Name	Description
Lowland forest	Lowland mixed dipterocarp forest on mineral soils. This is a “dry land” or non-swamp forest type and is found only in the northwestern portion of the PMZ where there are elevation gains of ca. 30-40 meters asl.
Lowland forest (lightly degraded)	Lowland mixed dipterocarp forest on mineral soils with some apparent logging damage, adjacent to lowland forest. Note that the term “degraded” is used rather than the Ministry of Forestry term “secondary” which implies forest

	succession from clear-cutting.
Lowland forest (highly degraded)	Lowland mixed dipterocarp forest on mineral soils with heavy damage from logging and fire. Occurs in the northwestern portion of the PMZ between lowland forest and low, sparse vegetation cover associated with burning and land clearing adjacent to WSSL palm oil plantation.
Peat swamp forest (lightly degraded)	Peat swamp forest, locally "hutanrawa" denoting seasonally wet forests on peat substrate. All peat swamp forests in Rimba Raya are lightly to highly degraded by selective logging.
Peat swamp forest (highly degraded)	Peat swamp forest patches bordering areas of intensive human activity and/or recent deforestation. These areas remain in forest cover but have more apparent damage and therefore lower expected biomass than lightly degraded forest. These forests are at high risk of loss.
Peat shrubland	Formerly peat swamp forests, these areas were deforested by fire in the last ten years. Seasonally wet areas characterized by shrubby regrowth and scattered remnant trees.
Kerangas forest	Heath and scrub forest on sandy soils. Isolated patches in peat swamp forest along the western border of RR, including survey transect 7. More prevalent in the south, where air photos show loose canopies of even height, lacking the broad leaves of peat swamp and lowland forest. Visually distinct on satellite imagery(e.g. smooth in texture) but not recognized in Ministry of Forestry mapping which classifies this type with swamp or dry forest depending on location. Relatively rare type, highly susceptible to fire and conversion to open sand scrub.
Open kerangas scrub (locally "padang")	Open sandy soils with patches of scrub forest or thin scrubby vegetation. In West Kalimantan and Sarawak, these areas are known as kerangas, but in Rimba Raya are locally named "padang". These are former heath or kerangas forests that have burned. Bright white sand may be apparent on imagery, or not depending on whether herb cover is present. These areas are often underlain with a hardpan and may be flooded during the wet season. Presence of standing water has confused some previous land cover interpretations of the area (e.g. Ministry of Forestry mapped some areas in the south as "swamp"). These ancient beach areas may intergrade with peatland areas in Rimba Raya, as in the northwestern part of the PMZ.
Cultivated land with shrubs	Repeatedly burned cultivation land, locally "ladang", often abandoned after several years of cultivation. Active cultivation land may appear bright green on imagery from post-fire herbaceous growth. Old ladang often has woody shrubs and scattered trees.
Oil palm plantation	In the Rimba Raya vicinity, all plantation agriculture is oil palm plantation and is currently confined to the WSSL concession in the north, with some recent expansion into the PMZ.
Low, sparse vegetation cover	Areas with sparse grass or herb cover or bare ground, usually associated with recent, severe or frequent burning in areas of human activity. Most of these areas have been cleared by fire but are interpreted to be outside cultivation lands.
Seasonally inundated wetlands	Locally "danau" or seasonal lake, most of these areas were formerly peat swamp forests that have been logged and burned. Where these are adjacent to rivers, flooding may be semi-permanent. Most are sedge-dominated.
Open water	Deep water with no vegetation, especially on or near the Seruyan River and lower reaches of the Baung River

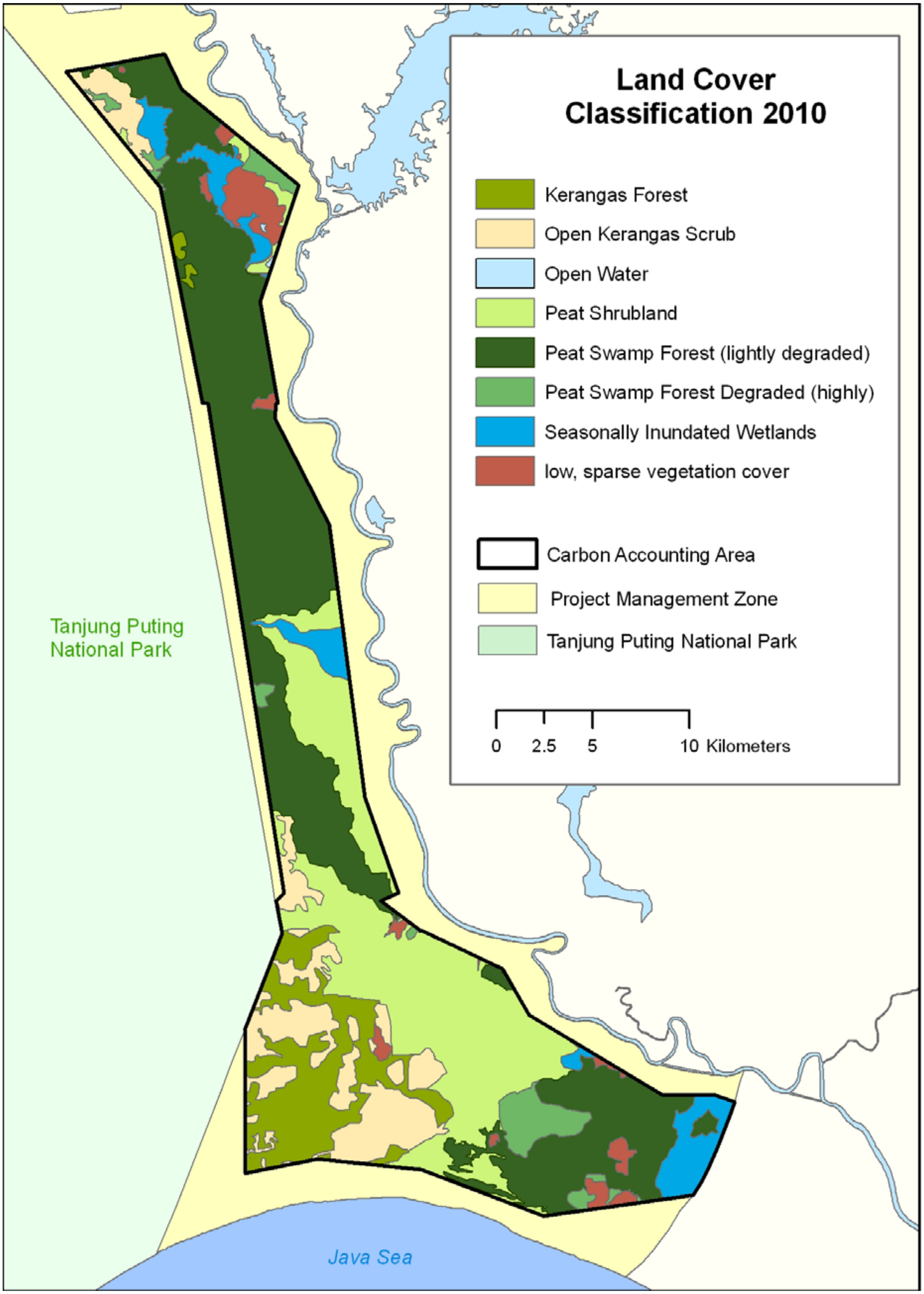


Figure 2. Landcover classification map for Rimba Raya

6.3 Landcover Accuracy Assessment

A landcover accuracy assessment was conducted to validate the 2009 land cover classification for Rimba Raya and quantify map accuracy, by comparing the satellite image-based landcover map to reference data from aerial photos flown July 2009. Aerial survey flight lines cover approximately 40% of the Rimba Raya Project Management Zone and all major landcover classes were represented in the aerial photos. Lowland forest classes, representing 5.9% of the total Project Management Zone, were not represented by aerial photos. All classes in the carbon accounting area were represented in the aerial photo reference data. A total of 342 sample points were used for the accuracy assessment.

Allocation of sample points to land cover classes was through stratified random sampling based on land cover class area, with a 20-sample minimum for the smallest classes where reference data were available. Reference labels containing the land cover class name interpreted from aerial photos were created for sample points. The initial set of 250 reference labels was created by an independent GIS analyst familiar with ground conditions and map interpretation in peat swamp forest. Map labels for the sample points were compared with reference labels and an error (confusion) matrix generated.

An overall classification accuracy of 81.3% was obtained. The predominant class by area, lightly degraded peat swamp forest which covers 30,445 ha or 33.5% of Rimba Raya, was mapped with 90.0% accuracy. A weighted kappa coefficient of 0.78 indicated there is good agreement between map classes interpreted from satellite imagery and aerial photo data. Landcover is used as the primary stratification for carbon accounting; therefore results of this analysis have been used to quantify uncertainty for carbon estimation. The landcover accuracy assessment will also be used to improve map classification and design a field-based survey for quantitative vegetation analysis for the project.

7. Forest Protection

7.1 Forest Protection Monitoring Plan

As part of monitoring forest protection activities, any increases in GHG emissions that occur within the project boundary after the start of the project will be recorded and deducted from the *ex ante* estimate of baseline emissions. The methodology describes a patrol log to be maintained showing the date, area covered indicated by GPS track, and type of disturbance that occurred including the following detailed information:

- Area where natural or anthropogenic disturbances (including fire, illegal logging and other land use change) occurred within the project boundary by date, location, biomass lost or affected, and the preventative or curative measures implemented.
- Number and location of logging gaps by date, biomass lost or affected, and the preventative or curative measures implemented.
- Area and approximate depth of peat burned within the project area by date, location, and the preventative or curative measures implemented.
- Area of peat, if any, that was drained within the project boundary by date, location, estimated peat emissions, and the preventative or curative measures implemented.

7.2 Forest Protection and Patrol Activities

Rimba Raya forest patrols have been ongoing since 2000 and cover a diversity of stakeholders (e.g. RRC, OFI, BKSDA, TNTP, and communities), modes (e.g. remote sensing and GIS analysis, field surveys, routine field patrols, joint stakeholder field expeditions, community-based informant system) and reporting schemes (spatial analysis, GPS data collection, post and radio patrol logs, stakeholder reports). Therefore rather than developing and implementing a simple patrol log system in a previously unpatrolled area, the task for Year-1 monitoring in Rimba Raya will be to compile, assess and employ existing patrol systems to continue area monitoring and protection and inform an improved management system in Year-2.

In order to make use of data from a variety of sources, an FMEA approach shall be undertaken. A failure modes and effects analysis (FMEA) is a procedure in product development and operations management for analysis of potential failure modes within a system for classification by the severity and likelihood of the failures. Failure modes are any errors or defects in a process, design, or item, especially those that affect the primary stakeholder, and can be potential or actual. Effects analysis refers to studying the consequences of those failures.

A successful FMEA activity helps a team to identify potential failure modes based on past experience with similar products or processes, enabling the team to design those failures out of the system with the minimum of effort and resource expenditure, thereby reducing development time and costs. It is widely used in manufacturing industries in various phases of the product life cycle and is now increasingly finding use in the service industry and environmental management.

7.3 Forest Patrol Description

In order to structure forest patrol monitoring, Rimba Raya has leveraged the 40-year experience of OFI and has adapted their procedures as outlined in the SOP for Field Patrols. Forest Patrols will be organized under three regimes:

- Routine Daily Field Patrols
- Incident Based Non-Routine Field Patrols
- Annual Monitoring Event Field Survey.

