REDD+ PROJECT FOR CARIBBEAN GUATEMALA: THE CONSERVATION COAST

Karen Aguilar, Development Director
k.aguilar@FUNDAECO.org.gt

Document Prepared By

Paz Lozano, Manager of Development Services
plozano@ecopartnersllc.com

Kyle Holland, Managing Director
kholland@ecopartnersllc.com

Project Title	REDD+ PROJECT FOR CARIBBEAN GUATEMALA: THE CONSERVATION COAST
Project Location	Department of Izabal, Guatemala
Project Proponent	Fundacion para el Ecodesarrollo y la Conservacion (FUNDAECO) Contact: Karen Aguilar Phone: (502) 23141900 Address: 25 calle 2-39 zona 1, Guatemala City, Guatemala Email: k.aguilar@FUNDAECO.org.gt Website: www.fundaeco.org.gt
Document Prepared By	Ecological Carbon Offsets Partners, LLC (ecoPartners) Contact: Paz Lozano Tel: +1 415 634 4650 Address: 2930 Shattuck Avenue, Suite 305, Berkeley, CA 94705 Email: plozano@ecopartnersllc.com Website: www.epcarbon.com
Auditor	AENOR International S.A.U. Contact: José Magro Gonzalez Phone: + 34 914 329 891 Address: Genova, 6. 28004 Madrid , Spain Email: medioambiente@aenor.com Website: www.aenor.es
Project Start Date	1 April 2012
GHG Crediting Period and Project Lifetime	1 April 2012 – 31 March 2042
Project Implementation Period and GHG Monitoring Period	Not applicable for validation.
Validation Status	Seeking full validation
CCB Status History	Undergoing initial validation
Standards Used	VCS v3.6, VCS Methodology VM0015 v1.1, CCB Standards Third Edition
CCB Benefits Summary	The project objectives are threefold: (i) to mitigate climate change by reducing deforestation; (ii) contribute to biodiversity conservation including High Conservation Values, and, (iii) foster sustainable development of local communities. The project aims to protect roughly 128,000 hectares of forest over the project lifetime, which will provide numerous climate and biodiversity benefits. This will also serve to protect at least 15 endangered or critically endangered species throughout the project area including: *Amazona oratrix, Alouatta pigra, Atteles geofroyi, Tapirus bairdii, Craugastor charadra, Craugastor sabrinus, Craugastor sandersoni,*

	Duellmanohyla soralia, Ptychohyla panchoi, Agalychnis moreletii, Craugastor trachydermus, Ptychohyla sanctaecrucis, Dermatemys mawii, Ceratozamia robusta and *Zamia variegata.* The protected area will also cover 11 different water basins covering an area of 145,000 ha and providing drinking water to roughly 80,000 people. Activities related to livelihoods impacts including agroforestry programs, ecotourism, and women's health clinics will provide communities with improved and diversified economic opportunities as well as access to vital reproductive health access and reproductive rights education. Collectively, these services are available to 111 communities within the project zone, and are estimated to be utilized by at least 20,000 people annually.
Gold Level Criteria	None
Date of PDD Completion	27 March 2017
PDD Version Number	2.36
Expected Verification Schedule	March 2017 and annually thereafter

Table of Contents

Figures

Tables

1 GENERAL

1.1 SUMMARY DESCRIPTION OF THE PROJECT (G1)

1.1.1 PROJECT DESCRIPTION

This project is an Agriculture, Forestry and Other Land Use (AFOLU) project under the Reducing Emissions from Deforestation and Degradation (REDD) project category. Specifically, the project is of the "Avoided Unplanned Deforestation & Degradation" (AUDD) project category.

The project is estimated to generate approximately 17,921,895 VCUs over 30 years. The project area is located in Department of Izabal in the Caribbean coast region of Guatemala in the Sarstun-Motagua reference region proposed by the national level REDD+ program. Belonging to the biologically diverse Mesoamerican Biological Corridor, forests in the project area are important nationally and internationally for the ecosystem services they provide. The project area forests, however, have experienced a continued reduction in biomass due largely to small-scale farmers and medium to large scale cattle ranchers that have sought to expand their activities or have been displaced by agro-industrial expansion. These forests have also historically been an important source of income for local families, who periodically harvest small amounts of timber when the economic needs arise.

In 2013 Guatemala passed the *Framework for the Regulation of the Reduction of Vulnerability, the Mandatory Adaptation to the effects of Climate Change and the Mitigation of the effects of Greenhouse Gases* (Decree 07-2013) which gave landowners the rights to emission reductions generated in either voluntary or compliance markets. This law allowed the REDD+ Project for Caribbean Guatemala to pursue a Grouped Project design where the project proponent, FUNDAECO, could represent small landowners and manage the development of a REDD+ project on their behalf through legal contracts that transfer project ownership to FUNDAECO.

The expansion of industrial agriculture and migration of subsistence farmers and cattle ranchers into protected areas is a historical trend observed in the project zone. Consequently, forests and land within protected areas are an important source of income within the project zone and is the major focus of the REDD+ project. The project aims to alleviate these pressures on the forests through the support of governance capacity (including individual property titling, land-use planning and conservation zone demarcation), the generation of alternative economic activities and income sources, and through capacity building in administration and management. These project activities, beyond protecting local forests and biodiversity, contribute to social and economic development in one of the poorest areas of Guatemala. The effectiveness of these activities is partially dependent on their long-term economic success and wide-spread adoption.

Since the project's inception, local communities have been actively participating in the project's formulation and implementation. The early involvement of participating communities has created awareness among community members and readiness for project implementation.

1.1.2 PROJECT OBJECTIVES

FUNDAECO seeks to address the issue of deforestation in Guatemala on a local level. This initiative will have positive climate, community and biodiversity impacts in the project zone. The project reduces CO_2 emissions by preventing deforestation caused by the conversion of forests into cropland and pasture. The project prevents deforestation by addressing the drivers of deforestation in the

project area through effective law enforcement, land-use planning, education, economic opportunities, and sustainable agroforestry initiatives. FUNDAECO created the following climate, community, and biodiversity objectives through an analysis of the drivers of deforestation in the project area, the focal issues identified in consultation with communities and the participatory rural appraisal, and threats to biodiversity in the project zone. To achieve these objectives, the project proponent designed an array of project activities that fall under five program areas: resource protection and governance, sustainable enterprise, community empowerment & inclusiveness, education, and improved access to resources.

1.1.2.1 Climate Objectives
The REDD+ Project for Caribbean Guatemala's primary climate objectives are as follows:

- **Reduce CO2 emissions that result from the conversion of intact forest to agricultural and pastoral land.**
    - Widespread protection of forest in project zone.
    - Extensive areas under agroforestry production or reforestation in project zone.
    - Alternative revenue streams from forest production (e.g. agroforestry) and conservation uses
    - Reduced illegal logging

1.1.2.2 Community Objectives
The REDD+ Project for Caribbean Guatemala's primary community objectives are as follows:

- **Empower marginalized and vulnerable communities through the legalization of land, promotion of reproductive rights and participation in resource management.**
    - All marginalized and vulnerable communities with customary right have legalized land
    - Widespread awareness among women and families of reproductive rights and health
    - Full access to reproductive health information and care within the project zone
    - Ability and capacity of communities to implement sustainable resource management techniques
    - Inclusion of all marginalized and vulnerable communities with customary rights in resource management decisions that may impact them
- **Improve quality of life in the project zone by creating access to new markets, promoting sustainable production and improving public health and education opportunities.**
    - Sufficient household income from provision of ecotourism services, sale of agroforestry products, and resource protection
    - Protection of ecosystem services important to livelihoods and health
    - Increased access to health information and care within the project zone
    - Widespread access to community capacity building and educational opportunities
- **Promote landowner and community self-sufficiency in the project zone through diversified economies and sustainable land uses.**
    - Sufficient household income from provision of ecotourism services, sale of agroforestry products, and resource protection
- **Preserve awareness and respect for traditional, cultural, spiritual and religious identities of communities within the project area.**

- o Recognition and assistance in protection of significant traditional, cultural, spiritual, and religious sites
- o Resource management with consideration of traditional, cultural, spiritual, and religious rights

1.1.2.3 Biodiversity Objectives

The REDD+ Project for Caribbean Guatemala's primary biodiversity objectives are as follows:

- **Maintain habitat for viable, abundant and diverse natural populations.**
  - o Widespread protection of forest in project zone
  - o Promote awareness of ecosystem and habitat importance for native species

- **Reduce threats to rare, threatened and endangered species**.
  - o Prevention of critical habitat loss for rare, threatened, and endangered within the project zone
  - o Maintenance or enhancement of critical habitat for rare, threatened, and endangered within the project zone
  - o Awareness of rare, threatened, and endangered species and their importance

- **Maintain the function of the natural ecosystems.**
  - o Widespread protection of forest in project zone.
  - o Maintenance or enhancement of the integrity of important ecosystem services

- **Support local and global knowledge of biodiversity in the project zone.**
  - o Increased awareness of the role of Guatemala's Caribbean coast in the support of diverse and globally important species populations
  - o Promote awareness of ecosystem and habitat importance for native species
  - o Awareness of rare, threatened, and endangered species and their importance

1.2 PROJECT LOCATION (G1)

The REDD+ Project for Caribbean Guatemala is located along the Caribbean coast of Guatemala, in the department of Izabal, and has the potential to conserve up to 128,448 hectares of tropical forest that make up part of the Mesoamerican Biological Corridor (see Section 1.2.5). The climate in the region is classified as Tropical Rainforest Climate (Af, according to the Koppen-Geiger classification) and has an average of roughly 3,000 mm of rainfall per year (climate-data.org). The northernmost boundary of the project area is the Sarstun river, which marks the border between Guatemala and Belize, and the southernmost boundary of the project area shares a border with Honduras.

1.2.1 OWNERSHIP AND CONTROL

Based on the VCS Standard Section 3.11.1, the project demonstrates that the proponent has ownership and or control over the emission reductions under subsection 4:

"Project ownership arising by virtue of a statutory, property or contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions and/or removals (where such right includes the right of use of such reductions or removals and the project proponent has not been divested of such project ownership)"

As a grouped project the REDD+ Project for Caribbean Guatemala has a number of landholders with different land tenure arrangements where project activities are and will be implemented and emission reductions can and will be claimed. The land tenure arrangements within the Grouped Project Area encompass all of the landowners who are currently participating in the project, and those landowners who may be participants in the future. See Section 1.2.5 for a full explanation of the delineation of the Grouped Project Area. Different tenure arrangements include private owners recognized by el Registro General de la Propiedad *"propietarios",* "*poseedores*" recognized by municipalities, state lands administered by CONAP, and state lands controlled by CECON. With the exception of *poseedores* all of the tenure arrangements present in the Grouped Project Area arise from either formal titles or formal management agreements with the State. These formal agreements are catalogued by the Cadastral Information Registry (RIC) following the Cadastral Information Registry Act of 2005 (Decree 41-2005).

In the case of *poseedore*s, land titles are recognized by the State through municipal certificates. A *poseedore* is defined as a land holder who without being land owner exercises some or all of the usual property rights over a piece of land (Article 23 of Decree 41-2005). PINPEP furthers the definition of a *poseedore* in the context of forests and delineates clear statutes of property rights and required documentation. PINPEP rules hold that to be recognized as a land holder without title (i.e. *poseedore)* a certificate provided by the mayor of the relevant municipality is required declaring that the person concerned is known as the local occupier of the land in a way that is peaceful, public, permanent and in good faith and that no competing claim on the land is known.

With established rights to property, Article 22 of the *Framework for the Regulation of the Reduction of Vulnerability, the Mandatory Adaptation to the effects of Climate Change and the Mitigation of the effects of Greenhouse Gases* (Decree 07-2013) furthers the project ownership of legal owners or *poseedores* to emission reductions generated in either voluntary or compliance markets. For the REDD+ Project for Caribbean Guatemala, all participating properties have transferred their emissions reductions project ownership to FUNDAECO. The confidential contracts with each land owner will be provided to the auditor by request, and an example contract has been provided in the project annexes (see Contrato VCUs entre FUNDAECO-PROPIETARIO 10915.doc). Each contract transfers carbon rights for a minimum of 30 years. Where project activities have been implemented since the project start date, carbon rights are transferred retroactively and land owners have declared to not participate in any other emissions trading programs.

1.2.2 GEOGRAPHIC BOUNDARIES

Project Activity Instances reside within the Grouped Project Area, which resides with the Project Zone (Figure 1). The Grouped Project Area is located near the Caribbean coast of Guatemala, in the *Departmento de Izabal*. Spatial boundaries and coordinates for the Grouped Project Area and Project Area are provided in Sections 1.2.5 and 1.2.6, respectively.
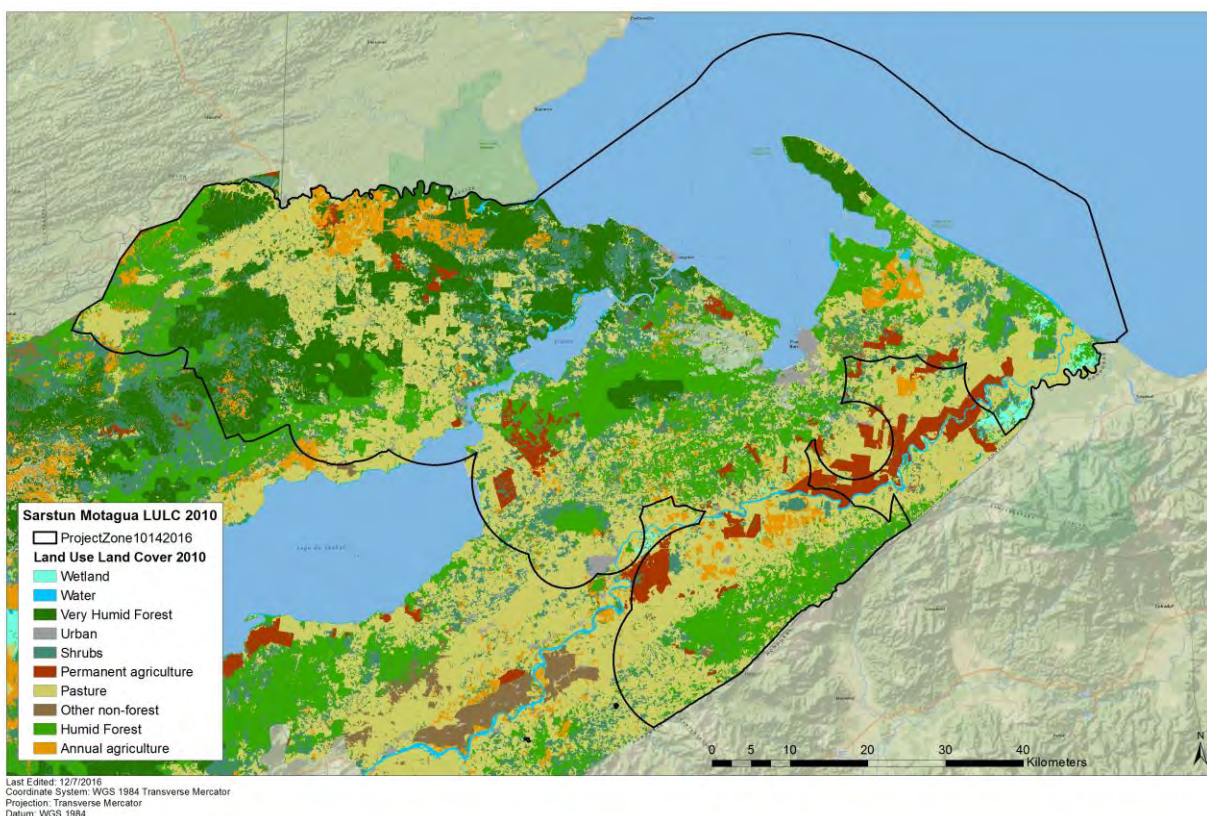
Figure 1. Project Zone of the REDD+ Project for Caribbean Guatemala in the Departmento de Izabal, Guatemala.

1.2.3 PROJECT PHYSICAL PARAMETERS

1.2.3.1 Soils

Soil taxonomy of the Project Zone (see Section 1.2.4) is based on the mostly used Soil Series, proposed by Simmons, who described a Soil Series as an area with similitude between all of its genetic horizons, that share parental material, and these horizons have the same color, structure, drainage and other characteristics (Simmons, Tarano T, & Pinto, 1959).

Soil Series are available in digital format (MAGA, 2001), and these layers were used to produce maps from which we can see (Figure 2) the main Soil Series in the area is Chacalté, Chacón and Inca. Each of the Soil Series extent and percentage of cover can be seen in Table 1.

The mostly found Soil Series is Chacalté at 37% or 150 thousand hectares. Chacalte soils can be originated from limestone, and may present a karstic relief. Its drainage is good, and its texture is mostly clay, with an average depth of 50 cm. This series is found mostly in areas above 500 meters over sea level, and it covers most of Cerro San Gil, the higher parts of Cerro Sarstún, and North of Sierra Santa Cruz.

The next predominant series is Inca at 13.82% of the Surface of interest which is equivalent to 56 thousand hectares. The main origin of these soils are the sediments of the Motagua River. Thus, these are poorly drained soils, consistent mostly of very fine clays, and very deep, they can go in average to 75cm. These soils are found mostly along the Motagua Valley.

And third comes the Chacón series, with a 11.37% cover or 46 thousand hectares. These are soils whose origins are marine materials. With good drainage, median texture, very deep rounding 100 cm in depth. They are found in low areas, mostly along the shores of Lake Izabal and the Santo Tomás Bay.

Simmons Soil Series	Hectares	%
Water bodies	69.41	0.02
Chacalté	149,645.06	37.09
Chacón	45,855.87	11.37
Champona	21,357.30	5.29
Gacho	36,975.40	9.16
Guapaca	16,389.95	4.06
Guapinol	14,139.10	3.50
Inca	55,756.20	13.82
Manabique	21,189.30	5.25
Quiriguá	3,967.36	0.98
Sarstún	1,599.19	0.40
Sebach	18,209.70	4.51
Suelos Aluviales	7,606.99	1.89
Tamahú	10,697.80	2.65
Total	403,458.63	100.00

Table 1. Extent of each soil cover in hectares and its percentages
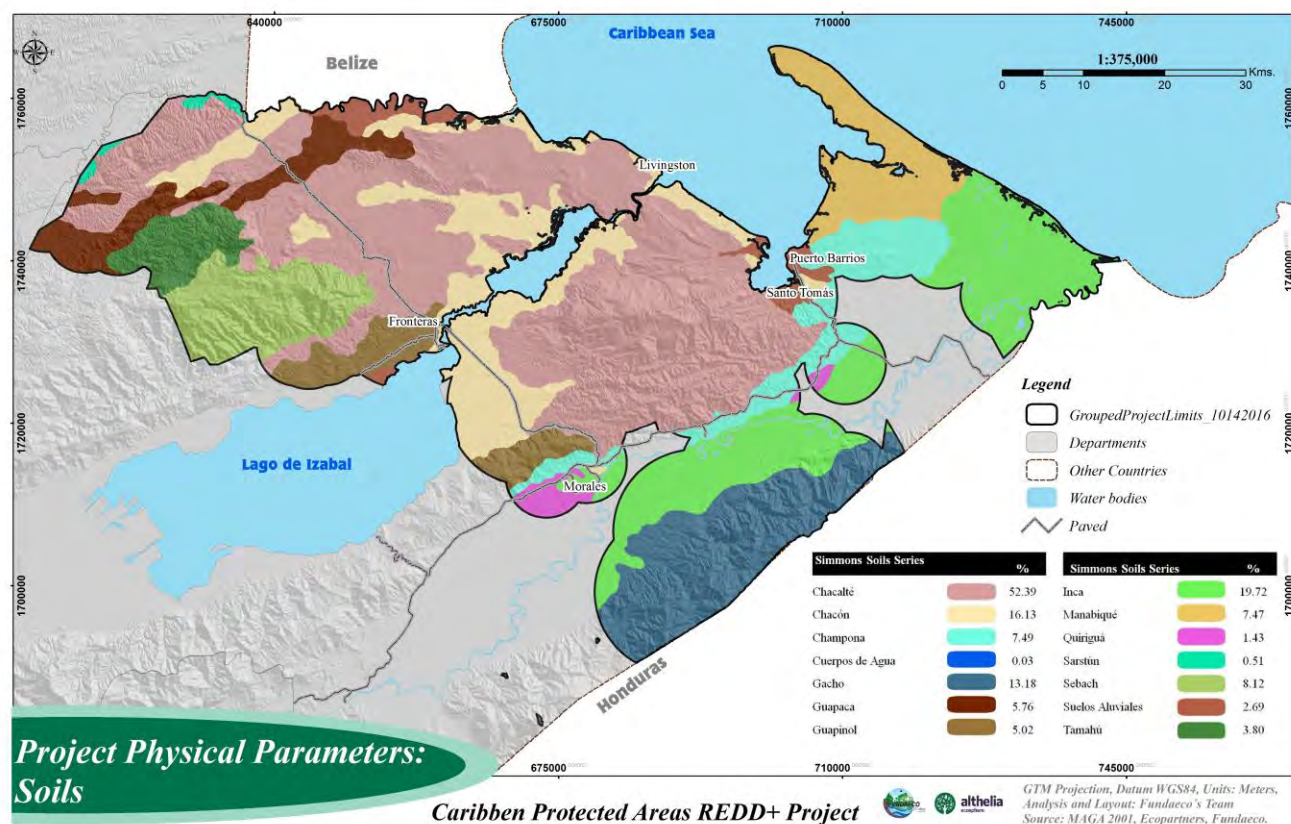
Figure 2. Soils in the Project Zone

1.2.3.2 Topography

The Guatemalan Caribbean is not as mountainous as the Highlands found west of Guatemala, but it is nevertheless a place with a more pronounced relief than the pacific coast. Izabal is mostly composed of areas at lower levels than 100 meters above sea level, but these plains are interrupted by the peaks of several Hills and Ranges.

In Figure 3, the topography of the area can be seen, where Cerro San Gil can reach up to 1200 meters above sea level in some parts, followed by Sierra Caral which stands in some parts above 1000 meters. Sierra Santa Cruz, is a range that averages 600 meters, going up to 900 at its highest, while the Cerro Sarstún is the lowest of the protected areas, where the most prominent place, is 500 meters.
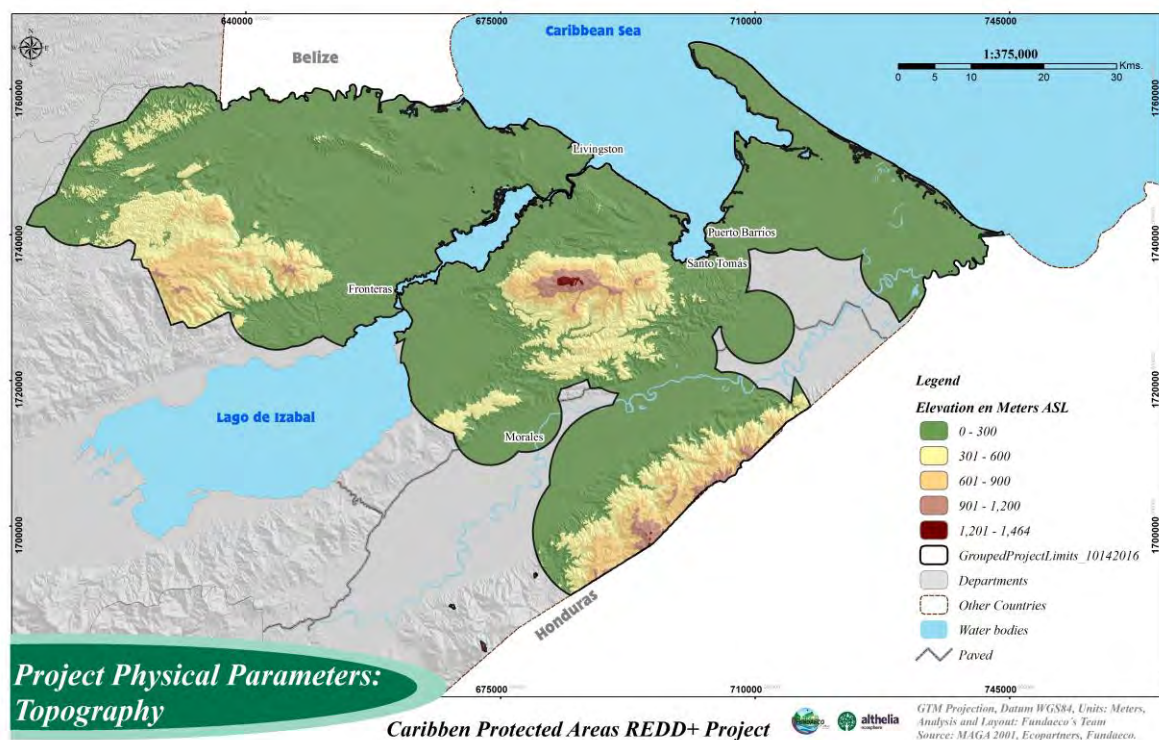
Figure 3. Topography of the Project Zone

1.2.3.3 Climate

Precipitation and temperature maps of the area were produced using information from the Very High Resolution Interpolated Climate Surface for Global Land Areas or WorldClim Project (Hijmans et al. 2005), which is global data but has been very useful in many national projects since it incorporates weather stations from continuant countries and thus represents weather in political borders in a more accurate way. Figure 4 shows precipitation in the area and Figure 5 shows temperatures.

This is a very rainy area, where precipitation starts at 2,000 millimeters of rain, near the Motagua Valley, and rises to the north, where it can reach more than 5,000 mm all along the Santo Tomás Bay.

There is a 10°C range of temperature, from the lowest areas where a yearly average temp is 29°C down to 20°C at the higher points such as the Cerro San Gil peak.
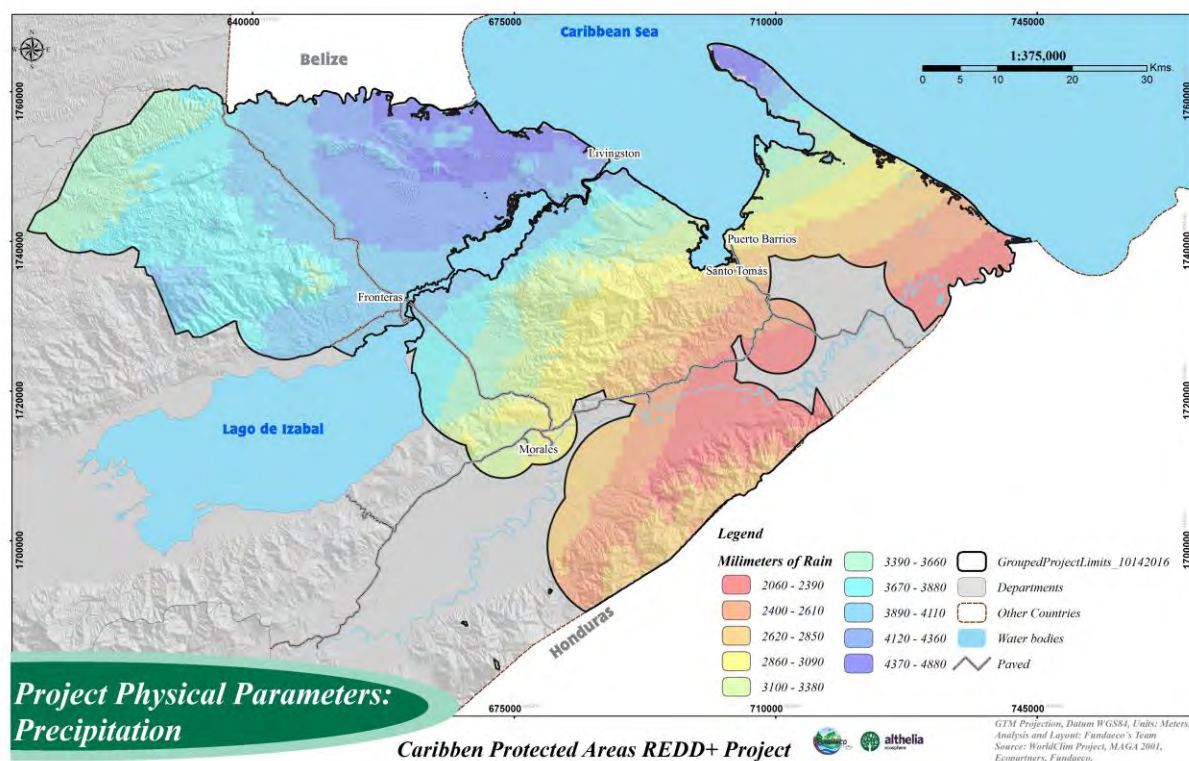
Figure 4. Precipitation in the Project Zone
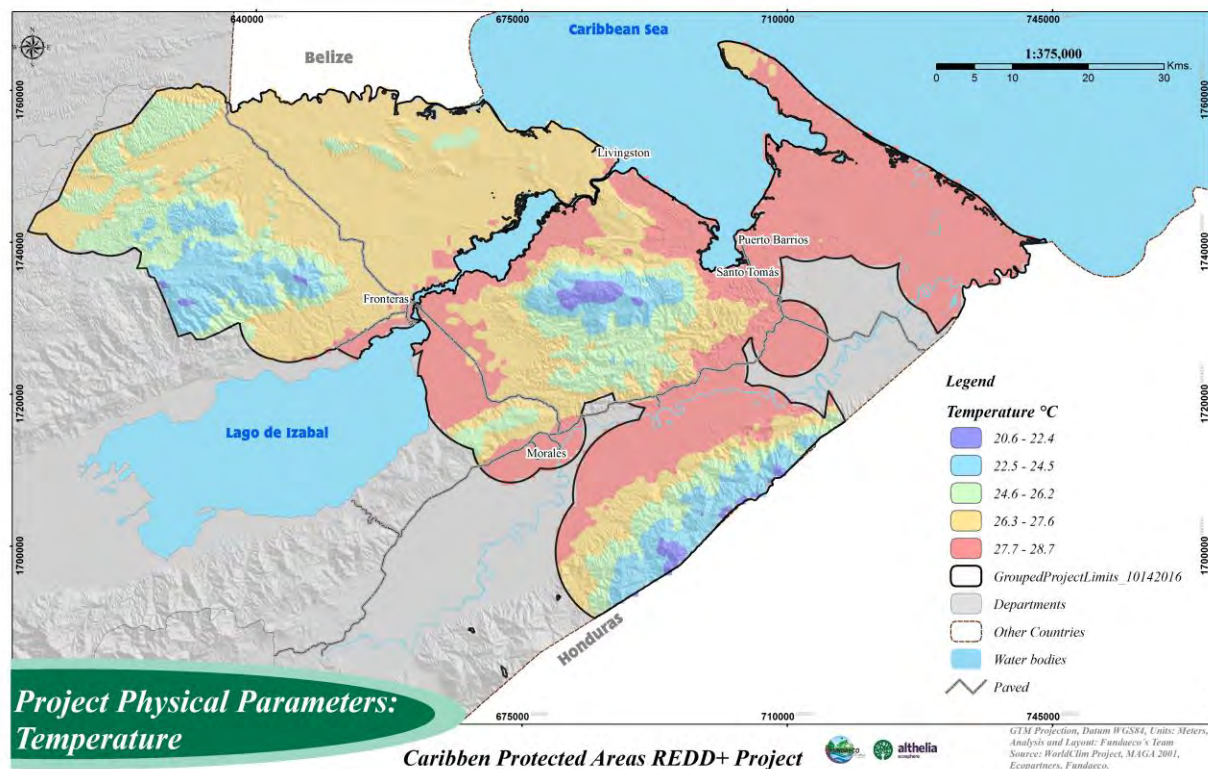
Figure 5. Temperature in the Project Zone

1.2.4 PROJECT ZONE

The REDD+ Project Zone is defined as the service area of the project activities implemented and provided by the project proponent. Following CCB Standard Third Edition, the project zone is defined as the area encompassing the Project Area (see Section 1.2.4) in which project activities that directly affect land and associated resources, including activities such as those related to provision of alternative livelihoods and community development, are implemented. From the array of project activities implemented by FUNDAECO (see Section 2.2) those that have spatial characteristics as well as provision alternative livelihoods, community development, and affect natural resources include:

1. Protected areas (*Areas Protegidas*)
2. Ecotourism sites
3. Health clinics (*Clinicas*)
4. Fisheries (*Refugios*)
5. Nurseries (*Viverios*)

Spatial datasets of these five areas were used to determine the service area of the FUNDAECO project activities and thus the project zone. Results from participatory rural appraisals that indicated how far individuals would travel to use resources such as nurseries, clinics, and fisheries were used to create a 10-km buffer around these. Following the requirements of the CCB Standard 3rd Edition, the Project Zone includes all the individual parcels and potential future parcels in the Project Area according to the programmatic approach. The results of this analysis can be seen in Figure 6 below.

1.2.4.1 Project Zone Map
Figure 6 below shows a map of the Project Zone located within the *Departmento de Izabal*.
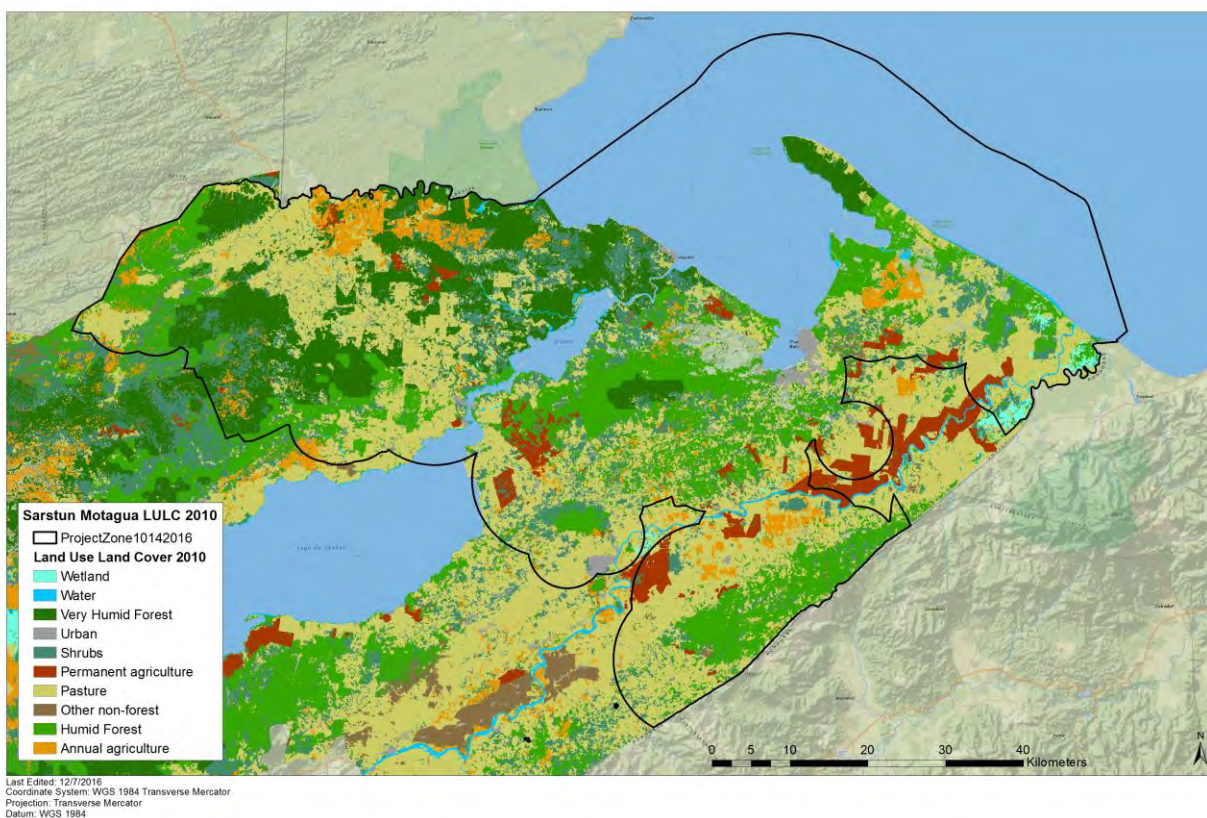
Figure 6: Map of the Project Zone

1.2.5 GROUPED PROJECT AREA

The Grouped Project Area is defined as forest area found at the project start date within the Grouped Project Zone (see Section 1.2.4) that has been forested for at least 10-years. These areas define where forest in additional parcels that meet the eligibility criteria (see Section 1.3.1 and Section 2.1.8) can be added in the future as Project Activity Instances to the Project Area. In order to define the Grouped Project Area, first, the parcels that met the eligibility criteria and were likely to be added to the project at some point in the future were collated into one shapefile. From this larger area, the areas that met the definition of forest for at least 10 years were extracted in order to create the final Grouped Project Area. Figure 7 below shows a map of the Grouped Project Area.