Methods of incorporating forest patrol and survey information into improving forest protection and providing data for annual carbon accounting will be tested and elaborated in year 1-3 monitoring.

7.4 High Risk Areas – Threats Analysis

Rimba Raya is an extensive area dominated by peat swamp forests that are accessible only by waterways, trails and old logging rails. Recent human activities in the Reserve have been concentrated on these access routes to the interior from the Seruyan River and its major tributaries the Baung and Sigintung Rivers.

In order to further improve and direct monitoring and management, a spatially-based threats analysis will be conducted to identify areas of particularly high risk within the 91,215 ha PMZ and 47,237 ha CAA.

8. Land Cover and Land Use Change

Section 19.2 of the Methodology

"Monitoring land cover and land use change within the project boundary must occur to ensure that any GHG benefits achieved by project activities during the crediting period are real, permanent and secure. Therefore, any decreases in carbon stocks or increases in peat emissions that occur inside the project boundary after the start of the project must be accounted for, including the GHG emissions from any land cover change that may occur within the project area over the crediting period."

8.1 Land Cover Change Monitoring Plan

Land cover change during the monitoring period will be assessed by two different approaches: 1) remote sensing and GIS assessment and 2) ground survey and patrols. The spatial analysis approach has the advantage of being synoptic, systematic, efficient and accurate but cannot provide detail, which informs impact assessment and management. As a complement to this top-down approach, ground survey and patrol data provide detail about the nature, cause and effect of land change, but cannot be used alone to reliably monitor and quantify land change over expansive areas on an annual basis. A combined approach takes advantage of both broad-scale spatial analysis and fine-scale ground assessments in order to conduct accurate and reliable monitoring in a way that informs and improves project monitoring and management.

Top-Down Assessment: Spatial Analysis

The first step in assessing annual emissions associated with degradation and deforestation is to conduct a systematic analysis of land cover change over the monitoring year, based on quantifying the areal difference between Year t and Year t+1 land cover. Land cover classification is carried out according to methods detailed in the stratification section then a post-classification change analysis is conducted by overlaying annual land cover maps.

Bottom-Up Assessment: Ground Surveys

In some cases, the top-down assessment directs ground surveys (e.g. patrols sent to investigate fire hotspots detected on satellite imagery) but ground surveys are also initiated independently of spatial analysis (e.g. routine patrols or patrols sent in response to communications about land use activities). Furthermore, ground patrols are used to record details about carbon impacts that also appear in satellite image assessments, but are also used to discover and record small-scale carbon impacts that do not appear on imagery.

9. Fire

9.1 Fire Monitoring Plan

Fire monitoring shall be conducted over a range of frequencies depending on the season and fire condition and rely on the Fire Information for Resource Management System (FIRMS) delivery of MODIS satellite maps of hotspot and fire locations. After the rainy season begins, usually December, fire map data will be monitored monthly. As the dry season approaches, usually July, fire map data will be monitored weekly. And at the height of fire season, usually August-October, fire data is to be monitored daily.

During the fire season, satellite monitoring will be implemented as part of the comprehensive fire plan described in VCS PD and shall be used to direct and deploy fire fighting and survey teams on an as-needed basis. Fire monitoring and response activities will then be reported annually at the end of fire season surveys.

At the end of the fire season, the presence or absence of burning within the project boundary in a given monitoring year is to then be determined by analyzing medium resolution remote sensing data. If no fires are detected within the project boundary or within a 1 km buffer zone around the project boundary in the monitoring year, then it is assumed that there were no GHG emissions associated with burning within the project boundary and $fire_{it}\,E = 0$.

If burned areas are detected within the project boundary or within a 1 km buffer of the project boundary in the monitoring year, then geo-referenced, high resolution aerial imagery or geo-referenced ground measurements shall be collected over these areas and the location and area of all fire scars are calculated and recorded.

9.2 Fire Hotspots

Fire ignition sites or "hotspots" can be derived by applying thermal analysis algorithms to NOAA-MODIS data. Daily updates of fire hotspot data in Kalimantan is available online and will be downloaded for Rimba Raya from http://firefly.geog.umd.edu/firemap/ and http://www.weather.gov.sg/wip/web/ASMC. The Fire Hotspots data acquisition and processing flow is illustrated in Figure 3.

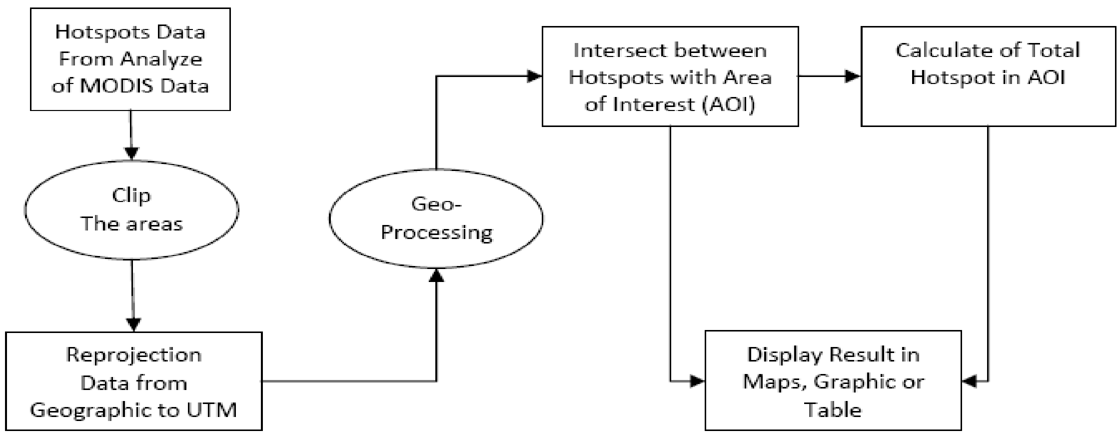


Figure 3. Fire Hotpsots Data Acquisition and Assessment Process Flow

The distribution of fire hotspots in Rimba Raya in Figure 4, shows the distribution of these hot spots can be clustered or individual. Clustered hotspots indicate more fire ignitions and larger burn areas, which can be detected and measured on the ground.

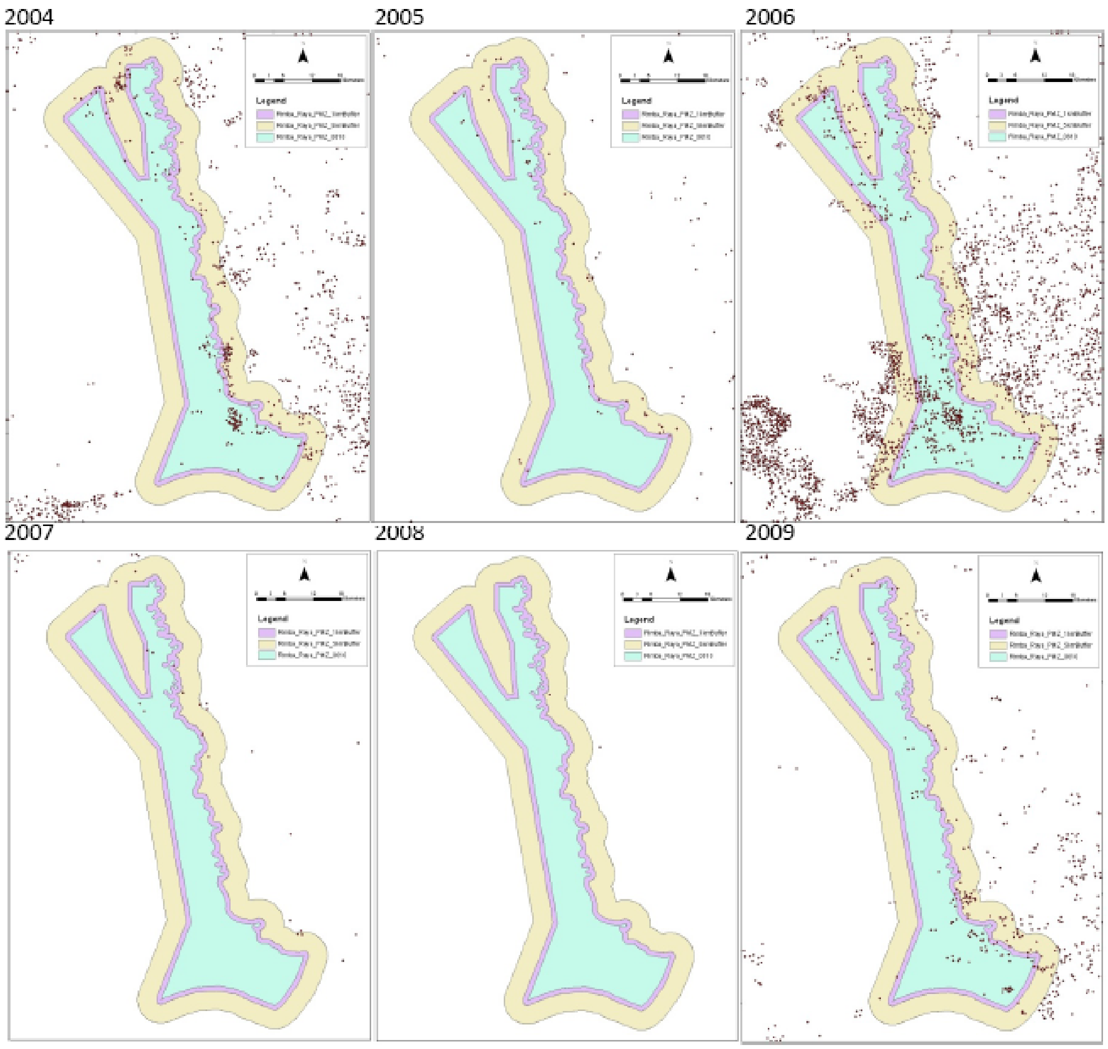


Figure 4. Map of Distribution Number of Hotspots in RRPM Areas Year 2001-2009

9.3 Ground Surveys

The hotspot analysis of Rimba Raya area will be distributed to BKSDA, TPNP management, the District of Seruyan and other relevant stakeholders in order to improve regional fire management. The hotspot analysis is the primary information available to Rimba Raya stakeholders for directing management activities. Based on hotspot mapping, patrols will be conducted to assess fire activity and fire damage in the field. Joint patrols may consist of OFI and BKSD staff and community members. These joint patrols have been ongoing since 2000 in northeastern Tanjung Puting and Rimba Raya and cover a diversity of stakeholders.

9.4 MODIS Burn Areas

In addition to fire hotspot mapping, more serious fires can be detected on MODIS satellite imagery that registers fire burn scars. MODIS offers unique spatial and radiometric capabilities for burn areas detection. And there is a direct link between the availability of information about burned areas and the decision making process for effective fire management. The primary objective of Burn Areas analysis is to provide information about burn areas in Rimba Raya Area to assess land cover change caused by fire damage and also to produce maps of fire risk. The overall processing flow of the MODIS burn data assessment is illustrated in Figure 5.