1.2.5.1 Grouped Project Area Map
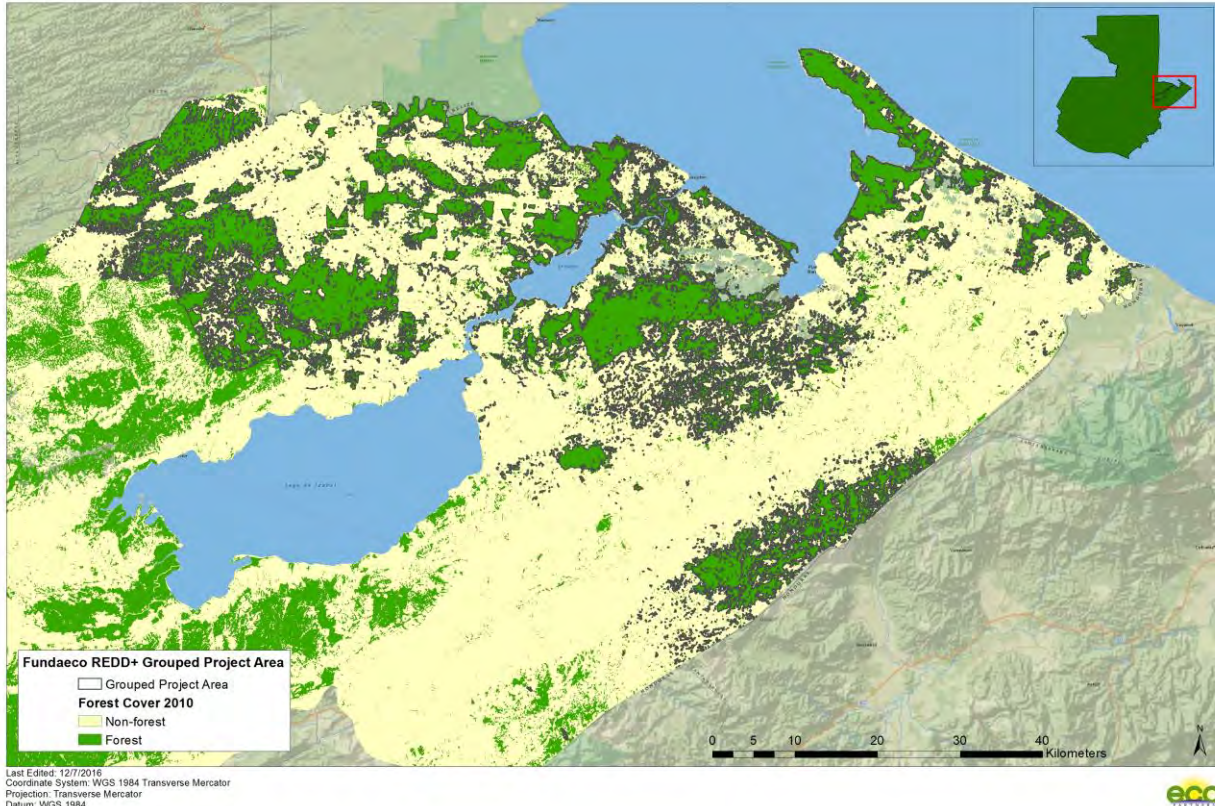
Figure 7. Map of the Grouped Project Area

1.2.5.2 Vector-Based Files

A Keyhole Markup Language (KLM) file is provided separately (see GroupedProjectArea.kmz).

1.2.6 PROJECT AREA

The Project Area is defined as forested parcels within the Grouped Project Area where the project proponent has demonstrated clear project ownership. At the time of validation, the parcels where project ownership has been demonstrated are shown in the map below. A FUNDAECO REDD+ Database has been provided in the Fundaeco VM0015 Accounting Model v1.57.xlsm that describes the name, physical boundary, description of current land-tenure and ownership, and a list of likely project participants for each individual parcel. Figure 8 below provides a map of the Project Area. The size of the Project Area is expected to increase over time as new Project Activity Instances are established.

1.2.6.1 Project Area Map
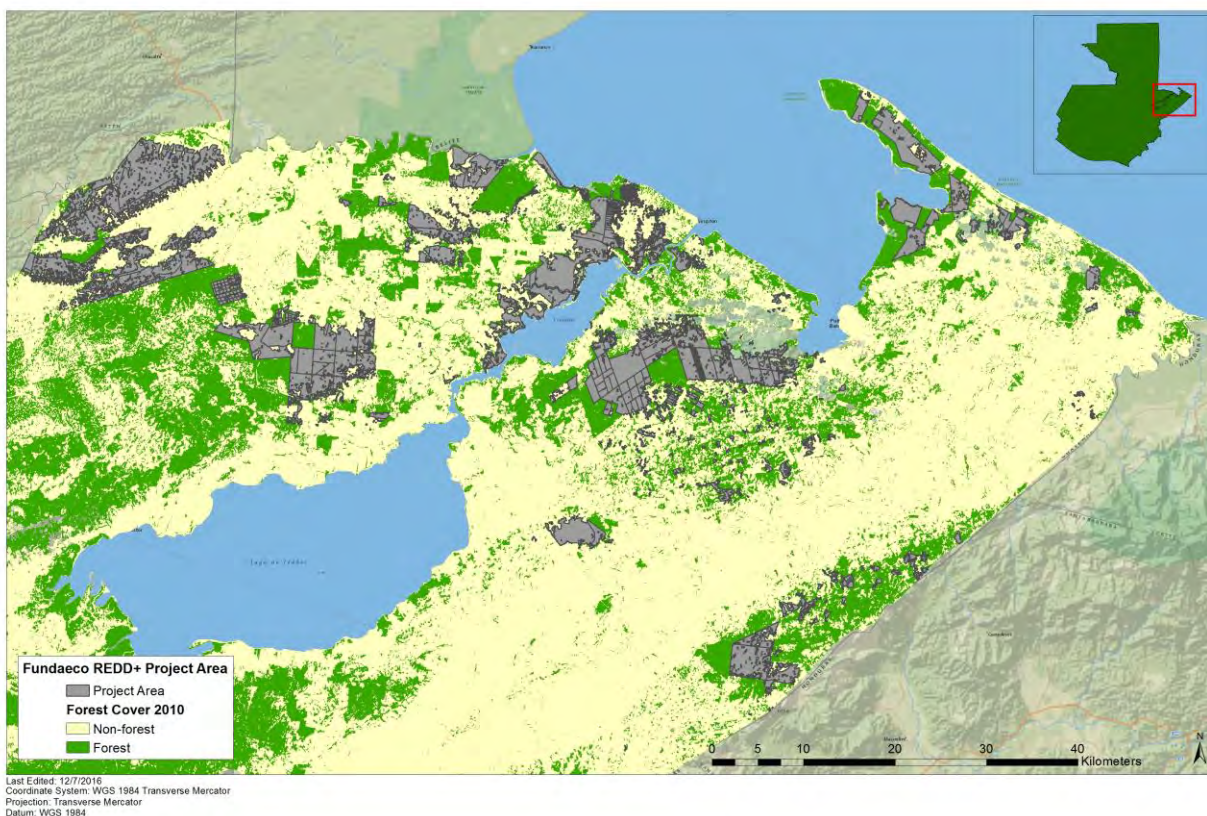
Figure 8. Map of the Project Area

1.2.6.2 Spatial Boundaries

Project Area	Area (ha)	Center point Coordinates (Long, Lat)	
Project Area	54157.68	-88.914903	15.662284

Table 2. Spatial boundaries of the project area as of time of validation (December 2016)

1.2.6.3 Multiple Parcels

As of the time of validation, the Project Area consists of 646 discrete parcels each corresponding to a Project Activity Instance. A complete list of individual Project Activity Instances is located in Fundaeco VM0015 Accounting Model v1.57.xlsm.

1.2.6.4 Project Area and Reference Region

The Reference Area corresponds to an area of 606,477.42 hectares of forest, presenting the same geographical, and deforestation and degradation conditions as the project area, as required by VM0015 and as described in Section 5.3.1.2. In addition, the reference area encompasses the project area. A map of the Reference Area can be found in Section 5.3.1.4.

1.2.6.5 Vector-Based Files

A Keyhole Markup Language (KLM) file is provided separately (see ProjectArea.kmz).

1.3 CONDITIONS PRIOR TO PROJECT INITIATION (G1 & G2)

1.3.1 ELIGIBILITY

The project activities have been designed as part of the REDD+ project with the intention of reducing CO_2 emissions from deforestation compared to baseline levels. As required by VM0015, the land in the project area is forested, meeting the definition of forest as defined by the Government of Guatemala and restated below in Section 4.2 Condition (c). These areas were forests for a minimum of 10 years before the project start date as evidenced by historical LULC analysis (see Section 5.3.2). Additionally, as required by VM0015 peat soils with organic matter content above 65% were removed from the project area.

The project area would be deforested in the absence of the REDD project activity and the deforested and degraded areas must be mosaic in nature. Drivers of deforestation include:

1. Lack of Economic and Employment Opportunities
2. Lack of Laws, Enforcement and Capacity
3. Land Tenure

For the determination of the drivers of deforestation, see Section 5.3.3.2.

1.3.2 VEGETATION AND FOREST TYPE

The project area is located in the biologically diverse tropical rainforests of the Mesoamerican Biological Corridor. Natural vegetation is either very humid tropical or sub-tropical rainforest (Cerezo 2013). Like many areas in this region, forests may be largely intact with instances of agriculture, ranching and logging in various patches. The region receives extensive seasonal rainfalls each year and vegetative growth can be quite large as well as varied. The Project Zone is at lower elevation levels along the Guatemalan Caribbean, thus rain from the mountainous inlands eventually passes through this region of tropical and sub-tropical rainforests in order to reach the ocean.

A two-tier canopy system is prevalent among rainforest ecotypes which aids in allowing a wide distribution of biologically diverse trees, plants and other vegetation. In this general region, CONAP recorded 7,754 different plant species which accounts for nearly 25% of all plant species in the county (CONAP 2007). This value is considered by many to be conservative due to the lack of studies performed in the region in the recent past. Of the total reported, 78 are species endemic to Guatemala (Proyecto FFEM 2010).

Many commercially valuable timber species are considered at risk in this general region. Of the 34 commercially valuable timber species (CONAP 2007) in this region, 33 are considered threatened and reside on CONAP's Red List (CONAP 2001) and 9 are considered threatened by the IUCN (IUCN 2015). Mentionable species include the Cypress Mountain (Podocarpus guatemalensis), Mahogany (Swietenia macrophylla), Sapodilla (Manilkara sapota) and Santa Maria (Callophyllum brasiliense) species.

1.3.3 CARBON STOCKS

Carbon stocks are present in the form of existing forest carbon pools associated with the forest types described in Section 1.3.2. See Section 4.4.1 for more information on included carbon pools and Section 5.3.6.2 for sources and detailed estimates of carbon stocks. The carbon stocks in the project area are

summarized below by carbon pool in Table 3. Carbon stock estimates provided in Table 3 are calculated in Fundaeco VM0015 Accounting Model v1.46.xlsm. Detailed estimates by LULC class are also provided in Section 5.3.6.1.

Carbon Pool	Very Humid Forest Carbon Stocks (tC/ha)	Humid Forests Carbon Stocks (tC/ha)
AGT (tC/ha)	116.2	128.7
AGNT (tC/ha)	N.D.	N.D.
BG (tC/ha)	27.9	30.9
DW (tC/ha)	N.D.	N.D.
Litter (tC/ha)	3.9	7.7
Wood Products (tC/ha)	7.5	3.3

Table 3. Carbon stock estimates (see VM0015 for pool designations)

1.3.4 LAND USE

Land uses in the project area and throughout the project region range considerably. Within intact tropical and sub-tropical rainforests, there can be minimal or no human disruption to the land. Much of eastern Guatemala is traditionally characterized by this type of intact tropical and sub-tropical rainforests. As described in Section 1.3.8.1, the department of Izabal, where the project area resides, is notable for its eight legally protected areas (Cerezo 2013). However, many fully and partially intact rainforests have experienced a steady reduction in forest cover due to small scale agriculture and medium to large scale cattle ranches.

Increased deforestation and forest degradation have coincided with the expansion of industrial agriculture and movement of subsistence farmers deeper into forested areas. Forests have traditionally been a source of income for local families who periodically harvest timber when the need arises or clear forest to plant subsistence crops.

As a result, forest fragmentation and eventual forest loss pervade throughout the project region are notable within the project area itself. These expansions have been historically noted as common trends occurring in the project zone and exemplify the monumental roles in which deforestation and forest degradation have played in changing land use within and around the project area.

1.3.5 PROPERTY RIGHTS

Through reviewing the databases and land registers available in the Geographic Information System of FUNDAECO, a comprehensive analysis of property rights and land tenure of forested areas was made for the Grouped Project Area. For this purpose, the land of each protected area of the region and the surrounding blocks that are considered important for the implementation of the project was analyzed.

According to the type of property and administration (secondment) or ownership of land, several forms of land tenure were defined to exist within the Grouped Project Area. These kinds are described below:

- **Privately owned lands,** are those lands that have been acquired in the market of land (farms) by individuals or private companies; or they have been granted by the State (plots). As explained before two cases are recognized by Guatemalan Law: properly registered in the General Property Registry under the name of its owners. For the most, these inscriptions date from the year of 1880 and onwards. This property regime is legislated by Article 39 of Legislative Agreement No.18-93 of 17 November 1993 of the Political Constitution of the Republic of Guatemala.

- **National Land owned by Poseedores:** In the case of *poseedore*s, land titles are recognized by the State through municipal certificates. A *poseedore* is defined as a land holder who without being land owner exercises some or all of the usual property rights over a piece of land (Article 23 of Decree 41-2005). Poseedores can hold its titles in state lands that have not been defined or registered under the name of the nation, to establish itself as farms (vacant). In these lands people exercise a simple, peaceful and good faith possession. Also found in this type, those lands that are occupied by communities with advanced regularization procedures in the National Land Fund, for legal adjudication by the state. The latter are properly registered in the General Registry of Property under the name of the nation. This typology is regulated by Decree 24-99. Land Fund Act and Regulations.

- **Community Land Ownership:** these lands are adjudicated by the State to the communities or groups properly organized in Family Agricultural Heritages. These lands are properly registered in the General Registry of Property under the name of the members of the community. This type of land is supported by the Decree 24-99, Law of the Land Fund and its Regulations.

- **National Land under administration by CONAP or CECON:** These are the lands owned by the Nation, which have been assigned to the National Council of Protected Areas or to the Center of Studies for the Conservation of Universidad de San Carlos de Guatemala, for strict conservation and protection. These lands are duly registered in the Registry of Property and / or are assigned on secondment agreements signed by the State of Guatemala by Governmental Agreements.

TYPE OF FOREST OWNERS	PERCENTAGE OF TOTAL FOREST	OBSERVATIONS
PRIVATE FOREST and FUNDAECO FOREST	55	Privately owned Forest. Owned by individuals, enterprises, and FUNDAECO
FORESTS OWNED BY COMMUNITY MEMBERS	14	Privately owned Forest, owned by individual living in communities with individual tenure of the land.
FOREST OWNED BY COMMUNITY MEMBER IN CO-OWNERSHIP	2	.Community forest ownership, owned in a collective tenure or co-ownership.

MUNICIPAL FOREST	1	The entire forested area of Chiclera Mountain Regional Park and surrounding farms accounted.
CECON NATIONAL FOREST	4	National Land under the administration of the CECON-USAC.
CONAP NATIONAL FOREST	7	National Land under the administration of CONAP.
OTHER NATIONAL FOREST	17	National land held by individual poseedores.
TOTAL	**100.00**	

Table 4. Analysis of land tenure type by forest area within a sample of cadastral data for the Grouped Project Area.

There is no precise information but estimations indicate that the actual number of possessors of lands can reach more than 1500, although in national lands regularized, in non-registered lands, and in the territorial reserves, there is not a real detail of current landholders, (this data will be defined during the project implementation). Likewise, the area of forest cover and number of possessors of land can be increased to the extent that other owners or possessors of forests are incorporated into the project.

All these types of land tenure rights are included in carbon emission reduction of greenhouse gases, referred to in Legislative Decree 07-2013, in Article 22.

1.3.6 COMMUNITIES

Inside the Project Zone 111 communities are found (See Figure 9. Communities Map), 69 of them are from the Maya-q'eqchi' ethnic group, 40 are mestizo communities and 2 are mixed mestizo-q'eqchi' communities. Q'eqchi' communities are located at the north, and ladino communities at the south. Communities own around 8% of forests inside the grouped project area.

Communities can have different organization levels; the Guatemalan Law for Urban and Rural Development Councils[1] stipulates the development of a Councils System, as the main way for citizen participation in the public planning and public demarche. At the community level, the law indicates the creation of Community Development Councils or COCODES, which are formed by the assembly and its board of directors or coordination board. The COCODES can work through different commissions, designated for specific topics, such as water, land, health and education. The COCODES are then represented in the next participation level, which is the Municipal Development Council or COMUDE.

Communities located in the project zone are very active also in other type of civil organization. Some of them organized as second level associations formed by several communities with similar objectives and concerns, especially regarding agriculture production and the management of natural resources in a certain geographic region. In the project zone, 8 second level associations are found, and more than 30 groups dedicated to specific productive activities and also women groups.

---

[1] Law 14-2002
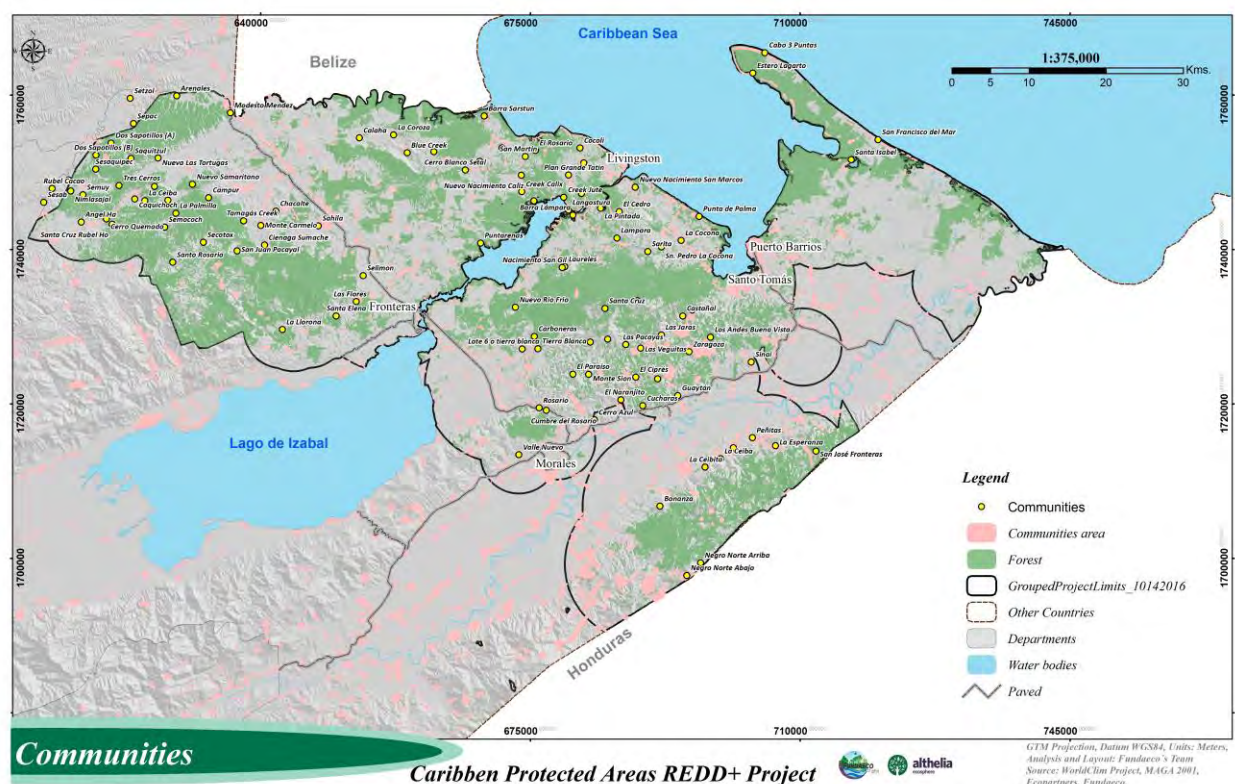
Figure 9. Communities identified inside project zone

1.3.6.1 Gender Situation

The Human Development Report from 2005 was dedicated to explain the cultural diversity in the country, but also the inequity reflected between the different cultural groups living in Guatemala; mestizo and q'eqchi'. A more recent report presented in 2011[2] indicates, the relation between ethnicity and poverty, this situation is confirmed in the municipalities inside the project zone; Livingston which is the municipality with the higher poverty rate -90.1%- is also the municipality with the higher indigenous population, and Morales and Puerto Barrios that have a lower indigenous population, have both poverty rates a half or third lower than Livingston.

Municipality	Poverty Rate (%)	Indigenous population (%)
Puerto Barrios	40.3	6.3
Livingston	90.1	52.4
Morales	62.4	1.9

Table 5. Poverty rates and indigenous populations in municipalities within the Project Zone. Fuente. Elaboración propia a partir de datos del Informe nacional de desarrollo Humano

This situation is also confirmed with the social assessment prepared for the project in 2015. From the total of the q'eqchi' population interviewed, 92.4% have incomes less than 1500 quetzales (192 USD),

---

[2] INE. Mapa de pobreza rural en Guatemala 2011.

5.3% have incomes from 1500 to 2500 quetzales (192-321 USD) and only 2.2% have incomes above 3000 quetzales (385 USD). On the other side within the mestizos, 58.5% have incomes less than 1500 quetzales (192 USD), 23.4% have incomes between 1500 and 2500 quetzales (192-321 USD), and 18.1% have incomes that exceed the 3000 quetzales (385USD).

Also other social indicators such as; housing materials, house conditions and access to basic services, show the inequity; between the mestizos 92% of the homes have access to electricity, while between the q'eqchi's only 73 have access to this service.

The National Statistics Institute estimates that in 2015[3], the population inside the project zone was 148,571 men and 151,648 women (50.51 %)

Municipality	Men	Women
Puerto Barrios	55,430	54,541
Livingston	33,463	34,594
Morales	59,678	62,513

Table 6. Population by municipality found in the Project Zone. Fuente. Elaboración propia a partir de Proyecciones de Población para el 2015 del INE

In most of the country, the population trends by sex are the same, but also the inequity conditions within the female population especially around: access to education;   access to job opportunities; and incomes, even when women participate directly in the family economy they rarely receive any incomes from the work they do.

Another evidence of gender inequity is the limited participation that women have in decision making, women rarely hold positions inside the COCODES commissions, and even less in Board of Directors for any other groups or associations. That is why women have opt to create their own groups in order to take their decisions and administrate directly their resources. Inside the project zone, 23 women groups were identified, most of them created to manage productive projects and ecotourism initiatives:

Name	Purpose	Location
Organization for Community Tourism Q'ana 'Itzam. Lagunita Salvador	Administrators of the restaurant and bungalows in the community of Lagunita Salvador	Protected Area Rio Sarstún
Women's Committee of Cayo Quemado	Management of the Mangrove Restaurant by the committee	Protected Area Rio Sarstún
Committee of Women and COCODE Caserío La Angostura.	Mixtamal project. Administration of La Angostura clinic.	Protected Area Rio Sarstún
Women's Committee of Nuevo Nacimiento San Marcos.	Previously they worked with home gardens, which did not work because of a lack of technical assistance and training.	Protected Area Rio Sarstún

---

[3] Según pproyecciones de población del INE a partir del Censo 2002

Women's Committee of Baltimore.	They are currently being trained by different organizations in order to manage projects.	Protected Area Rio Sarstún
Women's Committee of Barra Sarstún	Economic alternatives with the implementation of small projects: vegetables, mixtamal mill, bakery, the sale of food, and clay-based artisan work.	Protected Area Rio Sarstún
Women's Committee of Cerro Blanco	Handmade crafts with banana root and palm leaves	Protected Area Rio Sarstún
Women's Committee of San Juan	Create alternatives for fishing, and promotion of King fish bass.	Protected Area Rio Sarstún
Association of Women of the communities of Cerro San Gil	To help the improvement of the life of the families both through charity and social service. They give credits to the members, and they make crafts in coconut, reed, corozo and looms.	Cerro San Gil Protected Area and Water Reserve
Artisan Committee of the Women of Laureles San Gil	Currently, they make handicrafts with banana fiber and reeds.	Cerro San Gil Protected Area and Water Reserve
Women's Committee of Frontera Las Pavas	Activities that they carry out: they manage projects for the municipality of Puerto Barrios, government institutions and NGO'S, they clean the educational and health centers, and provide trainings for the members.	Cerro San Gil Protected Area and Water Reserve
Women's Committee of la Bendición (in Zapotillo community)	Activities they develop are the execution of projects through donations.	Cerro San Gil Protected Area and Water Reserve
Women's Committee	Promote the active participation of Women, manage projects and Integral Training for Women, Empowerment, Health Care and know and promote women's rights.	Sierra Caral Water and Forest Reserve
AMATURF (Association of Women of Attention to Tourism the Firmeza).	Providers of tourism services of the Sierra Caral Water and Forest Reserve.	Sierra Caral Water and Forest Reserve
Sierra Caral Coffee Association.	Produce coffee, with an equal distribution in the responsibility of each member and to be able to contribute to the family income.	Sierra Caral Water and Forest Reserve
Women's Committee	Promote the active participation of Women, manage projects and Integral Training for Women, Empowerment, Health Care and know and promote women's rights.	Sierra Caral Water and Forest Reserve
Municipal Commission of WOMEN - Sandra Arrivillaga and Vilma Peralta	Monitor the implementation of projects in favor of women at the municipal level - operational -	Sierra Caral Water and Forest Reserve

Municipal Office of Women - Evelyn Interiano	Monitor the implementation of projects in favor of women at the municipal level - project management team -	Sierra Caral Water and Forest Reserve
Women's Committee of Cuichichil	Manage the horticultural project	Protected Area Sierra Santa Cruz
Women's Committee of Vista del Golfete	Manage broiler breeding projects	Protected Area Sierra Santa Cruz
Women's Committee of Fajas Benque	Project of protection and conservation, manage the production of cardamom, raising of broiler chicken, are not yet in force	Protected Area Sierra Santa Cruz
Women's Committee of Frontera Rio Dulce	Active and empowered women manage the detergent project and others. Manage the production of xate and cardamom	Protected Area Sierra Santa Cruz
Women's Committee of Costa del Lago cocales	Women active, involved and empowered in the women's office.	Protected Area Sierra Santa Cruz

Table 7. Women groups within the Grouped Project Area as identified through workshops with FUNDAECO personnel.

1.3.6.2 Main Settlements

In the Project zone, we can find three municipal seats (county seats) Puerto Barrios, Morales and Livingston, however none of them have significant portions of forest. The population of municipal seats represents 14.54% of the population in the three municipalities.

	Men	Women	Area (ha)
Puerto Barrios	13477	14561	675.13
Morales	5824	5866	1541.87
Livingston	1853	2086	169.99

Table 8. Population and area in the each municipality. Source: Mapa de Centros Poblados con información del 10mo censo poblacional del 1994., 2001. INE

Puerto Barrios
Located 300km far from Guatemala City, Puerto Barrios is the Main City of Izabal Department, and was created in 1920 when a new train stretch to connect Zacapa to Puerto Barrios Port was created. Since then the main economic activities are related with the two ports located in the area: Santo Tomas de Castilla and Puerto Barrios; including direct works in the ports, industrial packing, and lodging and food services for the travelers.

Morales
Morales is located 248km far from Guatemala City. The town was founded in 1890, and its population expansion and economic growth were initially an impact of the UFCO[4] central offices opening. Then after 1904 the town rapidly turned into a pole of attraction for people in Morales and people coming from other sides of the country.

---

[4] La UFCO, United Fruit Company, fue una firma comercial multinacional estadounidense, fundada en 1899 que producía y comercializaba frutas tropicales cultivadas en América Latina. La UFCO se convirtió en una fuerza política y económica determinante en muchos países de la región durante el siglo XX.

Livingston

Livingston is located 65km away from Guatemala city and the main access is by water following the coast line in direction to Belize. The town was founded in 1831, but it was already colonized since 1806 by a group of afro-descendants called "the Garinagus" or "Garifunas", coming from Roatan Honduras. Currently Garinagus and Q'eqchis' inhabit the town, but the Garinagus influence is stronger. Livingston town has two main source of income; tourism, and remittances coming from Garinagus living most of all in New York.

1.3.6.3 Economic Activities

Even that industrial monocrops and cattle ranching dominate the region landscape, and even their strong participation in the region economy, they both change of scale across the territory, this is due to the economic history and the land tenure regime. For example in Puerto Barrios 89% of the *fincas* are in hands of private owners, 22% are Nation property under , and 8.6% is a mosaic of land tenure that includes small individual owner and communities[5]. This means that *campesinos* cultivate their land for sustance agriculture, but this lands do are not enough productive and they have to work for industrial *fincas*. The other economic activities –manufacture and import services- occur nearby the ports in Puerto Barrios .

In Morales municipality activities such as palm oil tree crop, pineapple, rubber and cattle ranching appears as the main land uses, but also four factories are important part of the local economy; the palm oil processing factory, the rubber processing factory, and two cardboard factories.

Livingston is the less industrial of the three municipalities, and the main economic activities are tourism services and small commerce (groceries stores). Tourism services are focus in two attractions Rio Dulce National Park and Livingston town, and more recently ecotourism and community tourism.

It worth to mention that family economy in rural areas is then based in three main activities; subsistence agriculture, cattle ranching, and seasonal work or mid-time work, such as agriculture or surveillance in private *fincas,* road maintenance, and construction, all this activities allows families to have incomes, and be able to take care of their crops –mainly maiz and frijol-.

1.3.6.4 Ethnic Groups

The Project Zone is inhabited mainly by two groups; mestizos and q'eqchi', garifunas are a minority who live only in Livingston town.

Q'eqchi´ is a Maya group originally stablished on the Verapaces Region; they reached their Pre-Hispanic peak before the Spanish invasion during the first quarter of the 16th century[6]. The Verapaces Region[7] is located at an strategic site between the North Lowlands, the Caribbean sea, and the West Highlands, and it is believed that the q'eqchis profited its location to develop commercial exchange with the east and the west during the Classic Period. Because of the commercial activities, the q'eqchi people were

---

[5] Plan de Desarrollo Municipal de Puerto Barrios.

[6] Wilk citado por Grandia

[7] 180km far from the Project zone

always travelers, but it was only after 1542 when the Dominicans started to have a control in their territory, that they started to migrate. During the second half of the XVI century, and all along the XVII, XVIII and XIX centuries, the q'eqchis' were running away in small groups, to Peten Lowlands and to a lesser extent to El Estor. At the end of the XIX century, a series of Liberal Policies, resulted in the grab of their lands by foreign coffee producers, making them to immigrate to other lands. In this case, they migrated to Peten, but they also started to move further away in Izabal, to the Atlantic coast, since they took the route coming from El Estor, they would remain until today in the north part of Izabal department.

Mestizos or Ladino:

This group includes the descendants from the miscegenation mainly between Spanish and Indigenous. The first mestizos were born or came to Izabal in the decade of 1830, when the president Mariano Galvez gave big agrarian concessions to foreign companies. It was with the establishment of this companies that a new colonizing dynamic started in the area. Because of the origins of the agrarian companies some mestizos might have also British, German, French or Belgian ancestors, however they predominantly were Spanish. The migration to Izabal continues today, with mestizos coming from other Guatemala Departments like Jalapa, Zacapa, Chiquimula and El Progreso, and even from El Salvador. Presently mestizos are all around Izabal department, but are more dominant in the central and south.

1.3.6.5 Migration

Even when there are no specific studies on migration for this region, Grandia and Robb[8] give information that allows to some conclusions: the people of the region migrate looking for better opportunities or better lands, also when the father does not has enough land and there is a new marriage in the family, the new couple will leave looking for new lands. This last situation is similar to both mestizos and q'eqchis', in both cases more than 60% of the persons interviewed, had migrated before because his father had no more land, or there were no more land in the community.

The question is where these people go. In the case of the q'eqchis'-who have very strong relationship links-, they would migrate to another community where they can find a relative or a godfather. When arriving to the new community they would be interrogated, and if there is enough land, and the community considers that the person or the family is nice, they would let them stay and work in the communal croplands. This practice happens in the project zone and in other areas inhabit by q'eqchis' in Peten and Belize. Eventually the person will have to pay some money to the community, but the amount is not related to the land price in the market, but to quotes stablished by the community according to actual needs.

Up to date migration from outside to the Project Zone, mainly occurs from El Estor zone, small groups enter through this route looking for "empty lands". If when arriving there are no claims over certain land, the group will grow until becoming a community. However, it is important to clear that this situation can change for example, in case of an absentee landowner or when an agrarian group is behind the occupation of the land.

---

[8] Estudio desarrollado en alianza con el proyecto CNCG, bajo liderazgo de la UVG y la Jane Robb.

1.3.6.6 Social Diversity

The demographic structure in the Project Zone shows that 50% of the population is in age class of 0 to 17, 44% is in the age of 18 to 59, and 6% has over 60 years.

The average family is composed by 5 individuals, however in more isolated areas families can have 9 members. The home is usually inhabited by the head of the household, the partner, the sons and daughters, and in 6% of the homes the grandchildren. 17.5% of the homes are single-parent homes[9].

At Izabal department 58.4% is economically active population, and from them 96.9 have a work, but less than 50% is in a full-time work. The formal workforce is dominated by men, however the Social assessment shows that women have an important role as home managers and support other family activities such as agriculture and fishing in case of coastal communities.

The Region presents one of the higher non-attendance for elementary and high school, with the lack of money as main cause. This is because even when children are going to public schools, parents have to pay for transport and school materials, and in other cases lack of money means that there is a need of children to support income generation for the family. The region has one of the lowest rates of enrollment to university, 87% of the population with ages between 19 and 24 are not enrolled at the university, and of course most of this population live in rural areas and indigenous communities.