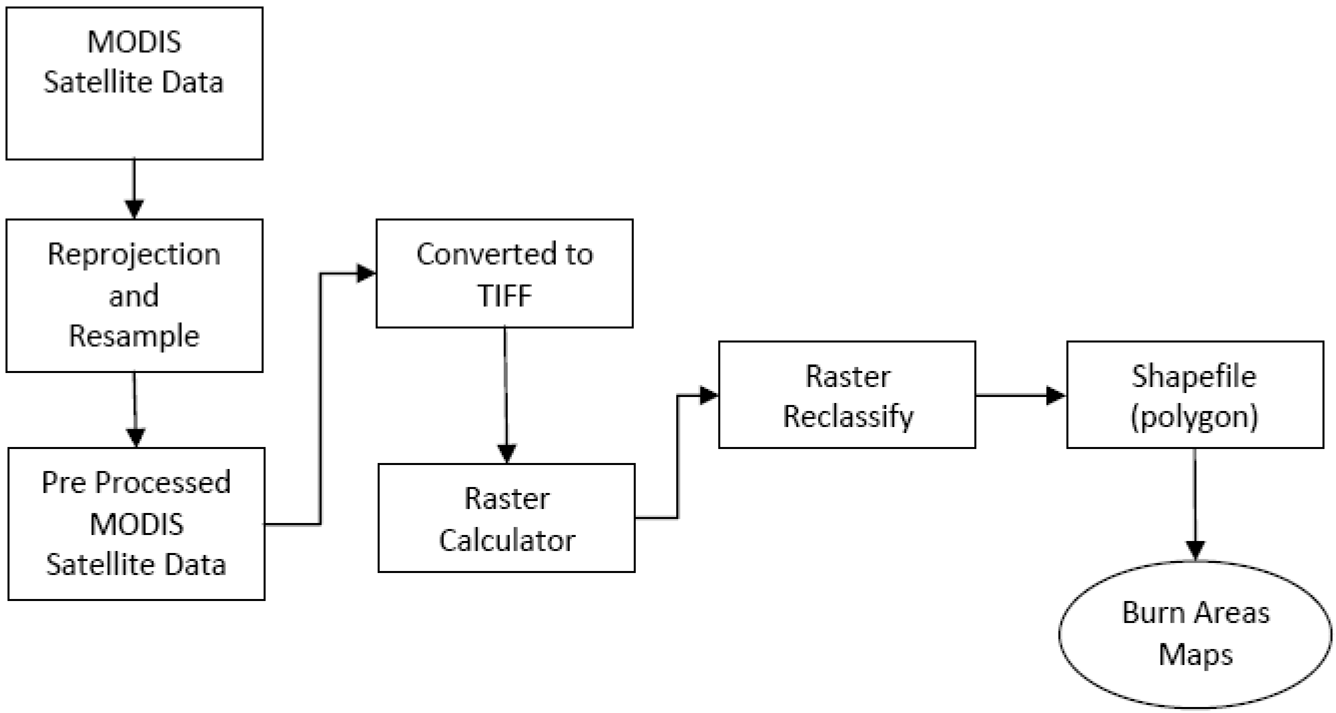


Figure 5. The methodology of MODIS Acquisition and Processing for Burn Areas Map

The area of land that is burned gives basic information on fire management, which can be obtained through detection of burn areas. MODIS offers unique spatial and radiometric capabilities for burn areas detection.

9.5 Fire Management

The Rimba Raya project has been subjected to fires over its recent history mostly resulted from human induced fires for agricultural land clearing. Thus, avoiding these fires from occurring is the main objective for fire management. This will be achieved through social approach as well as technical approach. Inhibiting the drainage of peat, putting in place a fire management system including fire watchtowers to rapidly detect, isolate and extinguish any fires that do occur are among of technical measures. Involvement of surrounding communities and other stakeholders is acknowledged by PT. Rimba Raya Conservation as the key feature of the fire management program, which will be continually improved, especially in monitoring years 1-3.

10. Selective Logging

10.1 Logging Monitoring Background and Purpose

Applicability Condition H of the Methodology

"Activities that involve the utilization of natural resources within the project boundary that do not lead to deforestation are permitted (e.g. selective logging, collection of NTFPs, fuel-wood collection, etc.) as this degradation is accounted for in the monitoring methodology.

Condition I: the biomass of vegetation within the project boundary at the start of the project is at steady-state, or is increasing due to recovery from past disturbance, and so monitoring of project GHG removals by vegetation can be conservatively neglected if desired."

Selective logging is permitted in Rimba Raya and is occasionally practiced by local villagers, working alone or in small groups to take small amounts of timber for subsistence use or for local sale. Rimba Raya is situated in former logging concessions of peat swamp forest and the area has been selectively logged for two decades by commercial timber organizations. Therefore the most valuable timber has been removed. Furthermore, old logging access routes are already established for timber removal to the Seruyan River and these existing routes are sufficient to support small-scale selective logging characteristic of the area.

Hand-logging is conducted on a small scale, where individuals and small groups (typically 1-4 people) extract logs on a selective basis to supply subsistence and local cash needs. This activity is infrequent and sparsely distributed across Rimba Raya's 91,215 ha area including the 40,007 ha Carbon Accounting Area, and amounts to low levels of degradation annually.

Rimba Raya forests have been recovering from large-scale commercial logging since the 1990's and most old forest gaps are filled in with secondary regeneration of varying tree heights. As suggested by the Methodology and as measured in similar sites, it is expected that above-ground biomass accumulation substantially exceeds biomass loss associated with selective logging in the project area. Given that Rimba Raya's 10-20 year old regenerating peat swamp forests are expected to more than compensate for continued low levels of aboveground biomass timber emissions associated with small-scale selective logging, the primary focus of logging emissions monitoring is aimed at protecting against, monitoring and surveying all new construction of logging canals that drain peat and lead to long-term emissions.

There are three components to GHG emissions that occur due to logging in descending order of importance: (1) emissions from peat drainage associated with new logging canal construction (2) changes in biomass caused by the extraction of timber and (3) damage to residual trees from the logging activities.

The monitoring methodology was designed to enable project participants to estimate an average emission factor per logging gap prior to the start of the project if desired; thus the only monitoring that is necessary over the crediting period is to detect the number of logging gaps and area of new peat drainage present within the project boundary in a given year t.

10.2 Estimation of GHG emissions due to logging

Section 19.2.1 of the Methodology

"The logging emission factor is estimated to link a readily monitored component (number of logging gaps detected in the monitoring year) with the total aboveground carbon impact. An initial set of ground measurements in logging gaps shall be completed at the beginning of the project or over the life of the project. The size of each gap k, the dimensions of the felled tree and commercial log and trees that are severely damaged or killed as a result of the tree fall are measured. The area of new canal construction is also monitored to estimate emissions from peat drainage over the monitoring interval."

The GHG emissions attributable to logging within the project boundary over the monitoring period are estimated as:

$$E_{P,it}^{logging} = (N_{P,it}^{gaps} \cdot EF_{logging,i}) + E_{drainage,it}^{logging}$$

where:

$E_{P,it}^{logging}$ = GHG emissions due to logging in the project area; t CO_2-e

$N_{P,it}^{gaps}$ = number of logging gaps detected in stratum i, time t in the project area; dimensionless

$EF_{logging,i}$ = average logging emission factor for stratum i; t CO_2-e (logging gap)$^{-1}$

$E_{drainage,it}^{logging}$ = CO_2 emissions from peat drainage in stratum i at time t, t CO_2-e

Methods for estimating the carbon impacts of logging activities have been documented previously in Pearson et al. (2006) and Brown et al. (2006) and were applied in the Mawas site near the Rimba Raya project area (unpublished data Winrock, 2008). At Mawas, 43 logging gaps were surveyed to obtain estimates for carbon loss associated with timber extracted, tree biomass logged but not extracted and tree biomass damaged due to logging at the site (Table 4). Average total carbon loss was estimated to be 1.16 t/C ha at each logging gap for logged trees with an average size of 39.25 cm DBH.

Table 4. Mawas Logging Gap Data – Biomass Carbon Loss

Mawas Logging Gap Data	Mean
DBH (cm) (average 43 logging gaps)	39.25
Extracted biomass carbon (t C) per gap	.28
Non-Extracted biomass carbon (t C) per gap	.54
Damage biomass carbon	0.43
Total EF logging biomass carbon	1.16

10.3 Monitoring Plan

The monitoring methodology was designed to enable project participants to estimate an average emission factor per logging gap prior to the start of the project if desired; thus the only monitoring that is necessary over the crediting period is to detect the number of logging gaps and area of new peat drainage present within the project boundary in a given year t.

Survey and calculation methods are comprised of the following steps:

STEP 1. Detect all logging gaps $N_{P,it}^{gaps}$

STEP 2. Conduct field surveys to record:

- timber extracted at logging sites
- logging access routes

- characteristics of any new logging canals

STEP 3. Estimate an average logging emissions factor for stratum $EF_{logging,i}$

STEP 4. Calculate CO2 emissions from peat drainage $E^{logging}_{drainage,t}$

STEP 5. Calculate GHG emissions attributable to logging

10.4 Description of Steps to Monitor Logging

STEP 1. Detect all logging gaps $N^{gaps}_{P,it}$

The aerial photo based method of logging gap detection was tested using July 2009 aerial photos, flown for the carbon survey assessment. Aerial photos were reviewed to evaluate logging gaps and detection methods. This review showed no new logging gaps among selected photos but also showed that gap detection is difficult given the canopy and ground characteristics of the project. In peat swamps, bare soil does not provide a visual cue for logging detection as seen in other tropical forest sites. In the project area, water and vegetation cover are predominant in the understory, so missing trees in the overstory are not easily spotted. Furthermore, high variation in canopy architecture, dominated in many places by abundant small tree crowns and regenerating rails and gaps from past logging activities are expected to significantly limit consistent year to year gap mapping required for gap detection using aerial methods.

Given the context of the project area and the limitations of aerial based methods for logging gap detection, it was determined that a field-based approach to logging gap detection would be used in Year 1 monitoring in order to develop key parameters for calculating logging emissions according to the methodology.

Other remote methods will be tested in Year 2, including LIDAR, which may offer a good alternative to optical-based sensors for automated methods of gap detection in the tropics. LIDAR is currently being tested at several sites in Kalimantan and its potential will be explored further for Rimba Raya.

STEP 2. Conduct surveys of timber extracted at logging sites

Surveys of each logging site will be conducted to record timber extraction including tree species and diameter. In initial monitoring years, these surveys will be used to calibrate detailed field survey data from other sites to Rimba Raya. In years 3-5, these survey data will be used to validate LIDAR or other satellite imagery and develop site-specific data for Rimba Raya logging sites.

STEP 3. Estimate an average logging emissions factor for each stratum $EF_{logging,i}$

Initial ground measurements recorded in logging gaps during Year-1 monitoring will be used as a site-based comparison to select the most applicable logging emissions factor from published studies in the region. A project-specific logging emissions factor will be developed by Year-3 of monitoring as allowed by the Methodology which specifies that survey data may be collected over the project life. Year-1 pilot field data on logging site characteristics will also be used to design these surveys.

STEP 4. Calculate CO2 emissions from peat drainage $E^{logging}_{drainage\,it}$

All access routes to all timber extraction sites will be recorded in the field in order to search for any new logging transport canals. Transport canals will also be the target of active searches during all other monitoring field work.

STEP 5. Calculate GHG emissions attributable to logging

The logging emissions factor developed for Rimba Raya will be applied to all new logging gaps detected during the monitoring year and added to CO2 emissions from peat drainage to calculate the total GHG emissions attributable to logging in each monitoring year.