1.3.6.7 Economic Diversity

Community economy is based in subsistence agriculture -79% of the homes-[10], in combination with part time or season works as guards or doing agriculture tasks in "Fincas". Men in communities nearby the oil pipe, also get season jobs to keep clean the pipe path, and for road maintenance. Subsistence agriculture is mainly dedicated to maize and black beans, in the case of communities in the border with Honduras Caral red beans are also part of subsistence crops.

It is usual to find in the family backyard orchards, different kind of peppers, spices being of particular interest is the "santa maria" leaf and the "zamat" used by q'eqchi' in their soups and hierbamora (Solanum americanum) which is high protein leaf. Orchards also includes different types of fruits such as citrics, bananas, plantains, caimito (*Crysophyllum cainito*) and more recently Bread fruit *Artocarpus altilis*, as well as different tuberous roots such as yucca or manioc and yampi.

Families also breed chickens or pigs, as a source of protein, when cash is needed they sale this animals in to other family at the local market. In the last years, FUNDAECO has been supporting economy diversification by: fostering community nurseries, which then sell plants to FUNDAECO agroforestry program; supporting small producers in crop diversification; partnering community groups or individuals as entrepreneurs for ecotourism services; and supporting women in handicraft production.
In some parts of the project region, landscape is dominated by cattle ranches. However, cattle ranching is a more prominent economic basis for families who are mestizo. Because it takes more up-front capital to invest in livestock and grazing land, much of the Q'eqchi' communities live in poverty or extreme poverty, and they are less likely to have the resources to transition from subsistence agriculture to cattle

---

[9] ENCOVI 2014, Tomo I

[10] Social Assesment

ranching. According to the Izabel Development Plan, 2816 bovine cattle ranches can be found across Izabel. In some cases, poor q'eqchis and ladino communities work in this fincas to complement their household incomes.

1.3.6.8 Cultural Diversity

Even their displacement and the Christian influence, the q'eqchi people still maintain their cosmovision, several of their cultural practices, and their language called also Q'eqchi'. But as in the rest of the indigenous groups of Guatemala, many of their religious practice are mixed with Christian practices.

Between the q'eqchis anyone who is charismatic and works hard for the community, can become a leader or an Elder (at the age of 60), but when communities are recent, the Elder can be in its late 40s or 50s. Any group formed by four Elder men and four Elder women can carry out religious ritual, or rituals dedicated to crops, as well as be part of the Elders Council, where important community decisions are made. It is important to mention that within the project zone, due that communities are relatively young, and due to new influences, the Elders Council tradition, is almost lost, but not other practices such as *Mayejak* and the *aj ilonel*. The *Mayejak* is one of the most known rituals, and it is a ceremony to show respect and ask permission to the *Tzuultaq'a* or mountain and valley deities.

The q'eqchi people have good knowledge about the forest and the use of wild plants; however, they rarely share this knowledge. When a man feels "the call", he can start studyng to become a healer or *aj ilonel*.

1.3.7 BIODIVERSITY

The Caribbean region of Guatemala is classified as Central American Atlantic Moist Forest, according to the Ecoregion classification (Olson 2001). It is characterized by a relatively large altitudinal gradient, ranging from 0 to 1300 masl. Because of this gradient, its neighboring position to the Caribbean Sea which provides very humid conditions in the area, and the isolation of several mountain peaks, distinct biotic communities are found. Vegetation ranges from mangrove forest, semi-flooded forest (i.e., swamp forest), lowland *terra firme* tropical forest, mid-elevation tropical forest, and pre-montane tropical forests.

Relatively intense field surveys for several vertebrate taxa have been conducted at the regional level (birds, bats, and amphibians). Nonetheless, several taxa have been understudied, especially plants and insects, but expert opinions affirm that the area contains high levels of species richness and endemism for both taxa, and there is some evidence of endemism for some well-studied insect and plant groups.

Characterizations of bird, bat, and amphibian communities have identified relatively distinct biotic communities according the type and elevation of the different forest communities. In particular, variation in amphibian and bat communities are also related to a latitudinal gradient (Cerezo et al. 2010).

Communities at higher elevations contain a relatively high proportion of species associated to montane subtropical ("cloud") forests to the west of the region. Thus, the distribution of plant and animal communities seem to be the product of the elevational variation, but also to biogeographic factors, related to relict cloud forest communities at higher elevations, which persist due to the isolation of very

humid mountain peaks ("Massenerhebung" effect, (Holder 2004)). These cloud forest species would have dispersed into the region presumably during historic events during the Pleistocene, related to episodes of glaciation and deglaciation (McVean and Schuster 1981).

Based on these results, in particular, the singularity of biotic communities, extant forest cover and level of fragmentation of forests associated to the different biotic communities, pre-montane forests above 800 masl and lowland *terra firme* forests (below 100 masl) have been identified as top conservation priorities at the regional level (Cerezo et al. 2010).

1.3.7.1 Species within the Project Zone

The Project Zone is considered one of the country´s biodiversity hotspots. With regard to its avian diversity, 426 species are reported, which corresponds to 58% of the bird species reported for the country, in only 18% of its land area (Cerezo et al. 2015, Eisenmann & Avendaño 2005). With respect to terrestrial year-round residents, 367 species are reported. The region is also critical for Neactic-Neotropical terrestrial migratory birds. One hundred and twenty (120) migratory species are reported, and use native forests as their main wintering or transiting habitat. Ninety-five (95) species are regular winter residents and of these, 46 depend on tropical rainforest as the main wintering habitat (Cerezo et al. 2015). Also, aquatic and coastal-marine habitats are important stop-over sites in autumn migration (August-October) for 24 species of shorebirds.

With respect to mammals, 145 species are recorded from the region (Rodriguez 2001, Sosa 2005) of which 52 are under some category of risk at the national or international level (CONAP 2001, IUCN 2015, CITES appendices), and 6 are Mesoamerican endemics. Among the large and threatened mammals of the region are the Jaguar (*Panthera onca*), Baird's Tapir, *Tapirus bairdii*), West Indian Manatee (*Trichechus manatus*), White-tailed deer (*Odoicoleus virginianus*), Red Brocket Deer (*Mazama americana*), and two species of peccaries, White-lipped and Collared Peccary (*Pecari tajacu* and *Tayassu pecari,* respectively*)*. With the exception of the tapir, for which relatively recent records exist only for Cerro San Gil (in 2001), all the other species are reported relatively frequently (several records per year) in various localities in the region, particularly were there are large, extant continuous forest in legally protected areas (Cerro San Gil, Río Sarstún, Punta de Manabique, Sierra Santa Cruz, Sierra Caral, Chocón Machacas Biotope). The White-lipped Peccary is the species with the largest number of reports. The manatee is reported annually in Chocón Machacas Biotope (also known as the Manatee Biotope), and less frequently in Río Sarstún, Río Dulce National Park, Lake Izabal, as well as the coastal portion between the Santo Tomás Bay and the border with Belize (the Sarstún River itself). Other charismatic mammal species found in the region are the rest of the felines, the Ocelot (*Leopardus pardalis)*, Margay (*Leopardus weidii)* and Yaguarundi (*Herpailurus yaguarondi),* three species of primates, Black and White-mantled Howler Monkey (*Allouata pigra* and *A. palliata,* respectively*)* and the Geoffroy´s Spider monkey (*Atteles geoffroyi*). Also, the Neotropical River Otter (*Lutra longicauda*), Kinkajou (*Potos flavus*) and the White-nosed Coati (*Nasua narica*) are also reported, the river otter having relatively few records in recent years. Several of these are also under some degree of risk at the global level (Table 1).

A total of fifty five (55) amphibian species occur in the region, representing 33.7% of the total diversity of this group for the country. The region is an important center of diversity for the frog family Hylidae (treefrogs). Seventeen (17) species have been reported from this family in the region.   Another important family is Brachycephalidae (leaflitters frogs) with thirteen (13) species.

One hundred six (106) reptilian species occur in the region, representing 43.4% of the total diversity of this group of reptilian richness reported for the country. Many of these species have a widespread distribution and are common in warm and tropical regions. The most abundant group of reptiles in the region are the snakes, with fifty four species (54), representing 51% of reptile species in the region. The second most abundant group are the lizards with thirty six species (36) representing 34% of reptile species in the region.

Although there is little information concerning insect diversity in the region, it is recognized by experts that it is one of the richest of the country, which many new species yet to be discovered. As is the case of insects, plant diversity in the region is much less known. According to historical records in the Flora of Guatemala, 1825 species are reported, which corresponds to roughly 25% of plant species recognized for the country (7,754 species reported by CONAP). Nonetheless, experts agree that this number is extremely conservative due to the absence of more systematic and extensive surveys in recent years.

1.3.7.2 Threats to Biodiversity

The majority of threats to biodiversity in the Project Zone are directly tied to the drivers of deforestation and forest degradation described in Section 5.3.1.1), in addition to the prevalence of unsustainable fishing practices along the Caribbean coast. The primary drivers of forest loss are the conversion of forest to cattle grazing and cropland for subsistence agriculture, while overfishing is driven primarily by a lack of employment and economic opportunities in the region. Deforestation rates within the region have been found to be at 3.41% from the year 2001 to 2010.

These factors have had numerous negative effects on biodiversity by causing a drop in marine species abundance, increasing habitat fragmentation, changing the forest's structural composition, and the overall loss of forest cover within the project region. All of this leads to changes in species composition and ecosystem function, which greatly impact an ecosystem's ability to maintain and support original levels of biodiversity. In order to reduce the threats to the broadest range of biodiversity within the project area, the project will focus on preventing deforestation and forest degradation as well as implementing fishing restoration zones. Due to the fact that biodiversity loss is clearly tied to habitat fragmentation and destruction, the most effective benefits for biodiversity will come as a result of forest conservation.

1.3.8 HIGH CONSERVATION VALUES

According to criteria associated to High Conservation Values, and the information described above and in the following subsections, and considering the precautionary principle, the region contains High Conservation Values following criteria 1 and 2. In general, the region is considered species-rich, a center of endemism (for amphibians in particular), harbors an important number of threatened species according to IUCN, other international and national standards, and contains a large number of protected areas.

1.3.8.1 Protected Areas

There are eight (8) protected areas within the project area which have some form of legal declaration at the national level:

- Cerro San Gil: declared in 1996 as a Watershed Protection Reserve, with and extension of 47,433 ha. Its native forests consist mainly of lowland humid tropical forest to humid pre-montane tropical forest, with a smaller proportion of mangrove and coastal habitats. Its elevational gradient varies from 0 to 1300 masl.

- Sierra Caral: Declared in 2014 as a Hydrological and Forest Reserve, with an extension of 19,013 ha. Its native habitats are humid tropical forest and humid pre-montane tropical forest. Its elevational gradient varies from 150 to 1300 masl.

- Sierra Santa Cruz: declared in 1990 as a Special Protection Area, with an extension of 59,748 ha. Its natural habitats vary from lowland humid tropical forest to humid pre-montane tropical forest. Its elevational gradient varies from 0 to 1000 masl.

- Chocón Machacas Biotope: declared in 1990, with an extension of 6,265 ha. Its native habitats consist of semi-flooded tropical forest, humid tropical forest and wetlands. The biotope was mainly created for the protection of the West Indian Manatee.

- Montaña Chiclera: Recognized by the National Council of Protected Areas (CONAP) in 2003 as a Municipal Reserve, with an extension of 1490 ha. Its native habitat is humid tropical forest, with elevations ranging from 150 to 450 masl.

- Río Sarstún: Declared in 2005 as Multiple Use Area, with an extension of 35,202 ha. Its natural habitats consist of lowland humid tropical forest and mangrove and coastal habitats.

- Punta de Manabique: Declared in 2005 as a Wildlife Refuge Reserve, with an extension of 151,878 ha. Its native habitats consist of semi-flooded tropical forest, humid tropical forest, mangrove forest and marine coastal areas.

- Río Dulce National Park: declared in 1955, with an extension of 13,000 ha. Its natural habitats are lowland humid tropical forest and freshwater coastal areas.

Because all of these protected areas contain significant proportions of natural habitats, it can be safely assumed that they contain a significant proportion of the region´s biodiversity, thus constituting High Conservation Values (see Section 2.4). The region has also been identified as an Important Bird Area, thus adding to its potentiality as a High Conservation Value.
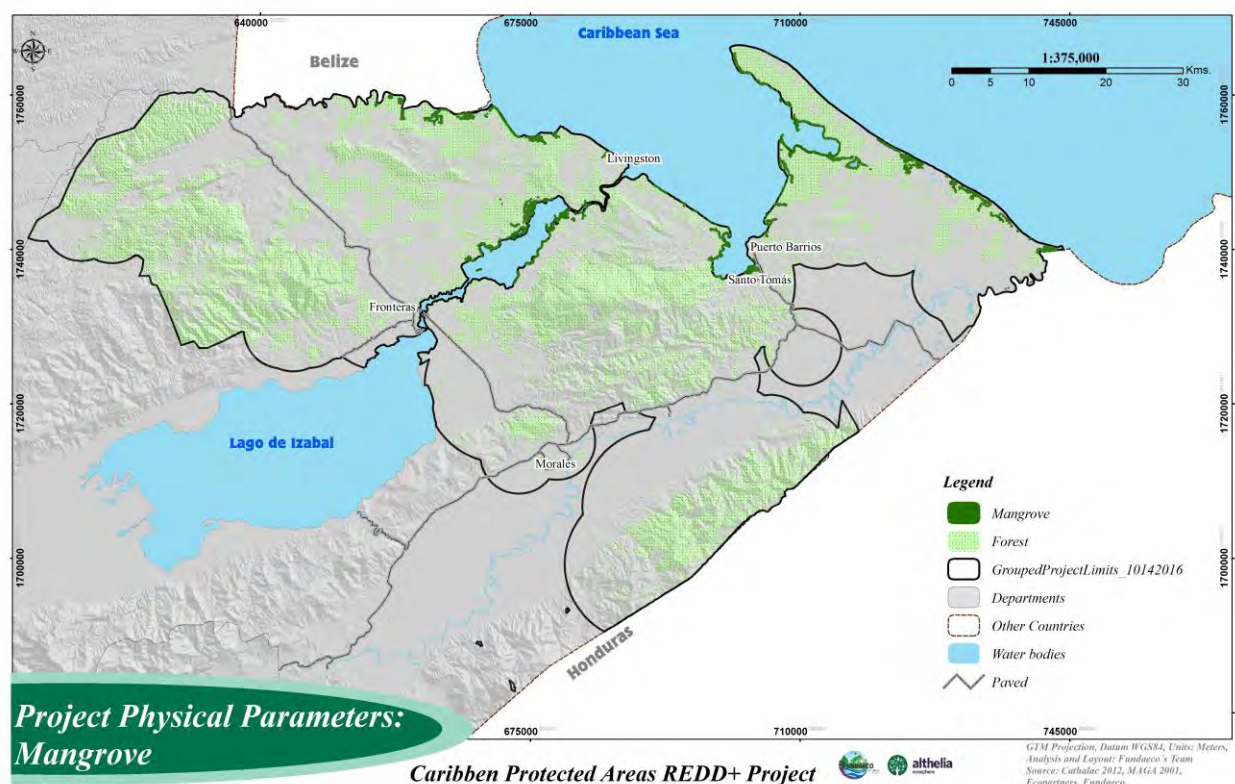
Figure 10: Map of Mangrove Areas

1.3.8.2 Threatened Species

According to IUCN, two resident bird species are considered "Vulnerable", Highland Guan (*Penelopina nigra*) and Keel-billed Motmot (*Electron carinatum*); one is "Endangered", Yellow-headed Parrot (*Amazona oratrix*). In addition, analyses of data from the North American Breeding Bird Survey (N.A.B.B.S.) indicate that populations of many of Nearctic-Neotropical migratory species have declined over the past three decades (Sauer et al. 2014).   Among the migratory land birds that winter in the region in large numbers are the Woodthrush (*Hylocichla mustelina*), Prothonotary Warbler (*Prothonotaria citrea*), Kentucky Warbler (*Geothlypis formosa*), and Worm-eating Warbler (*Helmitheros vermivorum*), all presenting declines in their populations that have warranted their listing in the National Fish and Wildlife Services´ "Birds of Conservation Concern 2008" (henceforth, BCC2008; USFWS, 2008) and American Bird Conservancy´s "List of Birds of the United States with Conservation Rankings" (American Bird Conservancy 2012). These species are particularly abundant at elevations below 500 m.a.s.l. The Cerulean Warbler (*Setophaga caerulea*) is considered "Vulnerable" (Cerulean Warbler) in IUCN´s Threatened Species Red List (IUCN 2016). The Golden-cheeked Warbler (*Setophaga chrysoparia*), also of "High Continental Concern" (USFWS 2008) and considered "At Risk" (ABC 2012), and listed as "Threatened" in IUCN´s Red List (IUCN 2016), is reported for Cerro San Gil (Howell and Webb 1995) and Sierra Santa Cruz (S. Pérez, pers. comm.). Thirty-three (33) additional species wintering or transiting through Cerro San Gil have also recently reported declines (Sauer et al. 2014), of which 14 are listed as BCC2008 (USFWS 2008). Fourteen (14) species not declining but listed in BCC2008 are also reported for the region.

Also, aquatic and coastal-marine habitats are important stop-over sites in autumn migration (August-October) for 24 species of shorebirds. Seven (7) species reported in this reserve are listed as " Birds of Conservation Concern 2008"(USFWS 2008): Wilson´s Plover (*Charadrius wilsonia*); American Oystercatcher (*Haematopus palliatus*); Solitary Sandiper (*Tringa solitaria*); Lesser Yellowlegs (*Tringa flavipes*); Whimbrel (*Numenius phaeopus*); Red Knot (*Calidris canutus*); and Short-billed Dowitcher (*Limnodromus griseus*). Four (4) additional species area listed in American Bird Conservancy´s Yellow List ("declining or rare continental species", American Bird Conservancy 2012): Sanderling (*Calidris alba*); Western Sandpiper (*Calidris mauri*); Stilt Sandpiper (*Calidris bairdii*); White-rumped Sandpiper (*Calidris fuscicollis*). Finally, the Buff-breasted Sandpiper (*Tryngites subruficollis*), listed as "Near-threatened" by IUCN and Birdlife International, is also reported.

With respect to mammals, and according to IUCN standards, three species are considered "Endangered": Yucatan Black Howler Monkey (*Alouatta pigra*), Geoffroy's Spider Monkey (*Atteles geofroyi*) and Baird´s Tapir (*Tapirus bairdii*); and two species are considered "Vulnerable": Thomas's Sac-winged Bat (*Balantiopterix io*) and White-lipped Peccary (*Tayassu pecari*).

Amphibians are by far the most threatened taxonomic group in the region, with 12 endangered species according to IUCN standards. Three frog species (*Craugastor aphanus*, *Craugastor psephosypharus* and *Eleutherodactylus leprus*) and one salamander species (*Bolitoglossa mulleri*) are considered "Vulnerable"; five frog species are considered "Endangered" (*Craugastor charadra*, *Craugastor sabrinus*, *Craugastor sandersoni*, *Duellmanohyla soralia* and *Ptychohyla panchoi*); and three frog species are considered "Critically Endangered" (*Agalychnis moreletii*, *Craugastor trachydermus* and *Ptychohyla sanctaecrucis*.

With respect to reptiles, two species are considered "Vulnerable": American Crocodile (*Crocodylus acutus*) and Mexican Caecilian (*Dermophis mexicanus*) and one is considered "Critically Endangered", the Central American River Turtle (*Dermatemys mawii*).

Considering plants, and according to IUCN standards, four species are considered "Vulnerable": *Chamaedorea adscendens*, *Chamaedorea oblongata*, *Dalbergia glomerata*, and *Hylocereus minutiflorus*; and two are "Endangered": *Ceratozamia robusta* and *Zamia variegata.*

Additionally, many commercially valuable tree species are considered at risk. Of 34 species considered of commercial importance reported for the region, 33 are considered threatened according to the National Council of Protected Areas´ red list (CONAP 2001, 2007). Of these, the most important species are: *Podocarpus guatemalensis*, *Swietenia macrophylla*, *Manilkara zapota* and *Callophyllum brasiliense*.

1.3.8.3 Endemic Species

With respect to birds, 38 are considered regional endemics (either Mesoamerican, or endemic to the Gulf-Caribbean Slope; Stotz et al. 1996, Howell & Webb 1995).

Regarding amphibians, and particularly the family Hylidae (tree frogs), four of seventeen (17) species are endemics (Cerezo & Vázquez 2015). *Ptychohyla sanctaecrucis* is endemic to Sierra Santa Cruz, and *Ptychohyla panchoi* is endemic to Cerro San Gil and is shared with Sierra de las Minas.   *Duellmanohyla soralia* is also endemic to Sierra Caral and shared with Sierra Merendón in Honduras. Also, *Isthmohyla*

melacaena, has been recently reported in Sierra Caral and is shared only with Sierra del Merendón along the Honduras border. Another important family is Brachycephalidae (leaflitter frogs) with 13 species in the region, of which eight are endemics.   Two species are endemic of Cerro San Gil (*Craugastor aphanus* shared with Sierra de las Minas, and *Craugastor campbelli)*, *Craugastor nefrens* is endemic of Sierra Caral, *Craugastor trachydermus* of Sierra Santa Cruz, and the rest are endemics of the Caribbean region, eastern Alta Verapaz and the Maya Mountains in Belize; some are shared along the Honduran border. Also, five of 11 species of the salamander family (Plethodontidae) are considered endemics. *Nototriton stuarti* and *Bolitoglossa sp. nova* are endemic to Cerro San Gil; *Nototriton brodiei*, *Cryptotriton nasalis* and *Bolitoglossa dunni* are endemic to Sierra Caral and shared with the Sierra Merendón on the Honduran border. *Bolitoglossa oddonelli* is endemic to Guatemala, occurring in Sierra Santa Cruz and Cerro San Gil, as well as Sierra de las Minas.

 With respect to reptiles, two species of snakes are considered regional endemics. *Bothriechis thalassinus* is endemic to Sierra Caral and shared with Sierra Merendón in Honduras. The other endemic snake is *Micrurus hippocrepis* which occurs in Cerro San Gil and is shared with some areas in Belize. Only one turtle species, *Dermatemys mawii,* is endemic to northern Guatemala, including Izabal, Yucatan Peninsula and Belize.

In the case of plants, the Flora of Guatemala recognizes 78 endemic species for the region.

1.3.8.4 Areas that Support Significant Concentrations of a Species During Any time in Their Lifecycles

As mentioned above, the area is critical for a large number of Nearctic-Neotropical Migratory species during the boreal winter. It is also an important migratory route for Neartic Shorebirds. Ninety-five (95) species are regular winter residents and of these, 46 depend on tropical rainforest as the main wintering habitat.

Also, aquatic and coastal-marine habitats are important stop-over sites in autumn migration (August-October) for 24 species of shorebirds.

1.3.8.5 Landscape Level Biodiversity

The Project Zone´s extent is well above the recommended threshold of 50,000 ha for the region to be considered a High Conservation Value, under criterium 2. Thus, the region probably maintains an area sufficient to maintain viable populations for most large species. For example, a recent study suggests that the region contains a population of Jaguar (*Panthera onca*) and several of its prey species, with recent records in several protected areas. This study also considers the region of critical importance for the connectivity of jaguar populations between northern Guatemala and Belize, and northern Honduras (Calderón 2015). In keeping with the precautionary principle, viable populations at the landscape level are an HCV until new information in the future indicates otherwise.

1.3.8.6 Threated or Rare Ecosystems

The most threatened ecosystems in the region are undoubtedly those at lower elevational levels. Lowland *terra firme* forests have recently suffered high deforestation rates, due to the advance of the agricultural frontier, associated mainly with cattle ranching activities (Castellanos et al. 2011, Regalado et al. 2012). Much of this forest is also degraded from timber and firewood extraction.

Mangrove forests and associated coastal areas are rare ecosystems in the region, constituting less than 5% of total forest cover, and are also highly threatened, mainly from beach housing developments, firewood extraction and low-scale coal production.

1.3.8.7 Areas that Provide Critical Ecosystem Services

Watershed and environmental services in the Caribbean Region of Guatemala: The Caribbean region of Guatemala occupies three large basins: 1) Motagua River Basin, 2) Basin of Lake Izabal-Río Dulce and 3) Sarstún River Basin. The main rivers are Rio Dulce (43 km), Rio Sarstún (55 Km) and Motagua (486 Km). They cross the protected areas and constitute the most important water bodies in the region. These tributaries provide navigation services, fishing, and tourism; drain directly into the Amatique Bay, and the slope of the Caribbean Sea.

Protected areas of the Caribbean Region comprises 21 sub basins that drain directly into the Golfete-Rio Dulce, the Bay of Santo Tomas, Amatique Bay, the Sarstún River, and in the maritime area of RVS Punta de Manabique Gulf of Honduras . These basins provide water to approximately 172 communities and villages that live in protected areas and adjacent areas. The forests of these basins are an important barrier that reduces the sedimentation and siltation of navigation canals of port complex in Amatique Bay, which includes the inner Bay of Santo Tomas de Castilla.

The RPM Cerro San Gil (RPMCSG): Extension: 47,434.65 hectares

This protected area includes the highest part of the mountains of Mico in Izabal. It preserves an important remnant of tropical rain forest. It has 9 sub basins, 43 micro basins and 19 tributaries of the first order, with a total of 187.94 km. of linear streams. The Reserve offers several environmental services including carbon capture and storage, biodiversity protection, regulation of the hydrological cycle and decreased erosion and sedimentation accordingly. The last two take particularly importance because there is a number of rivers that originate in the upper of the Cerro San Gil, and flow into Amatique Bay, where the port of Santo Tomas de Castilla is located. The main basins of the Reserve are:

1) **Las Escobas:** Located in the Recreation Zone and Protection Zona of the protected area, it covers an area of 1050.38 hectares, with 707 hectares of forest in good condition, which constitutes the recharge area of the micro basin, located at 960 m.a.s.l. The basin has a drainage area of 9.2 km^2 and is part of a hydrological complex consisting of other basins as Quebrada Seca River, San Carlos, La Esperanza and Rio Escondido River Cacao. The main tributary is 4.73 km. The watershed drains into the Bay of Santo Tomas. In the basin, there is dam that distributes water to the population of Puerto Barrios and Santo Tomas de Castilla, benefiting 5319 families. This dam is located in the middle part of the basin and limits the core area with the recreational area of the protected area. Water services generates a profit of USD 5,000 per year for forest protection. The water service is administered by the Municipality of Puerto Barrios. The basin has the capacity to supply water to at least 50,000 users of the municipalities of Livingston, Morales, Puerto Barrios and Santo Tomas de Castilla, and the 40 communities of the protected area. The 75% of the water is for domestic use, in an estimate of 120 liters/person/day.

2) **Tamejá:** It is located at the north side of the reserve. It covers an area of 9,386.91 hectares, of which 8,990.25 are within the perimeter of the protected area, the rest is in the PN Rio Dulce.

Water recharge area is located in the core area of Cerro San Gil at 1,267 meters. The mainstream measures 28.20 km, is navigable for shallow draft boats. The river drains into the widening of the Río Dulce, called the Golfete in the Rio Dulce National Park. This basin supplies water to seven communities for domestic use, and to five communities for agricultural use, for 5000 families that use about 54 gallons of water / family / day. The forests of the basin protects from sedimentation and siltation to the Río Dulce canyon.

3) **San Marcos:** Located in the Multiple Use Zone and Buffer Reserve, covering the biological corridor CSG. It covers an area of 12,839 hectares, with a forest cover of 3806.07 hectares. Water recharge area is at 700-800 meters in the Core Zone of CSG. The main stream measures 12.67 Km, and drains directly on Lake Izabal. This watershed provides water to 3 communities at the Reserve, and to about 1500 families. Water is for domestic use and for small-scale agriculture.

4) **Juan Vicente:** It covers an area of 4715.18 hectares. The basin flows into Lake Izabal-Rio Dulce. The water recharge area is at 900 meters in the Core Zone, with a forest cover of 7,900 hectares. The main stream has 17.60 km length. The basin provides water for 2500 families for domestic and agricultural use of subsistence.

The AP Sierra Santa Cruz (SSC): Extent: 59,748 hectares.

SSC is an important water recharge area. It has 17 tributaries that provide the water service to more than 10,000 people, including the tourist site of Frontera Rio Dulce. Most communities at SSC are supplied with water births wooded areas; very few communities have piped water service for its supply. The most important basins of the protected area are:

1) **Sumaché:** Located in the municipality of Livingston. It covers an area of 4,923.92 hectares. The water recharge area is located at 1,019 meters above sea level in the Core Zone of the AP. The main tributary is Sumaché River, which flows into the northeastern part of Lake Izabal. It has a length of 40 km, and it is formed at 600 meters above sea level, where there is a water catchment dam. The sub-basin has an estimated water potential of 14.18 m3 per year.

2) **Cienega:** Located in the municipality of Livingston. It covers an area of 1,864.77 hectares of which 1,305 hectares are covered with forest. The main river is a short river that forms on the north by the union with the Sumache. The rivers rise at 1019 m.a.s.l. It receives several tributaries, including Sahila and Caquilá and rivers. It flows into the Rio Dulce, and provides water to six communities. Its water is for domestic, agricultural, forestry and recreational use (tourism). For this river, a flow rate of 4.78 m3 /s is estimated. This basin has low sedimentation values (between 0 mm and 0.5 mm/h), indicating that the basin is well protected.

3) **Chahal.** It covers an area of 2,854 hectares, of which 1,871 hectares are covered with forest. The main tributary is a short river that rises in the foothills of the Sierra Santa Cruz 400 meters, and it is formed by the confluence of other streams. In Alta Verapaz, local Mayans know him as Sepemech (shells). It flows into the river Gracias a Dios, which is a tributary, which joins the

Chocon Machacas River, a tributary of Sarstún River. It is estimated that the river has a flow rate of 106.25 m3 /s. It provides water for domestic use, subsistence agriculture and tourism. Sedimentation values range from 0 mm to 10 mm / h. These values indicate a very low sedimentation in the dry season, indicating that the basin is well protected.

The Sierra Caral AP: Extension: 37.870 hectares.

It is located in the Motagua River Basin in the municipality of Morales in Izabal boundary with Honduras. The protected area consists of five sub basins and numerous streams and tributaries of the first order that flow into the Motagua River. The water potential of Sierra Caral favors 17 communities, about 8,000 people inside and on the periphery of the protected area. The main basins are:

1) **Bobos:** Located in the municipality of Morales, Izabal, and adjoins Honduras. It covers an area of 8433.59 hectares. The main tributary is the Bobos River, which rises southeast of the area in Honduras, and download into the Motagua River. This river is fed by several streams that provide abundant flow, used mostly by the hydroelectric generation plant known as "Fabrigas" in the San Silvestre (Hydroelectric Bobos River) located in the lower part of the Sierra, about 600 meters. In Guatemala, the river has an area of approximately 25 km. It provides water to seven communities within the protected area.

2) **Ánimas:** It covers an area of 9,207.06 hectares. The main tributary is the Animas River, which originates in Honduras; near the border, it receives the arroyo of Corozo, and empties into the Motagua River. In Guatemala, the river has an area of approximately 36 km. The basin has 3859.41 hectares of forest. It provides water to six communities in the protected area.

3) **Negro:** It covers an area of 9,713.11 hectares. The main tributary Negro River originates north of the hill of Meredoncito. Negro River flows through the village take the Northeast and receives the streams La Ceiba and La Vegona; download in the Motagua River, with an approximate distance 38 km. The basin supplies water to four communities.

4) **Chiquito:** It covers an area of nine, 263.03 hectares. The main channel, Chiquito River is the union of Frio River and Bananas River in the community of Peñitas, this river is the widest of all, with approximately 10 meters wide. The rivers flows through the valley of Motagua. The Quebrada Grande River originates in the area of Guatemala in the Water Pit Hill, irrigates the communities of San José Bonanza and Quebradas, and empties into the Motagua River through the union of the canals and rivers Animas.

Erosion Control

As part of the hydrological cycle, the protected area of Cerro San Gil plays an important role in the functioning of the Port of Santo Tomas de Castilla. This occurs due to the high forest cover in the area that minimizes erosion, thus generating less drag materials in rivers flowing into the Bay of Santo Tomas de Castilla, consequently in Amatique Bay. The materials carried by erosion in the bay decrease the

depth of the draft and dredged necessary to maintain the proper level of navigation channels and berths.

For the forest of the Core Zone of Cerro San Gil, the estimated erosion is less than 10 tons, average per hectare per year, which is classified as a slight erosion. While on the other hand, in a scenario of intensive deforestation in the Cerro San Gil (about 7492 hectares considered), the potential erosion could amount to an average of 216 tons per hectare per year (severe erosion). Consequently, in the absence of the Reserve, or under insufficient controls and conservation mechanisms in it, one would expect greater forest degradation and the consequent increase in soil erosion. Consequently increased sedimentation of the bay, which would increase the frequency of maintenance dredging, while increasing operating costs of the National Port Santo Tomas de Castilla, as well as the frequency and possibly a greater volume of material removed. The avoided cost represents in this case the benefit provided by the environmental service of the Reserve Cerro San Gil.

According to the projections of FUNDAECO, the annual erosion in the Reserve of Cerro San Gil is estimated at total 155,898 tons of materials. In a scenario of intensive deforestation, erosion could reach 1,616,433 tons; which means more than ten times the current erosion. This means that in one year, the maximum erosion is avoided 1,460,535 tons.

1.3.8.8 Fundamental Community Needs

The Project Zone is fundamental for water generation, especially watersheds mentioned in section 1.3.8.7. Local communities also obtain fuel wood; medicinal plants; fruits such as caimito, cushin, zapote, aguacate, guanaba, anona; and natural fibers and seeds that are used for the production of handicrafts.

Some communities around the mountain known as Sierra Santa Cruz, extract the leaves of an ornamental plan known as xate (*Chamaedorea elegans and Chamedorea oblongata*) which is exported to United States and Europe.

Regarding wild animals, it is believed that before it was an extended practice to hunt animals such as wild rabbits, tepezcuintle and iguanas, however since an important surface within the project zone is protected area, and special regulations are applied to protect wildlife, people are concern of having legal troubles when giving information and is hard then to know how usual is this practice today. For example in the social assessment only 5 people of the 370 interviewed informed that they extract wild animals for subsistence.

1.3.8.9 Cultural Identity

The Q'eqchi' beliefs revolves around respect to the earth and the cosmos that are recognized as *Tzuultaq'a*, which literally means "the mountain and what is below". The way in which Q'eqchi' express the faith related to *Tzuultaq'a* varies between regions, communities and families, but there is a common belief that *Tzuultaq'a* are living inside the mountains, specifically inside caves. While the sacred sites or *Tzuutaq'a* sites are not well defined geographically, participatory sessions and previous activities supporting cultural traditions, have allowed the project proponent to identify as sacred sites at a

regional level; the Tameja River cave system, Rio Quehueche cave system, and the mountain known as Cerro Sarstun.

1.4 PROJECT PROPONENT (G4)

Fundacion para el Ecodesarrollo y la Conservacion (FUNDAECO) is a non-profit organization dedicated to conservation and community development based in Guatemala City, Guatemala with field offices in the Department of Izabal. FUNDAECO is the project proponent and is solely responsible for all aspects of project design, implementation, and management. As discussed in Section 1.2.1, FUNDAECO has full project ownership for all emissions reductions from the REDD+ Project for Caribbean Guatemala.