11. Leakage

Introduction: Displacement Leakage Approach to Monitoring

Definition of Leakage

Section 10 of the Methodology

"Leakage (*LK*) represents the increase in GHG emissions by sources which occur outside the project boundary that are measurable and attributable to the project activity. Leakage is assumed to occur as a result of the displacement of economic activities (i.e., planned land use conversion) to areas outside the project that lead to deforestation and land use change, estimated in units of t CO2-e. Thus, as a result of the project activity, the baseline activity of planned land use change may be temporarily or permanently displaced from within the project boundary to areas outside the project boundary.

"Activity shifting leakage shall be assessed for five full years beyond the date at which deforestation was projected to occur in the baseline."

Description of Leakage Monitoring

Leakage monitoring is conducted for five years beyond the date at which deforestation was projected to occur in the baseline (July 2009 - July 2014) in accordance with the methodology. Five main points outline leakage monitoring and are described below:

1. PT BEST operates plantations only in Central Kalimantan
2. All existing PT. BEST concessions will be monitored for development and/or expansion
3. Any new PT. BEST concession in Indonesia will be monitored
4. Unpermitted plantation expansion will be monitored within PT BEST's infrastructure
5. The area of activity shifting leakage and carbon impact will be assessed and reported at each verification

PT BEST operates plantations only in Central Kalimantan

In Rimba Raya, the agent of proposed deforestation and conversion to oil palm plantation is PT BINTANG ERA SINAR TAMA (BEST) Investment Holding. The BEST Group, established in Surabaya by the Tjajadi Family in 1982, is involved in many aspects of the edible vegetable oil business, primarily processing, transport, holding and trading palm oil but also including cultivation.[1]

The only palm oil plantations owned or operated by PT. BEST are located in Central Kalimantan, which are served by Group-owned crude palm oil (CPO) mills in Pangakalan Bun and Sampit. All other PT BEST activity is focused in several major commercial and port cities in Java and Sumatra (e.g. processing plants in Semarang, Surabaya and Medan; tank farms in Belawan and Jakarta) and in regional transport by Group-owned road-tankers and ships.

PT BEST oil palm concessions are limited to four districts in Central Kalimantan and total 139,424 ha on 15 parcels according to government GIS data for HGU and Izin Lokasi permits in Central Kalimantan (Table 5 and Figure 6). This data augments information on permit licenses, which were also researched. Where concession name or concession location identified in permit records made a close match to the GIS data, the concession was conservatively, considered to be affiliated with PT BEST.

Table 5. PT BEST Group oil palm concessions in Indonesia

LABEL	NAME	hectares
1	PT. WANA SAWIT SUBUR LESTARI SK74 north	4,487
2	PT. WANA SAWIT SUBUR LESTARI SK74 south	8,836
3	PT. WANA SAWIT SUBUR LESTARI SK73	7,290
4	PT. WANASAWIT SUBUR LESTARI kucc north	5,708
5	PT. WANASAWIT SUBUR LESTARI kucc south	8,161
6	PT. BANGUN JAYA ALAM PERMAI south	10,824
7	PT. BANGUN JAYA ALAM PERMAI north	11,358
8	PT. BANGUN JAYA ALAM PERMAI east	2,116
9	PT. HAMPARAN MASAWIT BANGUN PERSADA north	4,638
10	PT. HAMPARAN MASAWIT BANGUN PERSADA south	6,642
11	PT. HAMPARAN MASAWIT BANGUN PERSADA east	8,135
12	PT. TUNAS AGRO SUBUR KENCANA north	8,830
13	PT. TUNAS AGRO SUBUR KENCANA south	12,641
14	PT. BERKAH ALAM FAJAR MAS	20,005
15	PT. BAHAUR ERA SAWIT TAMA	19,754
	TOTAL	**139,424**

[1] This description is sourced from http://www.asiacategory.com/co11011.html with reference to the PT BEST company website http://www.best-palmoil.com and confirmed by the Indonesian Ministry of Forestry to RRC.

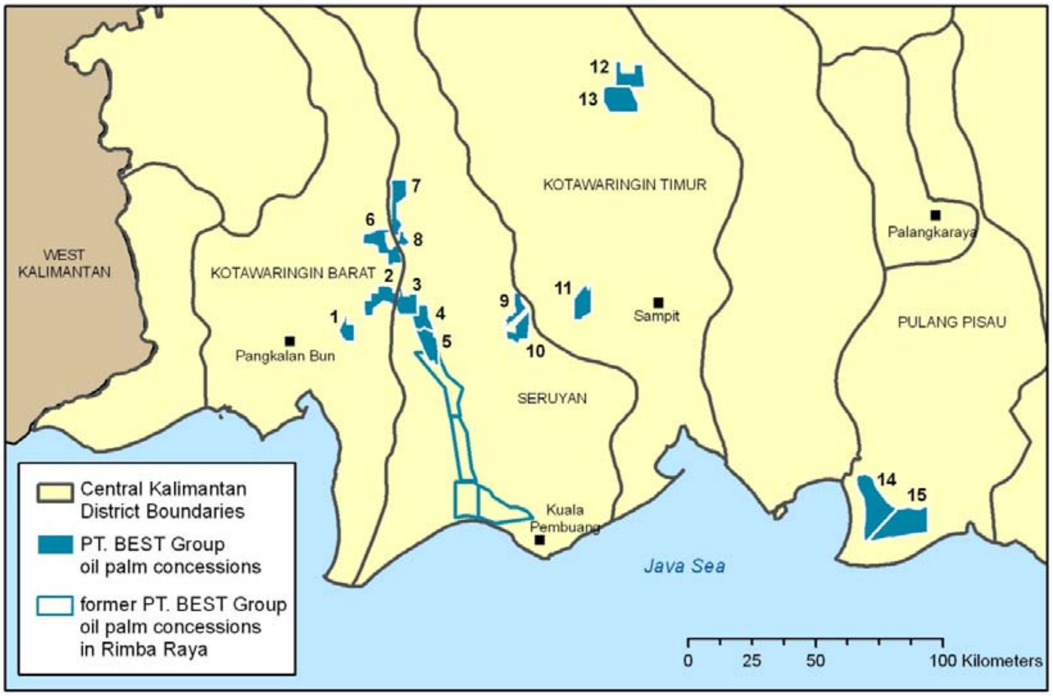


Figure 6. PT BEST Group oil palm concessions in Indonesia

Monitoring all existing PT. BEST concessions for development and/or expansion

PT BEST concessions identified in Table 5 and Figure 6 were viewed on satellite imagery (Landsat ETM+ February 2009, January 2010) to determine the extent of existing oil palm plantations, which are easily distinguished from other land cover types in Landsat data. This assessment showed that 12 of 15 concessions are already in plantation and are therefore not potential leakage sites (Figure 7).

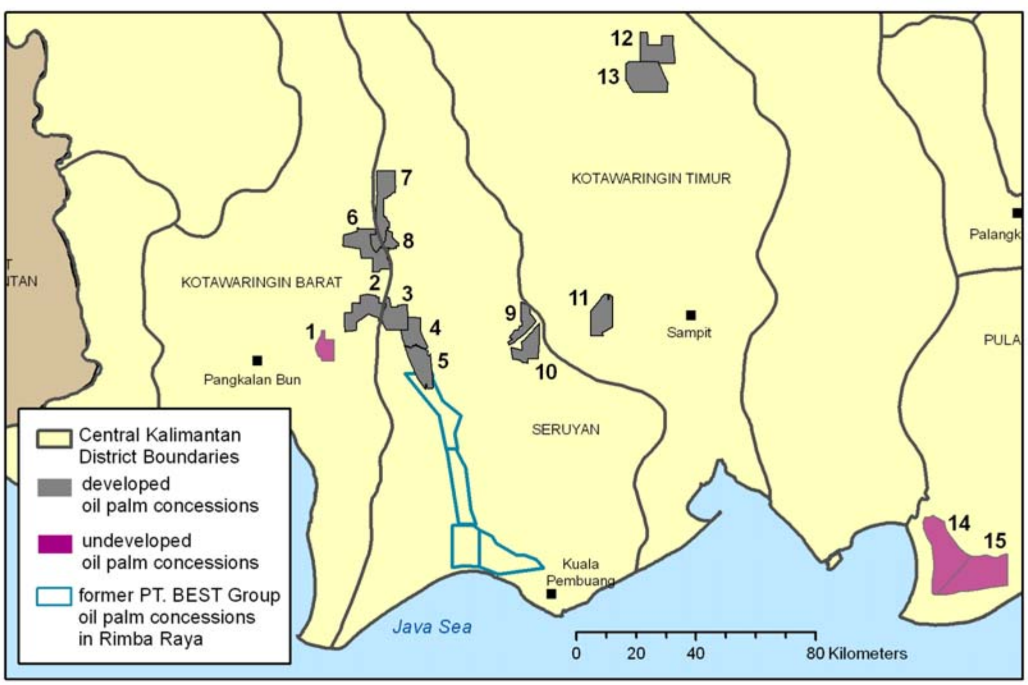


Figure 7. PT BEST Group undeveloped oil palm concessions in Indonesia

The three remaining concessions are being monitored during the 5-year period to stay informed on PT BEST activities, and any changes on these concessions will be detailed in annual monitoring reports. However, project proponents do not consider these permitted concessions to be potential leakage sites based on the following points supported by the methodology:

1. These areas have already been granted, therefore future conversion to plantation on these 3 concessions would not be considered an increase in area of government permits to PT BEST.

Section 10.2 of the Methodology

"At each verification, documentation shall be provided covering the other lands controlled by the baseline agent where leakage could occur, including, at a minimum, their location(s), area and type of existing land use(s), and management plans. It must also be demonstrated that the total area of government permits (for deforestation activities) that have been granted to the baseline agent of deforestation has not increased due to the implementation of project activities."

2. These concessions are primarily deforested and heavily degraded, therefore conversion to palm oil would have a negligible effect on aboveground carbon.

Section 10.2 of the Methodology

"No increases in GHG emissions caused by displacement of activities associated with the project are expected and LK = 0 if it can be demonstrated that all pre-project activities are displaced to degraded, non-forest land on mineral soils outside the project boundary that have negligible aboveground carbon stocks and that have been non-forest for at least ten years."

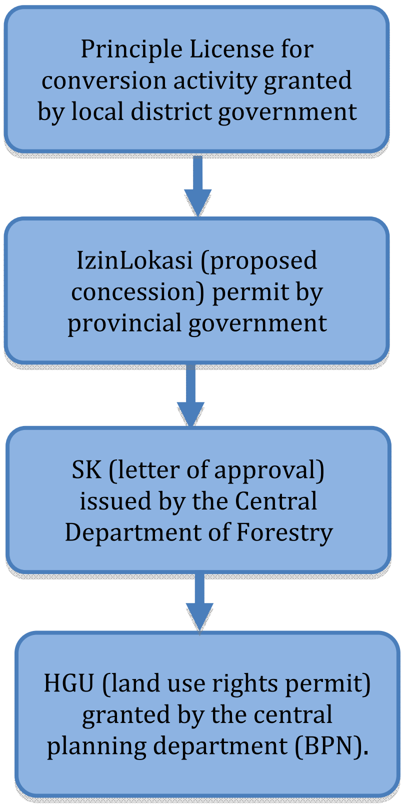
3. The land use plans for concession development were in place at the project start for these 3 concessions, so future development would not constitute a change in land use designation.