Organization name	Fundacion para el Ecodesarrollo y la Conservacion (FUNDAECO)
Contact person	Karen Aguilar
Title	Director of Development
Address	25 calle 2-39 zona 1
Telephone	50223141923/50223141900
Email	k.aguilar@FUNDAECO.org.gt
Website	http://www.FUNDAECO.org.gt/

1.4.1 MULTIPLE PROJECT PROPONENTS

Not applicable. FUNDAECO is the only project proponent at the time project validation.

1.5 OTHER ENTITIES INVOLVED IN THE PROJECT (G4)

Table 9 presents the main organizations and individuals currently providing services for the development of the REDD+ Project for Caribbean Guatemala.

Company	Brief Description of Roles	Key Contact
ecoPartners	Assistance in project design, PDD drafting, carbon accounting, spatial modelling – based in Berkeley, California, USA.	Kyle Holland
Universidad del Valle de Guatemala (UVG) Centro de Estudios Ambientales y de Biodiversidad (CEAB)	Establishment of LULC maps over the historical reference period, development of species specific allometric equations, and measurement of carbon stocks.	Edwin Josué Castellanos López
Althelia Ecosphere	Funding of project implementation and co-management of credit sales.	Adam Gibbon

Table 9. Other entities involved in the project.

Ecological Carbon Offset Partners, LLC (ecoPartners) is a consulting firm based out of Berkeley, California, USA. As a leader of carbon-financed conservation, ecoPartners works with project developers, forest owners and verification bodies to build successful carbon offset projects. They are experts in the technical aspects of project design, planning and development including biometrics, accounting methodologies and remote sensing. ecoPartners has extensive experience validating and

verifying projects under the California Air Resources Board (ARB), Climate Action Reserve (CAR) Standard, Verified Carbon Standard (VCS), and Climate Community & Biodiversity (CCB) Standard. For the REDD+ Project for Caribbean Guatemala, ecoPartners has provided technical consulting services to FUNDAECO on project design, documentation, carbon accounting, validation, and remote sensing, as well as in drafting this Project Description.

Contact: Kyle Holland, Managing Director, Member
Address: 2930 Shattuck Ave, Suite 305, Berkeley, CA, 94795, USA
Telephone: +1 415-634-4650
Email: kholland@ecopartnersllc.com
Website: www.epcarbon.com

Universidad del Valle de Guatemala (UVG) Centro de Estudios Ambientales y de Biodiversidad (CEAB) aims to find solutions to environmental problems in Guatemala with a comprehensive and interdisciplinary approach. UVG CEAB has been contracted with to develop the baseline for the Sarstun-Motagua reference region as part of the national REDD+ program under development in Guatemala. Under this capacity UVG CEAB has held workshops in the Sarstun-Motagua region to understand agents and drivers of deforestation, has developed land-use/land-cover maps for the region, and will eventually implement baseline estimates for this region. A number of technical materials for the REDD+ Project for Caribbean Guatemala has aligned with the national REDD+ program and Sarstun-Motagua region. As a result, many of the technical materials created by UVG CEAB have been used in the development of this project.

Contact: Edwin Josué Castellanos López, Director del Centro de Estudios Ambientales.
Address: Ecosphere Capital Partners LLP (advisors), 7 Chalcot Road, Primrose Hill, London NW1 8LH
Telephone: 2364-0336 al 40 ext 596
Email: ecastell@uvg.edu.gt
Website: http://www.uvg.edu.gt/investigacion/ceab/index.html

Althelia Ecosphere is a fund dedicated funding innovative models that lead to long term transitions to sustainable land use and mitigate greenhouse gas emissions while providing sustainable livelihoods. Their model aims to address the drivers of deforestation and unsustainable land-use and release additional value from standing forests through payments for environmental services. Through a focus on blended value investments that deliver the highest caliber of social, environmental, and economic performance, they aim to demonstrate that financial performance can be fully aligned with sound environmental stewardship and social development. In the context of the REDD+ Project for Caribbean Guatemala, Althelia has provided financing for project development costs.

Contact: Adam Gibbon, Chief Technical Officer
Address: Ecosphere Capital Partners LLP (advisors), 7 Chalcot Road, Primrose Hill, London NW1 8LH
Email: adam.gibbon@althelia.com
Website: www.althelia.com

1.5.1 TECHNICAL SKILLS AND CAPACITY

The FUNDAECO leadership team has extensive experience in community engagement, biodiversity assessment, and forest measurement in Guatemala. The organizational structure for the REDD+ Project for Caribbean Guatemala as well as the team's experience is detailed in the Implementation Plan (see Plan de Implementación REDD V6.docx).

1.5.2 REGULATORS

The Ministry of the Environment and Natural Resources (MARN) is the primary regulator of Climate Change related issues and GHG in the Guatemala. Compliance with VCS and CCB standards is regulated by a third party verification body. AENOR International S.A.U. is an accredited verification body for VCS and CCB and serves as the initial validator and verifier for the project.

1.5.3 GHG PROGRAMME ADMINISTRATORS

The VCS Association (VCSA) and the Climate, Community and Biodiversity Alliance (CCBA) are responsible for administering their respective programs. These responsibilities include maintaining documents relevant to project design, implementation, and monitoring. CCBA posts a version of this document for public comment during validation as well as the Monitoring and Implementation Report when the project seeks verification. VCSA maintains a registry of projects including descriptions, monitoring results, and emissions reductions issued.

1.6 PROJECT START DATE (G1)

1.6.1 PROGRAM START DATE

The project start date is April 1, 2012. This is the date of the first Project Activity Instance (PAI) established using expected carbon revenues and debt-finance with anticipation of REDD+ carbon credit payments (see Section 1.6.2). FUNDAECO began a transition from grant and philanthropic funding to results based payments mechanisms found in REDD+ as early as 2010. The start of this transition was marked by a Memorandum of Understanding (MOU) signed in August 2010 between BNP Paribas/ Althelia Ecosphere and FUNDAECO to reduce emissions through a REDD+ project (MOU BNP PARIBAS_Complete.pdf). In addition to increasing the focus on a finance strategy based on REDD+ the funding from grant and philanthropic sources was ramped down as early as 2011. In 2011 the contract between FUNDAECO and the Jade Project, supported by the Netherlands, the supported conservation activities in the network of protected area in Izabal was terminated with the last disbursement schedule in April 2011 (Finalizacion CONTRATO JADE 2010-2011.pdf). This last payment covered operational costs for the remainder of the 2011 annum and FUNDAECO thereafter sough debt-financing to support a REDD+ project starting in 2012.

FUNDAECO demonstrated its intent to develop a REDD+ program in the Izabal region by following the five phases set out within the scope of the MOU including Project Identification, Commercial Structuring, Development, Implementation, and Monetization. Important milestones within the MOU were achieved including completion of a feasibility study September 14th, 2012, commercial structuring of a REDD+ program with Althelia with a contract reach in early 2015, and the contracting of ecoPartners LLC in early 2015 to assist with the development and implementation of REDD+ project activities.

This timeline demonstrates FUNDAECO's intentional transition between conservation finance strategies that, in terms of financial cash-flows, transitioned at the start of 2012. The project start date is reflected as the first PAI that resulted in emission reductions as a result of project activities funded through FUNDAECO's new financial strategy based on REDD+. The first PAI occurred on April 1, 2012 and created emission reductions from the patrolling of forest areas. See the Project Description Annexes for all of the start date materials discussed above.

1.6.2 PROJECT ACTIVITY INSTANCE START DATES

In addition to the Project Start Date for the REDD+ Project for Caribbean Guatemala start dates were collected for each Project Activity Instance (PAI). These start dates were based on a number of potential project activities implemented by FUNDAECO that lead to emission. Examples of the types of project activities are summarized below in Table 10 along with the type of documentation provided to demonstrate each PAI start date. For a full list of PAI types and start dates, see the FUNDAECO REDD+ Database in the Fundaeco VM0015 Accounting Model v1.57.xlsm.

PAI Code	Project Activity Instance	PAI Start Date	Evidence Establishing PAI Start Date
LD	A parcel protected by legal designation	Date of protected area status	Documents showing FUNDAECO's instrumental role in the designation of a new protected area; Documents establishing date of protected area designation
EDU	A parcel protected after environmental training	Date of the training	Training report, participants list
CP	A parcel protected after BAP training	Date of the training	Training report, participants list
PP	A parcel protected by patrol	Date of first patrol after Althelia MOU	Documentation of first forest patrol post-Althelia MOU for parcel (reports, participants list, logbooks). This PAI includes: • PPI: forest owner allows FUNDAECO or CONAP to develop a patrol • PP2: forest owner participates or support the realization of patrols in his forest and surrounding forests • PP3: implementation of rounds and fence or boundaries maintenance for better forest protection • PP4: implementation of infrastructure to reduce illegal deforestation; fences, gates, security cabins

			PP5: implementation of firebreaks
PINFOR/PINPEP	**A parcel protected by PINFOR or PINPEP**	**Date of PINFOR/PINPEP approval or verification after Althelia MOU**	PINFOR/PINPEP resolution or vertification, post-Althelia MOU showing contract date and forest area under protection/natural forest management
PA	**A parcel protected by acquisition**	**Date of purchase**	Purchase agreements, title records
			FUNDAECO
PM	**A parcel protected by contractual agreement for protection or management**	**Date of agreement**	Contracts or land management plans between landowners and FUNDAECO specifying FUNDAECO's involvement in land management and forest protection. Must be dated post-Althelia MOU and include evidence showing FUNDAECO's role in forest protection
PD	**Parcel protected after alternative productive activities to reduce pressure over the forest**	**Date of implementation**	Logbook
ECO	**Parcel protected after ecotourism project to reduce pressure over the forest**	**Date of implementation**	Logbook
LL	**Land Legalization**	**Date of legalization**	FUNDAECO's role in legalization

Table 10. Examples of project activity instances for the establishment of project start dates for each parcel.

1.7 PROJECT CREDITING PERIOD (G1)

The project crediting period is 30 years, starting 1 April 2012 and ending 31 March 2042.

1.7.1 PROJECT LIFETIME AND CHRONOLOGICAL PLAN

The Project has four implementation phases; phase one starts in April 2012 and finishes in December 2014; phase two start in January 2015 and runs through to December 2022 (baseline reassessment); phase three is from January 2023 to December 2032 (baseline reassessment); and the last phase will from January 2032 to the end of March 2042.

A detailed chronological plan is presented in the implementation plan, showing activities to be implemented for each project component, and expected outcomes for each group of activities. The plan is constructed showing the years that each activity will cover along the crediting period. FUNDAECO will use adaptive management to review activities effectiveness and their duration. See the Implementation Plan (Plan de Implementación REDD V6.docx) for details.

1.7.2 IMPLEMENTATION SCHEDULE

The Project Implementation Plan includes a 30 years schedule that presents, expected outcomes and activities for the whole period. Refer to the implementation plan for a full implementation schedule.

1.7.3 BASELINE REASSESSMENT

The project baseline will be reassessed in years 11 and 21.

1.7.4 ARR/ IFM HARVESTING PERIODS

Not applicable. The project is not conducting ARR or IFM activities.

2 PROJECT DESIGN (G1)

2.1 SECTORAL SCOPE AND PROJECT TYPE

This project is an Agriculture, Forestry and Other Land Use (AFOLU) project under the Reducing Emissions from Deforestation and Degradation (REDD) project category, sectoral scope 14. Specifically, the project is of the "Avoided Unplanned Deforestation & Degradation" (AUDD) project category. The project will not pursue IFM nor ANR activities in any of the project areas. Some of the project activities do occur on wetlands; however the specific carbon pools and GHG sources have not been accounted for as their exclusion leads to conservative estimates of the total GHG emission reductions. Specifically, peat soils have been removed from the project. The methodology VM0015 establishes that both below ground biomass and soil organic carbon are optional carbon pools and may be conservatively excluded.

2.1.1 GROUPED PROJECT

This project is a grouped project and also uses the programmatic approach. The grouped project area is shown in Figure 7 and described fully in Section 1.2.5. The grouped project area has been designed to display a single baseline scenario (Section 2.4) and demonstration of additionality (Section 2.5). The risk rating is divided into two areas based on land ownership (Section 2.3.4).

2.1.2 PROJECT ELIGIBILITY

The project meets all of the requirements set forth in the VCS Standard v3.6, issued October 19th 2016, and the VCS AFOLU Requirements v3.5, issued October 19th 2016.

The project further complies with all of the rules and requirements of the Climate, Community and Biodiversity Standard (CCBS), Third Edition, December 2013.

The project also complies with all relevant legislation as specified in Section 3.

2.1.3 METHODOLOGY REQUIREMENTS

The project is using VCS-approved methodology VM0015, "Methodology for Avoided Unplanned Deforestation v1.1" for quantification of GHG emission reductions and removals generated in mosaic and landscape scale REDD+ projects. The project applies the methodology VM0015 in full (See Section 4).

This methodology also refers to the latest versions of the following approved tools and modules:

-   CDM A/R Methodological Tool Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities.
-   CDM A/R Methodological Tool 03 Calculation of the number of sample plots for measurements within A/R CDM project activities.
-   CDM A/R Methodological Tool 06 Procedure to determine when accounting of the soil organic carbon pool may be conservatively neglected.
-   CDM A/R Methodological Tool 09 Estimation of GHG emissions related to displacement of grazing activities in A/R CDM project activity.
-   CDM Tool for testing significance of GHG emissions in A/R CDM project activities.
-   VCS Tool VT0001 Tool for the demonstration and assessment of additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) project activities.
-   VCS Tool for Remote Sensing Biomass Measurement v2.0
-   VCS Tool for calculating deforestation rates using incomplete remote sensing images.
-   VCS Module VMD0033 Estimation of emissions from market leakage.

Finally, the project meets all of the requirements for models and default factors set forth in the VCS Standard v3.6, issued October 19th 2016, and the VCS AFOLU Requirements v3.5, issued October 19th 2016.

2.1.4 PROJECT CONVERSIONS

The project is designed to protect native vegetation. None of the project activities will lead to the conversion of forest ecosystems nor will any of the project activities drain native ecosystems.

The project does not contain any ARR, ALM, or ACoGS project areas and is therefore not required to provide documentation that the project activities (alternative agricultural activities) will not lead to conversion of forest ecosystems. The project does not account for emissions reductions for project activities which occur on wetlands and is therefore not subject to WRC requirements (see Section 2.1). Although project activities may occur on wetlands, those activities do not account for emissions reductions because of the presence of peat soils and thus those areas are not subject to WRC requirements.

2.1.5 JURISDICTIONAL REDD+

Currently, there is no national or jurisdictional REDD+ program. Therefore, the project is not located within a jurisdiction covered by a REDD+ jurisdictional program in Guatemala and not required to follow the VCS jurisdictional REDD+ requirements.

However, the Guatemalan government led by the Ministry of Environment and Natural Resources (MARN) as the REDD+ focal point is in the process of developing a national REDD+ strategy. The Guatemala National Emissions Reduction Program has followed a jurisdictional nested approach and has delineated five regions that will independently establish reference emission levels (RELs). Additional programmatic details have been described in the latest version of the Emission Reductions Program Idea Note (ER-PIN) (Guatemala ER-PIN Version Sept 2014.pdf). The REDD+ Project for Caribbean Guatemala falls within the Sarstun-Motagua region which has initiated the collection of data for determining a REL. The REDD+ Project for Caribbean Guatemala is moving faster than the national strategy, however, it recognizes the importance and need to harmonize with programmatic details that have been established. FUNDAECO is participating in the national REDD+ strategy discussions, and is also coordinating with Universidad Valle (UVG) to ensure that all information produced on deforestation and degradation, carbon estimates, and land use classification can be used in the development of the REDD+ Project for Caribbean Guatemala.

2.1.6 GOOD PRACTICE AND GUIDANCE

The project follows the IPCC good practice guidance for land-use, land-use change and forestry (LULUCF) that was developed from the Marrakesh Accords; as well as the Social and Biodiversity Impact Assessment Manual for REDD+ Projects ("SBIA Manual") Manual for REDD+ Projects for guidance on the community and biodiversity elements of the project.

2.1.7 MULTIPLE PROJECT ACTIVITIES

The project includes only one VCS project activity, AUD and is using only one methodology, VM0015. Further, the methodology does not specify requirements for demonstrating additionality other than those specified in the latest version of the VCS approved *VT0001 Tool for the Demonstration and Assessment of Additionality in VCS AFOLU Project Activities* to demonstrate additionality; therefore, only the additionality requirements of the VCS Tool are adhered to.

2.1.8 MULTIPLE PROJECT ACTIVITY INSTANCES

As a grouped project multiple project activity instances will be incorporated into the Grouped Project Area for quantification of GHG emissions and each new project activity instance must meet the 15 eligibility criteria outlined in this section as per the VCS Standard v3.6 (Sections 3.4.1, 3.4.9, and 3.4.10) as well as the VM0015 Methodology v1.1 applicability conditions (Part 1 Section 2).

Eligibility Criteria for New Project Activity Instances:

- **Criteria Specific to the VCS Standard v3.6:**
    1. All new project activity instances included must be located within the Grouped Project Area, which is one of the designated geographic areas specified in Section 1.2.5 above. Because the Grouped Project Area is delineated in such a way to meet the similarity criteria to the Reference Region described in Section 1.1.1 of the VM0015 Methodology v1.1 and Section 5.3.1 of the PD, the requirement that all new project activity instances be contained within the Grouped Project Area means that new PAIs will automatically meet the geographic criteria outlined in the PD and methodology.
    2. All new project activity instances must comply with the eligibility criteria delineated in this section of the PD.
    3. All new project activity instances will be included in the monitoring report with sufficient necessary information to demonstrate compliance and enable sampling by the validation/verification body.
    4. All new project activity instances will be validated at the time of verification against the applicable eligibility criteria described in this section.
    5. All new project activity instances will have evidence of project ownership for each project activity instance starting at least at the respective start date of each project activity instance provided.
    6. All new project activity instances will be eligible for crediting only from the start date of that project activity instance through to the end of the project crediting period.