Section 10.2 of the Methodology

"In such cases, the project shall demonstrate that the management plans and/or land-use designations of other lands controlled by the baseline agent of deforestation have not materially changed as a result of the planned project (e.g., designating new lands as plantation concessions, increasing harvest rates in lands already managed for plantation products, clearing intact forests for plantation establishment);"

Any new PT. BEST concession in Indonesia will be monitored

Project proponents will also look beyond the known lands controlled by PT BEST at the beginning of the five-year monitoring period and investigate whether any new lands have come under their control. This will be accomplished by monitoring new concession licenses granted to PT BEST by the Indonesian government, through national, provincial and district land permitting offices. The following description provides background on the license process, which has informed permit monitoring.



Concession license process in Central Kalimantan

In Indonesia, district and provincial land use planning are designed to follow national land use planning established by the Ministry of Forestry. National spatial planning maps describe various land use zones such as: production forest, conservation forests, protected forests, and agricultural conversion areas. Agricultural conversion areas are designated as the legal zones where agricultural crops such as rubber and palm oil can be planted as permitted at the provincial and district levels. Conversion of forest areas outside of these zones is normally prohibited.

In Central Kalimantan, and Seruyan District, in particular, palm oil development regularly follows a bottom-up licensing process for forest conversion to agriculture. The district government is the first in the chain of approvals to grant a license that follows a typical pattern (shown left).

Thus, at any given time, there are proposed concessions (those holding an Izin Lokasi) and licensed concessions (those holding a HGU) throughout the province, with the majority of these concentrated on the centers of palm oil production. In Central Kalimantan this permitting process constitutes legal palm oil plantation development and most existing palm oil plantations are developed within or adjacent to these boundaries.

Obtaining a legal license by this process takes 2-3 years, so that legal activity shifting, e.g. obtaining a new HGU prior to plantation development, is not expected to occur in less than two years after the project start and planned concessions are canceled.

Monitoring unpermitted (illegal) plantation expansion

There is a substantial amount of spatial data available that can be used to identify potential leakage, including satellite imagery for mapping plantation conversion and GIS data for overlaying mapped concession boundaries and agents. These data provide a direct method of investigating leakage and determining impact area for quantifying carbon stock and emission changes. Satellite image and GIS analysis are especially valuable for monitoring unpermitted plantation expansion beyond their legal boundaries. The series of steps below describes the process of monitoring unpermitted plantation development. These steps operationalize the general methodology requirement to monitor all activity-shifting leakage by the deforestation agent.

Unpermitted plantation expansion monitoring steps

Leakage monitoring for unpermitted plantation expansion is accomplished through a multi-step process that relies primarily on linking actual palm oil conversion derived from satellite image analysis with land-use planning maps and permits. Stratification is employed at Step 3 to focus the leakage analysis and then again in Step 6 to refine impact assessment for carbon stock and emissions changes if leakage is detected. Steps 1-3 are conducted up-front prior to monitoring. Steps 4-6 are conducted every year during monitoring and Steps 7-8 are conducted if Steps 4-6 show the occurrence of leakage.

Establish unpermitted plantation expansion monitoring zone at project start:

STEP 1. Identify agent, assess holdings and operations
STEP 2. Establish agent-specific operational distance monitoring zone for unpermitted plantation expansion
STEP 3. Stratify monitoring zone to define leakage risk areas

Conduct annual monitoring for unpermitted plantation expansion:

STEP 4. Monitor and update permitted concessions maps
STEP 5. Monitor and map actual oil palm plantations (potential leakage sites)
STEP 6. Overlay permitted concessions and actual plantations to determine leakage

<u>Details of unpermitted plantation expansion monitoring process</u>

STEP 1. Identify agent, assess holdings and operations

PT BEST Agro International, a large Oil Palm Conglomerate with long-term lease rights to 15 concessions in Central Kalimantan, 12 of which are already developed to palm oil. The remaining 3 are primarily deforested.

STEP 2. Establish agent-specific operational distance monitoring zone for unpermitted plantation expansion

Palm oil concessionaires rely on transportation infrastructure to haul edible grade oil palm fruit to Crude Palm Oil (CPO) processing mills within 24 hours of harvest. This places a significant operational constraint on concessionaires who must locate plantations close to processing plants especially where road conditions are poor. In Central Kalimantan, this presents an effective operational zone of no more than 100km from palm oil plantation to CPO plant. Illegal plantation expansion, if it occurs, would be expected to occur within these zones.

All of the PT BEST concessions currently under operation were developed around and are dependent on two CPO processing mills, one in Pangkalan Bun and one in Sampit. These locations form the centers of 100km operational constraint zones for monitoring illegal plantation expansion (Figure 8). Note that undeveloped concessions 14 and 15 lie outside of this monitoring zone and are cut off from Sampit by extensive deep swamps of Sebangau National Park. Currently there are no plantations in this region to monitor for expansion and no infrastructure to develop them. These concessions will be monitored as described above and infrastructure development, expected to develop south from Palangakaraya will also be monitored. Should this infrastructure and/or plantations develop during the leakage monitoring period, illegal expansion beyond permitted borders will also be monitored.

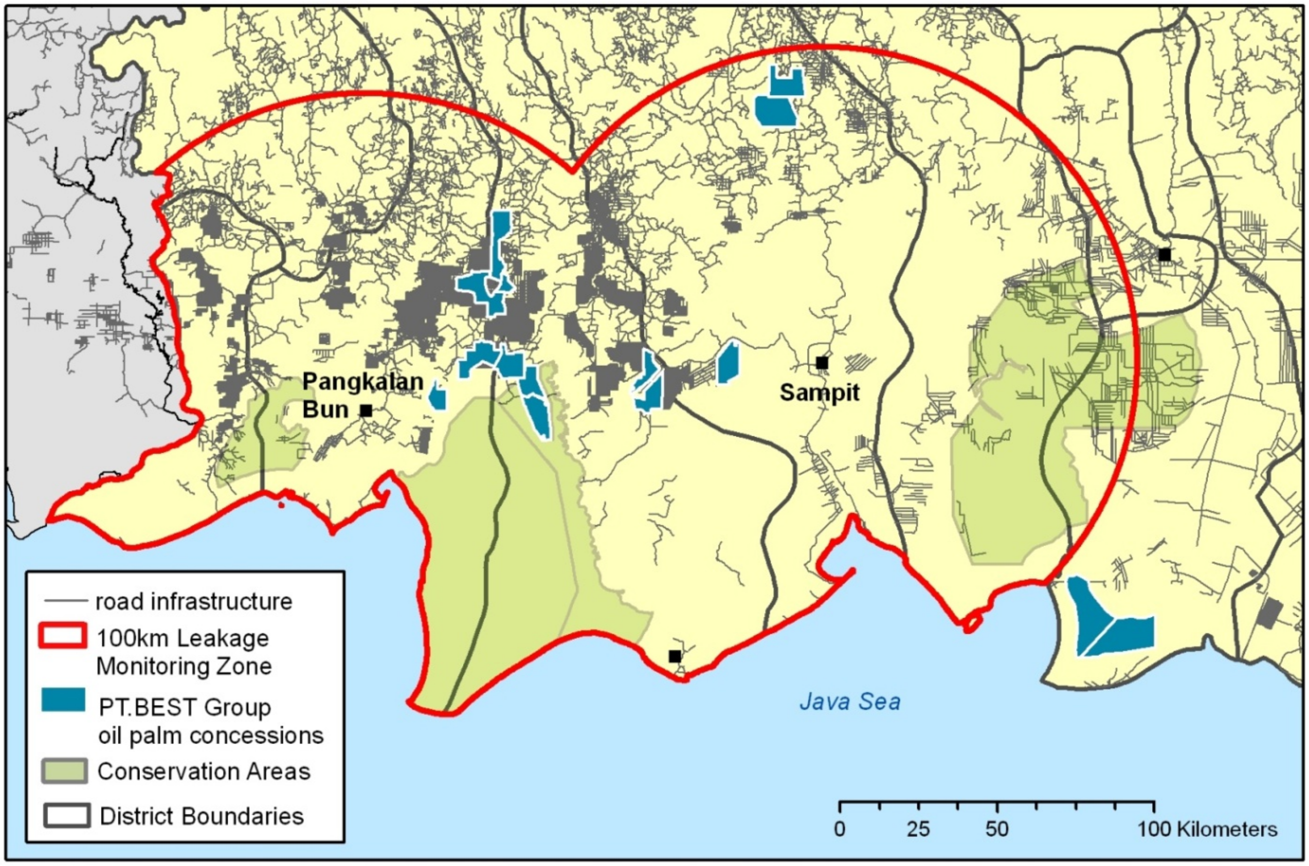


Figure 8. Unpermitted activity shifting leakage monitoring zone for Rimba Raya based on 100km distance from PT BEST Agro's CPO processing mills in Pangkalan Bun and Sampit, Central Kalimantan.

STEP 3. Stratify monitoring zone to define leakage risk areas

The unpermitted plantation expansion monitoring zone is stratified by land use and land planning information in order to focus the area of analysis to those places where leakage could occur. This analysis is carried out in GIS using overlays of spatial data to include or exclude certain layers as follows:

1. Include 100km areas centered on palm oil processing plants in Pangkalan Bun and Sampit
2. Exclude project area (Rimba Raya) and provinces where agent does not operate (West Kalimantan)
3. Include only areas that were forested in 2000
4. Exclude all permitted oil palm concessions at project start (2009 Izin Lokasi and HGU permits)
5. Exclude all existing palm oil plantations at project start (2009 Landsat mapping)

Results of the first three overlays are shown in Figure 9. GIS data layers for HGU and Izin Lokasi permits (Figure 10) were combined then overlaid with monitoring zone forests to exclude all areas already permitted for conversion at the project start. Concession boundaries were buffered by 500 meters in GIS to eliminate errors associated with mapping and reduce the number of "sliver" polygons produced by spatial mismatches in data layers. Tests of buffer distance were conducted to insure that the buffered GIS file captures actual palm oil expansion outside permit boundaries.

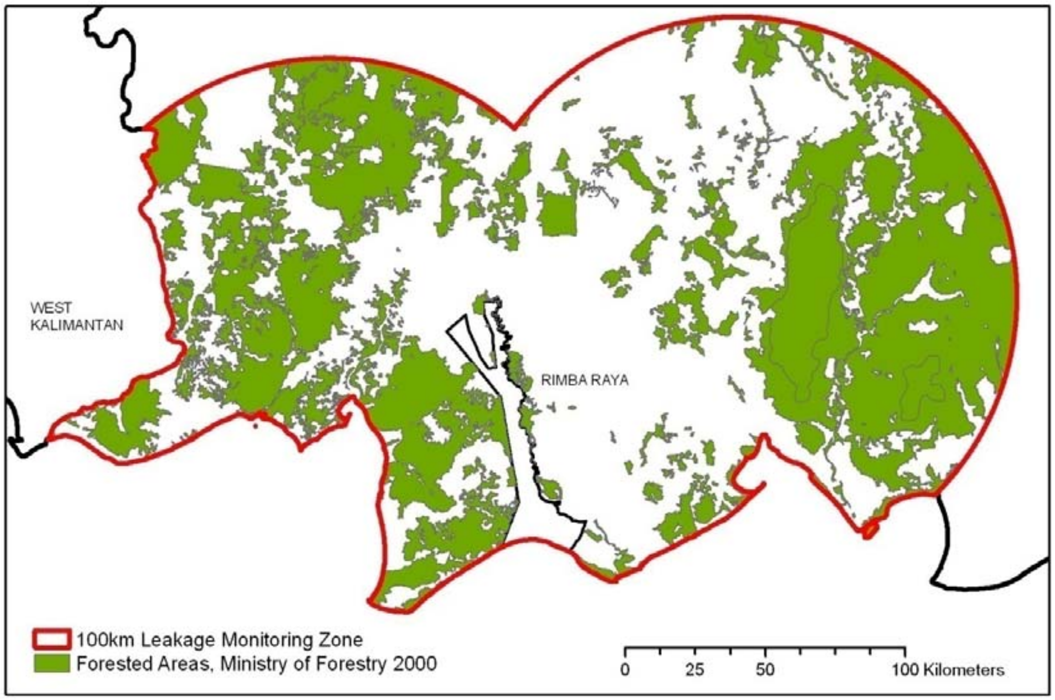


Figure 9. Results of the first three steps of plantation expansion leakage monitoring. Forested areas shown represent existing forest in 2000 for the 100km monitoring zone.

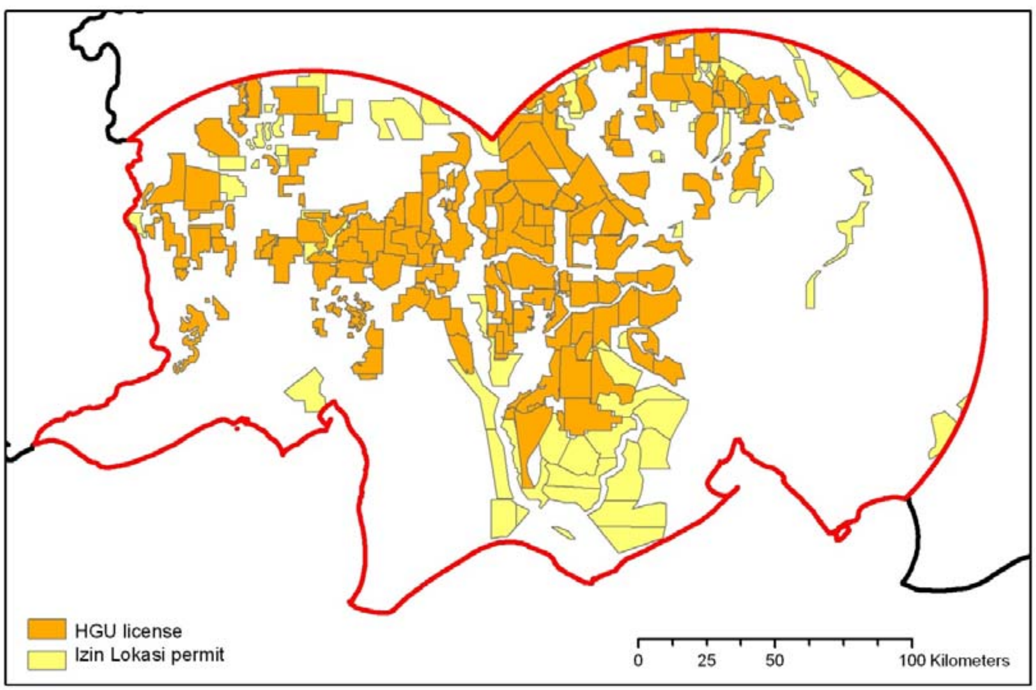


Figure 10. Existing oil palm concession licenses at project start. GIS data represents government mapping obtained through NGOs and represents the best available data as of July 2009.

All existing palm oil plantations in the monitoring zone at project start were interpreted and digitized on Landsat ETM+ satellite imagery (Figure 11). Six scenes were required to cover the monitoring zone and images were searched to find cloud-free images closest to the project start date. Two scenes each from three dates: May 13, June 7 and August 8 were selected and downloaded, bands stacked and geo-referenced if displays saved for import into ArcGIS for digitizing. Palm oil boundaries were conservatively interpreted to include alreadyconstructed plantation blocks. Mapping shows that most HGU concessions have already been converted to plantation and conversely, the majority of palm oil conversion has occurred in or adjacent to permitted concessions. An earlier pilot study outside of PT BEST concessions showed a 15% encroachment in area beyond permitted concessions.

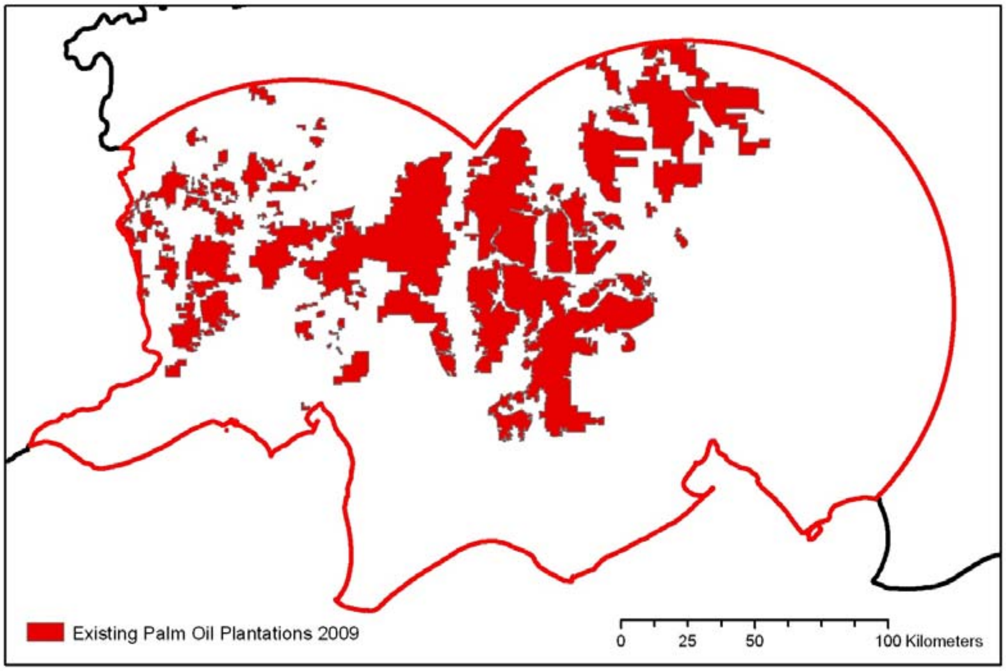


Figure 11. Existing palm oil plantations at project start interpreted and digitized from Landsat 7 ETM+ satellite imagery path-row 118-061 and 118-062 June 7; 119-061 and 199-062 May 13; 120-061 and 120-062 August 8.

After removing permitted and existing palm oil plantations, the remaining areas forested in 2000 are being monitored for plantation conversion and expansion (Figure 12). Note that conservation areas (except the project) are included in leakage monitoring although palm oil conversion is not expected to occur in these areas.

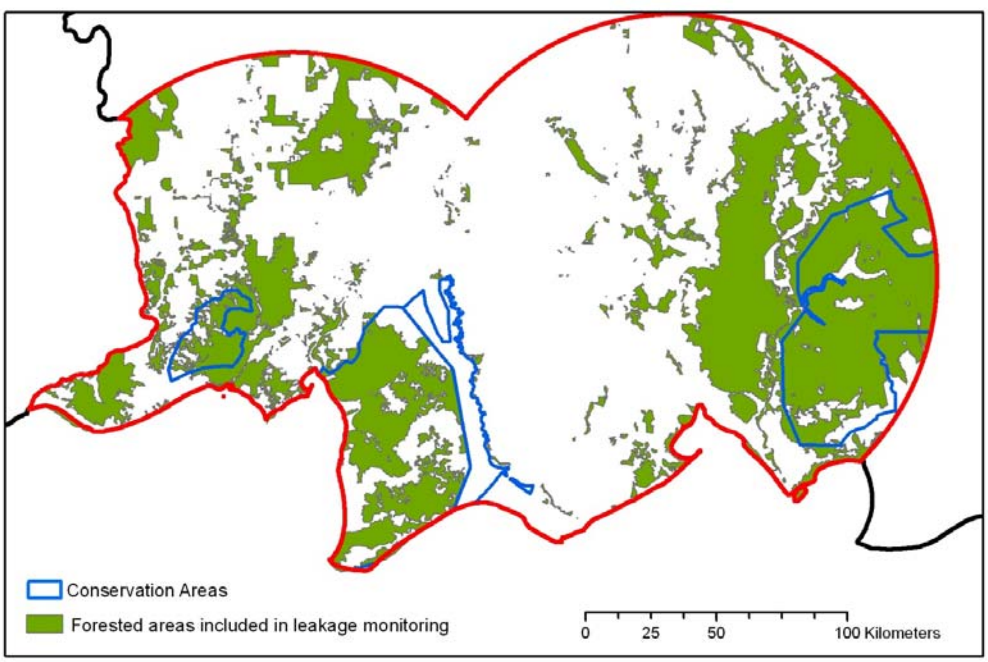


Figure 12. Leakage risk areas representing forests in 2000 inside the 100km distance buffer to CPO plants and excluding permitted concessions and existing plantations. Forests inside conservation areas are also monitored for leakage.

STEP 4. Monitor permits and update concession maps

Researching new licenses and updating GIS data on concession boundaries is the first step of the annual leakage monitoring process. Permits are searched to identify any new license activity by PT. BEST. In Step 3, the current status of existing concessions (holding a HGU) and proposed concessions (holding an Izin Lokasi) was established at both the District and Provincial levels. This map and list of existing and planned conversion areas represents the known area and location of planned land conversion within the District and Province at the project start. The current HGU and Izin Lokasi map (shown in Figure 10) will be updated to add any new license boundaries and improve mapping for existing boundaries consistent with government planning office GIS.

STEP 5. Monitor and update oil palm plantation boundaries (potential leakage sites)

Mapping new palm oil conversion lands consists of overlaying year t mapped plantations onto year t+1 satellite imagery and digitizing all new and/or expanded plantations in the entire 100 km monitoring zone (updating Figure 11). New areas of palm oil plantation are then overlaid with leakage risk areas (Figure 12) to identify all areas of potential leakage on the ground. The example in Figure 13 illustrates this process. In this case, palm oil conversion had begun inside permitted concessions prior to project start, but then expanded beyond concession boundaries and into the leakage risk area where it was detected during the GIS overlay process. The spatial overlay approach facilitates both a visual and quantitative assessment of potential leakage.

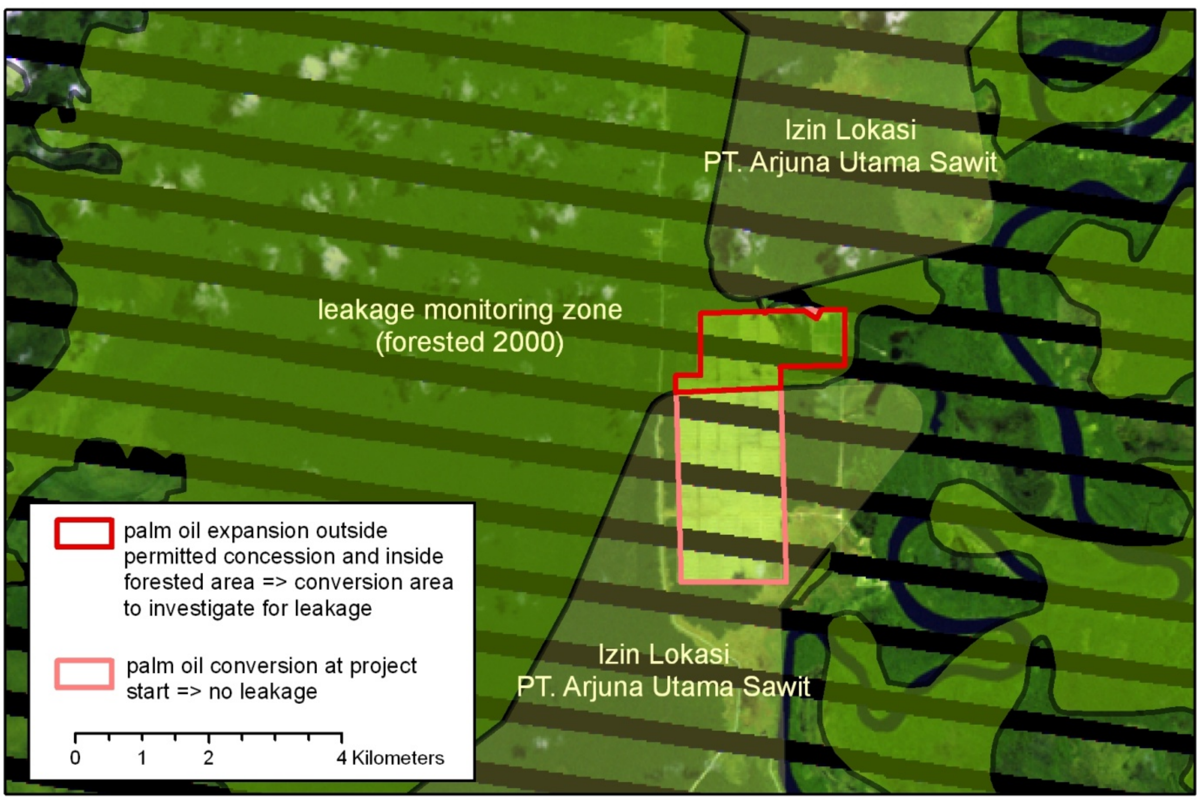


Figure 13. Example of overlay process to detect and highlight new forest conversion to palm oil.

STEP 6. Overlay concession boundaries and palm oil plantations to determine agent

If new deforestation is detected within the leakage monitoring zone and is confirmed to be new activity outside a pre-existing concession license, then Step 6 is carried out to determine the agent of deforestation. Overlay analysis of updated concession boundaries (Step 4) and palm oil expansion (Step 5) is used to identify the agent or possible agents responsible for conversion. As illustrated in Figure 13, overlaying concession boundaries provides information about agents. In this case, plantation conversion extended 1.5 km between two concessions for which an Izin Lokasi had been granted to PT. Arjuna Utama Sawit. Since this company is not an affiliate of PT BEST, whose closest concession is 75 km distant, we can conclude that PT BEST is not the agent of this conversion and therefore this palm oil expansion does not represent leakage associated with Rimba Raya. If it is determined that PT BEST is the likely agent, then steps 7 and 8 will be carried out to confirm and quantify leakage.

Assess the area of activity shifting leakage and quantify impact to carbon

Any activity shifting leakage detected during monitoring including leakage in existing or new PT BEST concessions and unpermitted plantation conversion will be assessed and reported annually in accordance with the methodology.

Conduct site-level analysis to confirm leakage and stratify area

If it is determined that PT BEST is the likely agent of leakage, then a site-scale analysis is conducted to confirm the agent and develop data for carbon accounting. First, the boundary of the new or expanded palm oil concession will be delineated using concession permit maps and the best available satellite imagery. Then the leakage area will be stratified using the same procedures and vegetation classes as used for Rimba Raya.

Assess net carbon stock changes and GHG emissions associated with leakage

Following leakage area delineation and stratification, carbon stock changes and continued GHG emissions will be calculated according to the methodology. Emissions that result from displacement of pre-project activities to areas outside the project boundary are estimated as:

$$LK = \sum_{t=1}^{t^*}\sum_{i=1}^{M_{LK}} LKA_{planned,i,t} \cdot \Delta C_{i}$$

where:

LK	= Leakage emissions resulting from displacement of economic activities; tCO_2e
$LKA_{planned,i,t}$	= the area of activity shifting leakage in stratum *i*, at time *t*; ha
ΔC_{i}	= average carbon stock changes and greenhouse gas emissions in all pools in stratum *i*, $tCO_2e\ ha^{-1}$
i	= 1, 2, 3, …, M_{LK} leakage strata
t	= 1, 2, 3, …, *t** years elapsed since the start of the project activity

Monitoring Period and Reporting

The area of activity shifting leakage will be assessed for five full years beyond the date at which deforestation was projected to occur (July 2009). And emissions resulting from activity shifting will be tracked beyond the initial year of clearing as required and described by the Methodology Section 10.2.2.

At each verification, documentation will be provided covering lands controlled by PT BEST where leakage could occur, including their location, area and type of existing land use(s) and management plans. The status of government permits that have been granted to PT BEST will also be reported.

Market Leakage Deduction (not monitored)

In accordance with the methodology, a deduction against the biomass of timber extracted under the baseline scenario must be estimated for Market Leakage by implementing steps outlined in Section 10.1 in the methodology:

Section 10.1 of the Methodology

When REDD project activities result in reductions in wood harvest, it is likely that production could shift to other areas of the country to compensate for the reduction. Therefore, in cases where the project area would be harvested for commercial timber before clearing the site for a new land use, market effects leakage must be estimated as the baseline emissions from logging multiplied by a leakage factor:

$$LK_{MarketEffects} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{LK}} LK_{ME,it} \quad \textbf{(66)}$$

$$LK_{ME,it} = LF_{ME,i} * C_{B,XBT,it} \quad \textbf{(67)}$$

Where:

$LK_{MarketEffects}$ = Total GHG emissions due to market effects leakage through decreased harvest; t CO_2e

$LK_{ME,it}$ = Total GHG emissions due to market effects leakage through decreased harvest in stratum i at time t; t CO_2-e

$LF_{ME,i}$ = Leakage factor for market effects calculations; dimensionless

$C_{B,XBT,it}$ = Carbon emission due to displaced timber harvests in the baseline scenario in stratum i at time t; t CO_2-e

The amount of leakage is determined by where harvesting would likely be displaced to. If in the forests to which displacement would occur a lower proportion of biomass in commercial species is in merchantable material than in the project area, then more trees will need to be cut to supply the same volume and thus higher emissions should be expected. In contrast, if a higher proportion of biomass of commercial species is merchantable in the displacement forest than in the project forest, then a smaller area would need to be harvested and lower emissions would result.

Each project thus shall calculate within each stratum the proportion of total biomass in commercial species that is merchantable (*PMPi*). Merchantable biomass per stratum is conservatively defined as the total volume (converted to biomass) of all commercially valuable trees within a stratum that are above the minimum size class sold in the local timber market (see Applicability Condition J). *PMPi* is therefore equal to the merchantable biomass as a proportion of total aboveground tree biomass for stratum *I* within the project boundaries. *PMPi* shall then be compared to the mean proportion of total biomass that is merchantable for each forest type (*PMLFT*) to which displacement is likely to occur.

The following deduction factors ($LF_{ME,i}$) shall be used:

PML_{FT} is equal (±0.15) to PMP_i	$LF_{ME,i}$ =	0.4
PML_{FT} is > 0.15 less than PMP_i	$LF_{ME,i}$ =	0.7
PML_{FT} is >0.15 greater than PMP_i	$LF_{ME,i}$ =	0.2

Where:

PML_{FT} = Mean merchantable biomass as a proportion of total aboveground tree biomass for each forest type; dimensionless

PMP_i = Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries; dimensionless

$LF_{ME,i}$ = Leakage factor for stratum i market-effects calculations; dimensionless

Instead of applying the default market leakage discounts, project proponents may opt to estimate the project's market leakage effects across the entire country and/or use analysis(es) from other similar projects to justify a different market leakage value. A description of the market leakage assessment, including steps for determining where leakage is likely to occur (i.e., to which forest types leakage is likely to occur) and what the carbon stocks of those lands are, shall be outlined in the PDD. The outcome of this assessment conducted at first VCU issuance (whether using default discounts or project specific analysis(es)) shall be subject to the VCS double approval process. Market leakage assessments conducted at validation stage and at verification other than the first VCU issuance are not required to undergo the double approval process.

The next step is to estimate the emissions associated with the displaced logging activity – this is based on the total volume that would have been logged in the project area in the baseline scenario. The emission due to the displaced logging has two components: the biomass carbon of the extracted timber and the biomass carbon in the forest damaged in the process of timber extraction:

$$C_{B,XBT,it} = \left(\left[V_{B,it} * \phi_i * CF\right] + \left[V_{B,it} * LDF\right]\right) * \frac{44}{12} \quad \textbf{(68)}$$

Where:

$C_{B,XBT,it}$ = Carbon emission due to displaced timber harvests in the baseline scenario in stratum i at time t; t CO_2-e

$V_{B,it}$ = Volume to be extracted under the baseline scenario in stratum i at time t; m^3

ϕ_i = volume-weighted average wood density; t d.m. m^{-3} merchantable volume

CF = carbon fraction of dry matter (0.5 t C / t biomass); dimensionless

LDF = Logging damage factor; t C m^{-3} (default 0.37 t C m^{-3})

i = 1, 2, 3, ..., m_{BL} baseline strata

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

The total volume to be extracted under the baseline scenario in stratum *i* at time *t* (*VB,it*) can be estimated by multiplying the plot-level volume per stratum (*MVB,it* see Eq. 34) by the area cleared or logged in stratum *I* at time *t* (A cleared ,it or A logged B,it)

The logging damage factor (*LDF*) is a representation of the quantity of emissions that will ultimately arise per unit of extracted timber (m^3). These emissions arise from the non-commercial portion of the felled tree (the branches and stump) and trees incidentally killed during tree felling. The default value given here comes from the slope of the regression equation between carbon damaged and volume extracted based on 534 logging gaps measured by Winrock International in Bolivia, Belize, Mexico, the Republic of Congo, Brazil, and Indonesia.

Leakage from Market Effects was taken as one-time[2] deduction of **-3,627,641 t CO2e** .

12. Biomass Plots

Section 2 of the methodology

Baseline net GHG emissions are not monitored in this methodology. The methodology prescribes validity of the baseline identified ex ante at the start of the project activity for the crediting period, thereby avoiding the need for monitoring the baseline over the crediting period, and achieves savings in the costs associated with baseline monitoring.

Section 16.2 Sampling Framework of the methodology

The monitoring methodology was designed so that all sampling can involve temporary plots and can occur at the beginning of the project.

Permanent plots are not required for monitoring, however project proponents have elected to monitor biomass plots over the life of the project in order to improve the understanding of forest and biomass change over time in Rimba Raya for informing ongoing carbon assessments and science. Biomass plots were surveyed for the carbon assessment July-September 2009 and these data and results are included in the Carbon Assessment Survey Reports and the Baseline Report.

Biomass plots and transects surveyed during the Carbon Assessment were rechecked and permanently marked during Year 1 monitoring. These sites will be rechecked annually and resurveyed every 4-5 years and survey data added to the project database.

13. Carbon Accounting

13.1 Introduction: Background on Carbon Accounting

Carbon accounting follows the procedure described by the approved methodology. It describes calculation of actual (*ex post*) net GHG emissions avoided within the project boundary as a result of the project activities. GHG emissions reductions are calculated as the sum of observed emissions from logging, fires and land cover change (deforestation) for all strata during each monitoring year.

GHG emissions avoided were thus calculated as follows:

$$C_{ACTUAL} = C_{BSL} - C_{PRJ}$$

where

C_{ACTUAL} = actual net greenhouse gas emissions avoided; t CO_2-e

C_{BSL} = sum of peat emissions and carbon stock changes in aboveground biomass under the baseline scenario; t CO_2-e

C_{PRJ} = sum of emissions that occur within the project boundary; t CO_2-e

[2] Market leakage is not monitored but is taken as a one-time, up front over a five-year period coinciding with estimated clearing rates and time periods.

The subject of annual monitoring is focused on the calculation of C_{PRJ}, defined as:

$$C_{PRJ} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{ps}} E_{P,it}^{logging} + E_{P,it}^{fire} + E_{P,it}^{LUC}$$

where

C_{PRJ} = sum of emissions that occur within the project boundary as a result of emissions that were unanticipated and/or unable to be avoided by project activities; tCO_2-e

$E_{P,it}^{logging}$ = GHG emissions due to logging in stratum i, time t; tCO_2-e

$E_{P,it}^{fire}$ = GHG emissions due to fire in stratum i, time t; tCO_2-e

$E_{P,it}^{LUC}$ = GHG emissions due to land use/cover change in stratum i, time t; tCO_2-e

i = 1, 2, 3, …, m strata

t = 1, 2, 3, …, t* years

13.2 GHG Emissions

Changes in landcover change/use will be detected in the analysis of year t and year t+1 satellite imagery. Further spatial analysis and ground surveys will be carried out to assess the nature of land change and the impact on carbon stocks and emissions.

13.2.1 GHG Emissions due to fire ($E_{P,it}^{fire}$)

$E_{P,it}^{fire}$ refers to emissions from all fires that occur inside the project boundary over the monitoring period. Burned areas will be determined through spatial analysis of annual landcover changes using Landsat and other imagery, in conjunction with fire hotspot and burn area data from the MODIS sensor and ground surveys.

In accordance with the methodology, emissions from fire damage will be partitioned into CO_2, CH_4 and N_2O emissions resulting from the burning of aboveground and belowground (peat) biomass. Above and belowground emissions from fire will be summarized in the tables similar to those presented below.

GHG Emissions from Aboveground Biomass Burning

Aboveground emissions are those arising from the combustion of live, aboveground, plant and tree material during wildfires. Using data from the annual landcover change spatial analysis, the total area of each burned strata layer within the CAA will be calculated using ArcGIS. Area, biomass, carbon stock and the corresponding emissions will be calculated independently for each of the seven strata and reported in a template similar to Table 6 in annual monitoring reports.

Table 6. Template for Estimation of aboveground biomass emissions from burning

for each MONITORING YEAR t Strata	Biomass in land cover type (t d.m. ha^{-1})	Carbon in land cover type (t C ha^{-1})	Timber extraction (t C ha^{-1})	Carbon remaining (t C ha^{-1})	CO_2 emission (t CO_2 ha^{-1})	CH_4 emission (t CO_2 ha^{-1})	N_2O emission (t CO_2 ha^{-1})	Total CO_2e (t CO_2e ha^{-1})	Total Emissions (t CO2e ha^{-1})
Peat Swamp Forest (lightly degraded)									
Peat Swamp Forest Degraded (highly)									
Peat Shrubland (<30% Tree Cover)									
Kerangas Forest									
Kerangas Open Scrub									
Low, sparse vegetation cover									
Seasonally Inundated Wetlands									
TOTAL emissions from AGB biomass burned									

Aboveground biomass burning calculations of CO_2, CH_4, and N_2O emissions will use IPCC default parameter values for N/C ratio, Global Warming Potentials and combustion efficiency, which are summarized in Table 7.

Table 7. Parameters used in estimation of aboveground biomass emissions from burning

Aboveground Biomass Burning Parameters	
IPCC defaults:	Value
N/C ratio	**0.01**
Emission ratio for CH4	**0.012**
Emission ratio for N2O	**0.007**
Global Warming Potential for CH4	**21**
Global Warming Potential for N2O	**310**
Combustion Efficiency:	**0.5**
Proportion Burned:	**1**

GHG Emissions from Belowground Biomass Burning

Landcover changes due to fires within the CAA will result in the loss of belowground peat biomass. The total burned area will be stratified by peat and non-peat areas using the landcover classification, consistent with baseline calculations and will be presented in a template similar to Table 8 in annual monitoring reports.

Kerangas forest and kerangas open scrub lie on sandy (non-peat) soils, so all burn areas that occur in these landcover types will be assumed to have 0 belowground biomass burned. All other areas will conservatively be assessed as peat soil types with belowground biomass losses. Prior to site-specific data collection, a burn depth of 34 cm will be used to calculate carbon losses associated with belowground biomass burning.

Table 8. Template for Landcover of Burned Areas – Kerangas Forest and Scrub are on sandy soils (non-peat)

Landcover Stratification of Burned Areas in CAA	
Landcover Class	Peat Area Burned (ha)
Peat Swamp Forest (lightly degraded)	
Peat Swamp Forest Degraded (highly)	
Peat Shrubland (<30% Tree Cover)	
Kerangas Forest (Non-peat soils)	
Kerangas Open Scrub (Non-peat soils)	
Low, sparse vegetation cover	
Seasonally Inundated Wetlands	
TOTAL Area Burned	

In accordance with the methodology calculations of total peat burn emissions will be derived using parameters including area burned, burn depth, peat bulk density, mass and emissions factors. IPCC default and methodology values will be used for all parameters where site-specific data are unavailable.

Parameters values are summarized in Table 9. Total emissions from burning belowground biomass will be presented in annual monitoring reports in a template similar to Table 10.

Table 9. Parameters used in estimation of belowground biomass emissions from burning

Belowground Biomass Burning Parameters		
IPCC defaults:	Value	Units
scaling factor (ha to m^2)	**10000**	
depth of peat burned	**0.34**	**m**
peat bulk density	**0.14**	**$t\ m^{-3}$**
CO2 emission factor	**185,000**	**$g\ CO_2\ (t\ peat)^{-1}$**
CH4 emission factor	**5,785**	**$g\ CH_4\ (t\ peat)^{-1}$**
CH4 Global Warming Potential	**21**	
Scaling factor (g to t)	**0.000001**	

Table 10. Template for Estimation of emissions from burning belowground biomass

Estimation of emissions due to wildfire from burning of the belowground biomass					
Belowground Soil Type	**Area Burned (ha)**	**Mass of peat burned (t)**	**CO2 emissions (t CO2e)**	**CH4 emissions (t CO2e)**	**Total peat burn emissions (t CO2e)**
Total					

13.2.2 GHG Emissions due to Land Use / Land Cover (LU/LC) changes ($E_{P,it}^{LUC}$)

$E_{P,it}^{LUC}$ refers to emissions associated with the area of land for which land cover changes occur that are not due to fire or logging such as mechanical clearing for plantations. Given Rimba Raya's low-lying swamps and absence of road infrastructure throughout most of the CAA, such clearing is not expected, but will be monitored using remote sensing analysis and ground surveys. Areas of land use change are highly visible on satellite imagery and if subsequent analysis and ground survey shows that the disturbance is neither caused by fire nor logging, additional surveys will be conducted to detail land cover changes and related emissions in accordance with the methodology. Emissions estimations for Land Use / Land Cover change will follow the same summary and calculation approach presented in other monitoring plan sections e.g. timber extraction, aboveground biomass loss, and logging drainage components as needed.

13.2.3 Logging ($E_{P,it}^{logging}$)

$E_{P,it}^{logging}$ refers to emissions associated with the area of land for which logging and logging gaps occur. Logging within the PMZ and CAA has been shown to be small scale and community level. However, these emissions are still accounted and will be presented in annual monitoring reports in a template similar to Table 11.

Table 11. Template for Estimation of emissions in aboveground biomass from timber extraction

Stratum	Actual # of logging gaps detected	Carbon extracted as timber (t C)	CO2 emissions (t CO2)
Peat Swamp Forest (lightly degraded)			
Peat Swamp Forest Degraded (highly)			
Peat Shrubland (<20% Tree Cover)			
Kerangas Forest			
Kerangas Open Scrub			
Low, sparse vegetation cover			
Seasonally Inundated Wetlands			

13.3 Indirect Impacts (Displacement and Market Leakage)

Activity shifting leakage will be accounted in each monitoring period, as described in section 11 of this monitoring plan. Any leakage (deforestation by PT BEST associated with a change in land use outside the project area) will be assessed for its impact on carbon stocks and carbon emissions using the same calculation approaches used to assess carbon impact in the baseline scenario.

Market leakage is not monitored in this methodology but is accounted one-time at the beginning of the project and deducted against the baseline over a five-year period. The market leakage deduction period begins Year 2 when according to the methodology, possible shifting of timber extraction activities displaced from the project area, but remaining outside of lands controlled by PT BEST could occur. Market leakage calculations are detailed in the Baseline calculation spreadsheet. An "up-front" deduction of **-3,627,641 t CO2** has been taken against the baseline as presented in the baseline report.

13.4 Summary of Carbon Accounting (Carbon Emissions Avoided in Year t)

The sum total of avoided carbon emissions is expressed in terms of the baseline expected carbon emissions after Year 1, less deductions for emissions from $E_{P,it}^{fire}$, $E_{P,it}^{LUC}$ and $E_{P,it}^{\log ging}$ as well as any emissions identified as Leakage in each monitoring year. Results of annual monitoring deductions against Baseline Carbon Emissions avoided will be summarized and presented in a template similar to Table 12.

$$C_{ACTUAL} = C_{BSL} - C_{PRJ}$$

where

C_{ACTUAL} actual net greenhouse gas emissions avoided; t CO_2-e

C_{BSL} sum of peat emissions and carbon stock changes in aboveground biomass under the baseline scenario; t CO_2-e (after all buffers and deductions)

C_{PRJ} sum of emissions that occur within the project boundary; t CO_2-e

The subject of annual monitoring is focused on the calculation of C_{PRJ}, defined as:

$$C_{PRJ} = \sum_{t=1}^{t*} \sum_{i=1}^{m_{ps}} E_{P,it}^{\log ging} + E_{P,it}^{fire} + E_{P,it}^{LUC}$$

where

C_{PRJ} sum of emissions that occur within the project boundary as a result of emissions that were unanticipated and/or unable to be avoided by project activities; tCO_2-e

$E_{P,it}^{\log ging}$ GHG emissions due to logging in stratum i, time t; tCO_2-e

$E_{P,it}^{fire}$ GHG emissions due to fire in stratum i, time t; tCO_2-e

$E_{P,it}^{LUC}$ GHG emissions due to land use/cover change in stratum i, time t; tCO_2-e

Table 12. Template for Monitoring Year Avoided Carbon Emissions

Year t Avoided Carbon Emissions	
Factor	Value
Expected Emissions	
Year-1 Baseline Carbon Emissions *after 20% Non-Permanence Buffer and Market Leakage Deduction (calculated up-front and reducing project credits in years 2-6)	
Observed Emissions	
Emissions from Fire	
Aboveground Biomass	
Belowground Biomass	
Emissions from Land Use / Land Change	
Emissions from Logging	
Emissions from Leakage	
Total Year-1 Emission Reduction	
Net Year-1 Carbon Stocks	