- **Project Criteria and Applicability of VM0015 Methodology v1.1**
    7. Each new PAI must demonstrate that the project ownership has been transferred to the FUNDAECO through a legal contract.
    8. Communities or private landowners for new project activity instances must have been engaged in the FPIC process according to section 3.7.1 of the PD.
    9. Baseline activities may include planned or unplanned logging for timber, fuel-wood collection, charcoal production, agricultural and grazing activities as long as the category is unplanned deforestation according to the most recent VCS AFOLU requirements;
    10. Project activities may include one or a combination of the eligible categories defined in the description of the scope of the VM0015 methodology;
    11. The project area can include different types of forest, such as, but not limited to, old-growth forest, degraded forest, secondary forests, planted forests and agro-forestry systems meeting the national definition of "forest";
    12. The project area shall only include land qualifying as "forest" for a minimum of 10 years prior to the project start date.

13. The project area cannot include any forested area that grows on peat soils. Peat shall be defined as organic soils with at least 65% organic matter and a minimum thickness of 50 cm.

14. New project activity instances must use technologies specified below and in section 2.2 of the Project Description, and must apply these technologies in the same manner as is described in section 2.2 of the Project Description. Project technologies will be enabled by the financial or technical assistance of the project proponent.
    - Parcel protection by legal designation as a protected area
    - Parcel protected by forest patrols
    - Parcel protected by PINFOR/ PINPEP
    - Parcel protected by acquisition
    - Parcel protected after environmental and forest training
    - Parcel protected after Best Agricultural Practices training – BPA – to reduce pressure over the forest
    - Parcel protected after alternative productive activities to reduce pressure over the forest
    - Parcel protected after ecotourism project to reduce pressure over the forest
    - Parcel protected by contractual agreement for protection or management
    - Parcel protected by land legalization

15. All new project activity instances are subject to the single baseline that has been established for the Grouped Project Area (Section 4.5) and new project activity instances must also fall under a baseline scenario of unplanned deforestation by known agents and drivers of deforestation.

16. New project activity instances must have characteristics with respect to additionality that are consistent with those demonstrated in Section 4.6 for the specified project activity (AUD) within the Grouped Project Area. As a result, new PAIs must demonstrate that they received financial or technical support from the project proponent that resulted in emission reductions. Project activities can be those described in Section 2.2.

2.2 DESCRIPTION OF THE PROJECT ACTIVITY (G2)

The REDD+ Project for the Caribbean Guatemala includes a series of actions that altogether will allow the reduction of deforestation caused by the following factors:

- Due to the lack of productive options and because people do not implement appropriate practices of soil productivity, more land is needed for subsistence crops.

- A weakness in Law enforcement due to insufficient presence of the authorities and low budget for surveillance, which allows for encroachment into forest areas by subsistence farmers and cattle ranchers.

In order to mitigate these factors and achieve solutions, the REDD+ Project has planned the following strategies:

- Supporting and Assisting Agroforestry: providing supplies and assisting the establishment of crops which products have a potential market, to diversify family economy and generate alternative incomes in key communities. FUNDAECO has selected 7 productive systems with high potential of income generating, establishing a strategic alliance with The Guatemalan Exporters Association (AGEXPORT) for a successful production chain.

- Fostering Forest value: supporting the access to forest incentives of the PINFOR, PINPEP and more recently PROBOSQUE forestry incentives. The project covers all expenses related to the preparation of files required by forestry incentives programs, such as forest inventories, legal files, forest management plans. In addition, endorsing the registration, validation, verification and sell of VCU's in support of the forest owners that have joined the project.

- Education of girls and young women, and improving the training opportunities: supporting young women to finish their elementary education and to continue high school studies; also, assisting with direct training in order to expand their job opportunities.

- Raising awareness on sustainable management of natural resources and the biodiversity values of the Caribbean Guatemala: FUNDAECO through formal education supporting or giving environmental and biodiversity talks with students in public and private schools and through organizing and supporting non-formal education activities such as talks and workshops with communities, environmental fair and exhibits.

- Raising forest value and creating economic opportunities through Ecotourism: FUNDAECO is promoting the conservation coast as an ecotourism destination in Guatemala, the destination is integrated by Ecotourism sites, which not only expose the biodiversity values of the region but also generate alternative economic activities for local communities. The model of these sites is that FUNDAECO gives "concessions" to local communities and entrepreneurs to give tourism services such as guiding, food services, handicrafts and souvenirs sales, and lodging services. Services demand in the ecotourism sites also benefits local transport such as taxis and boats.

- Law enforcement: Two main strategies
    o Control and Surveillance: Project will strengthen the protection and surveillance actions inside the project zone, especially in the highly threatened sites- in coordination with the National Protected Areas Council (CONAP), the Public Prosecutor's Office, and the Nature Protection Division of the National Police (DIPRONA), the Guatemalan Army and Navy, the Fisheries Department (UNIPESCA), Municipalities and local communities.
    o Litigation and Environmental Defense: to stop illegal logging and deforestation, the Project will follow up the legal complaints against deforestation or other related illegal activities. FUNDAECO will work closely with the Natural Protection Division (DIPRONA), the Public Prosecutor's Office, the National Protected Areas Council (CONAP) and local courts, to ensure the proper conclusion of the high priority cases. In addition, the

Project will offer legal assistance to communities and individual forest owners when and illegal activity is committed by a third party inside their forest.

- Land legalization: the Project will support the communities that have inhabited the zone but do not have their land titles, to obtain land legalization; FUNDAECO supports the preparation of social studies, legal files and land use capacity studies that need to be presented to the legalization programs from FONTIERRAS (ACCESO and Programa de Regularización y Adjudicación). Land titling allows not legalized communities to form part of the REDD+ project Grouped Project Area.

- Social and biological monitoring: in order to verify the relevance of the actions and the achievement of their results, the Project will maintain a social monitoring program for the local communities. Also, the Project will implement the monitoring of HCV species.

2.2.1 DESCRIPTION OF PROJECT TECHNOLOGIES

In order to reduce GHG emissions, the project will use a series of technologies to avoid deforestation. Law enforcement; by increasing control and surveillance in deforestation fronts, and also supporting institutions and protected area councils in forest governance. Increasing forest value through supporting access to forest incentive programs PINFOR, PINPEP and PROBOSQUE, and also with VCUs benefit share, as well as raising awareness on forest value for environmental services generation especially water.

The project also includes activities designed to reduce the need for new agricultural land, by supporting economy diversification specifically supporting the implementation of permanent crops and agroforestry systems in previous deforested lands, and encouraging improved agricultural practices for soil conservation and a sustainable management of maiz lands.

2.2.2 PROJECT CLIMATE IMPACTS

According to the ex-ante GHG estimates, the project is expected to reduce 27,268,810 tonnes of CO2 over a period of 30 years (net anthropogenic emissions reductions).

The theory of change analysis was used to determine causal relations between drivers of deforestation and degradation, and the activities to be implemented to generate climate impacts.
According to the agents and drivers analysis, Illegal land use change for cattle-ranching and Illegal logging were identified as deforestation drivers related to lack of law or a weak law enforcement. The impacts resulting from addressing these drivers are: Widespread protection of forest in project zone and the reduction of illegal logging.

In addition, the lack of economic and employment opportunities were identified as another strong factor for deforestation in the Sarstun-Motagua Region, specially related to the expansion of

subsistence agriculture. This underlying driver can be tackled improving two basic conditions Access to Resources and Economic Opportunities, and Education that will then trigger positive long-term climate impacts; Extensive areas under agroforestry production or reforestation in project zone; and Alternative revenue streams from forest production (e.g. agroforestry) and conservation uses.

2.2.3 PROJECT COMMUNITY IMPACTS

A study on drivers of deforestation in the Sarstun Motagua Region carried out in 2015[11], mention the lack of economic and employment opportunities as the strongest factor for deforestation in the Sarstun-Motagua Region, where the project is located. According to the project Theory of Change (TOC Activity Matrix v1.14.xlsm) this underlying driver can be tackled improving two basic conditions that will then trigger positive long term impacts: Access to Resources and Economic Opportunities, and Education. The theory of change presents the path in which project activities will generate outcomes and positive impacts for communities inside the project zone, identified impacts are:

- Sufficient household income from provision of ecotourism services, sale of agroforestry products, and resource protection
- Widespread access to community capacity building and educational opportunities
- Widespread awareness among women and families of reproductive rights and health
- Full access to reproductive health information and care within the project zone
- All marginalized and vulnerable communities with customary right have legalized land
- Ability and capacity of communities to implement sustainable resource management techniques
- Inclusion of all marginalized and vulnerable communities with customary rights in resource management decisions that may impact them.
- Protection of ecosystem services important to livelihoods and health
- Increased access to health information and care within the project zone
- Recognition and assistance in protection of significant traditional, cultural, spiritual, and religious sites.

An impact of Law enforcement activities is the increased control on verifying legal permits for familial timber extraction or woodshop permits, which can be perceived by communities as less access to resources. FUNDAECO organizes community talks and visits to woodshops in order to raise awareness on legal procedures to obtain familial permits, as well as to obtain wood shops permits. Familial Permits are given to a family when building a home, or any other familial but non-commercial purpose, and in a limited volume once in a year[12]. In the case of woodshops, they need to have a document that states the volume they are receiving and the origin, in order to guarantee that wood is coming from an authorized forest plantation or managed forest outside the grouped project area[13]. Woodshops and their operations also need to be registered at the SEINEF[14].

---

[11] Robb J.   Using Exploratory Factor Analysis to Explore the Drivers of Deforestation in the Sarstun Motagua Region of Guatemala

[12] Regulations for Protected Areas Law (Manual Forestal)

[13] Regulations for Forestry Law

[14] Regulations for Forestry Law (Reglamento de industrias Forestales)

2.2.4 PROJECT BIODIVERSITY IMPACTS

The Project Zone consists of one of the most important biodiversity hotspots in Guatemala, and serves as crucial habitat for numerous migratory and endemic species of birds, amphibians, mammals, and marine life. FUNDAECO has designed project activities that will have a positive impact on biodiversity within the project area and the region as a whole. By using the Theory of Change framework, project activities were designed with long term biodiversity impacts in mind. This framework provides a method for structuring project activities in a way that considers the short and medium term outcomes of the project activity, as well as the long term benefits. For example, the theory of change analysis identifies land use change resulting from lack of law enforcement as a key threat to biodiversity. The related activity consists of designating forest patrols to man the perimeter of protected areas to discourage anyone from partaking in illegal logging or the unauthorized clearing of land. The short term outcome of this activity is the prevention of habitat loss and the maintenance of natural ecosystems, and the medium term outcome is the widespread protection of forest in the project zone, through the effective enforcement of the law. A more detailed breakdown of the project activities with positive biodiversity impacts can be found in section 7.1, or in the Theory of Change Matrix (TOC Activity Matrix v1.14.xlsm).

No negative impacts on biodiversity are expected as a result of project activities, as these activities are designed to prevent deforestation and forest degradation, improve environmental management, and promote a widespread awareness of environmental stewardship. However, potential negative effects on the environment could arise from the use of pesticides/fertilizers, ineffective waste management, and monoculture plantations. FUNDAECO has taken steps to mitigate any of these risks using a combination of organization protocols and USAID safeguards, as described in Sections 2.3.3 and 7.

2.2.5 PROJECT ACTIVITY LIFETIME

Both the crediting period of the project and the project lifetime are 30 years. The financial plan for the project also extends 30 years.

2.3 MANAGEMENT OF RISKS TO PROJECT BENEFITS (G1)

2.3.1 CLIMATE RISKS

Institutional weakness is one the risks that can affect both climate and biodiversity benefits, especially due to lack of resources and lack of continuity of public servants, which results in a slow and interrupted implementation of public policies and strategies. This can affect the project coordination with authorities in charge of law enforcement. To manage these risks FUNDAECO has included in the project an Environmental Litigation and Lobbying and Advocacy Program. At the National level, FUNDAECO is also part from ASOREMA. ASOREMA is the national association for environmental NGOs that holds a chair at INAB Board of Directors, CONAP Council, and the Climate Change Council. At the local level (Izabal Department) FUNDAECO is part of the CODEDE, the MICAI, and Izabal Competitiveness Work Group. From these mechanisms, FUNDAECO is constantly guaranteeing coordination and support to project strategies and activities. The project was presented and obtained endorsement from PRONACOM, Izabal Government, MARN and SEGEPLAN.

Lack of governance in areas surrounding project zone can indirectly affect the project. To reduce this risk the project team is integrated by local technicians and community promotors that keep a constant and close communication with communities and landowners to understand their situation and demands. FUNDAECO participates actively in the MICAI to identify and avoid potential conflicts.
The potential lack of carbon market to cover opportunity costs is also a risk that can affect benefits to climate, communities and biodiversity benefits. To manage this risk FUNDAECO has obtained the initial support of Althelia Climate Fund as carbon investors, ACF and FUNDAECO are creating a joint carbon marketing unit, and initial VCUs buyers portfolio is prepared.

2.3.2 COMMUNITY RISKS

Lack to access markets is a risk for agroforestry, artisans, ecotourism and VCUs beneficiaries. FUNDAECO is closely working with AGEXPORT in order to increase market opportunities for vendors and producers supported by the project. AGEXPORT has been assessing FUNDAECO in market identification and contacts, value chains, and commercial image. FUNDAECO has registered the "Conservation Coast" as the trademark that will support project products image and marketing; based on a value differentiation.

FUNDAECO is also training local producers and vendors to implement BPAs, improve productivity and in the case of artisans to improve and update handicrafts designs.
As mentioned in the Climate Risks section lack of carbon markets to cover opportunity costs is also a risk. As informed above FUNDAECO is managing these risks by working closely with ACF in the preparation of a VCUs marketing strategy, but also supporting communities and individual landowners to diversify their household economy, through supporting resources for alternative economic activities, access to markets, and technical support to forest incentives such as PROBOSQIES, PINPEP, and PINFOR.

Backing commitments under REDD+ project is a challenge since expectations may change over the years. FUNDAECO anticipated this challenge through a broad consultation process including the discussion of the carbon contract with each beneficiary. The project team is integrated by local technicians that are committed to sustainable development and nature conservation in the project zone, and that have a close communication with communities and individual landowners. The grievance and redress mechanism, and the adoption of an adaptive management approach will timely implement solutions. An annual social survey will be carried out to know about beneficiaries' satisfaction level with FUNDAECO work.

2.3.3 BIODIVERSITY RISKS

The FUNDAECO project has used the theory of change to determine the most effective methods for bringing about benefits to biodiversity. However, there are still several natural and human induced risks to biodiversity benefits that underlie assumptions in the theory of change model. Some of these threats may be outside of the project's control, but others may have concrete mitigation measures that can be implemented by the project.

Specific risks to biodiversity that may be out of the project's control include the risk of continued habitat degradation outside of the project area, as well as the socio-political stability of Guatemala, which could impact economic drivers of deforestation as well as FUNDAECO's influence over the project area. There

is also the risk that income generated from agroforestry systems and ecosystem services payments may not be enough to compete with income derived from activities such as illegal logging and the clearing of forest for agriculture or cattle grazing, resulting in less reductions in deforestation than anticipated. Additional human-induced risks include changes in local economic conditions, the lack of capacity and governance in local communities, the potential use of environmentally harmful practices as part of project activities, and the lack of a functional land tenure system. Natural risks to the project have been evaluated using the Non-Permanence Risk Tool (see Fundaeco REDD+ Non-Permanence Risk Report_Risk Area A v2.10.doc and Fundaeco REDD+ Non-Permanence Risk Report_Risk Area B v2.10.doc), and have been found to pose insignificant threats to the project area, and consequently pose little threat to the project's biodiversity benefits.

FUNDAECO has implemented several strategies for mitigating many of these risks to the project's biodiversity benefits. Targeted project activities as well as organization policy both will serve to strengthen biodiversity benefits and reduce any potential risks (see Section 7 for more details on project activities tied to biodiversity benefits). Although several risks are outside of the project's control, including local governance, changes in local economies, and land tenure systems, FUNDAECO is working to minimize these through project activities geared at empowering communities and providing land tenure access to vulnerable populations. Any biodiversity threats caused by the degradation or fragmentation of forest outside of the current project area also have the potential to be minimized through educational initiatives and the incorporation of these properties into the project area over time.

FUNDAECO's policy documents also outline the measures that the organization will take to ensure that project activities do not cause environmental harm. For example, in the FUNDAECO Policy document (Plan General de BPA 2016.docx), the use of GMOs and invasive species are prohibited, and environmentally friendly waste management measures are to be implemented as part of any project activity. All agroforestry and sustainable agricultural programs through FUNDAECO also abide by USAID guidelines for safe pesticide use (Plan General de BPA 2016.docx), and an internal best agricultural practices policy that outlines and justifies safe and appropriate pesticide and fertilizer use (Plan General de BPA 2016.docx). FUNDAECO agroforestry programs do use non-native and non-invasive species such as rubber in small-scale plantations within a larger mixed-use sustainable agriculture system. By using naturalized non-native and non-invasive species in sustainable and mixed-use agroforestry systems, FUNDAECO can enable farmers to access markets that provide them with better economic opportunities, thus preventing them from further clearing forest. A detailed justification for the use of non-native species in small-scale agroforestry plantations can be found in Consultoria Selvin Perez doc Final 10062014.docx. Overall with a combination of targeted project activities and organization policies, FUNDAECO is continuously taking steps to identify and mitigate threats to biodiversity within the project area and project zone.

2.3.4 NON-PERMANENCE RISK AND BUFFER TOOL

The project team has prepared separate risk ratings according for defined risk areas within the Project Area under the VCS AFOLU Non-Permanence Risk Assessment Tool (VCS Version 3.3) and following Section 3.8.2 of the AFOLU Requirements. The project area, as defined in Section 1.2.6, has been divided into 2 separate risk areas distinguished based on differing land tenure and conservation commitments. Risks are assigned at the property level based on the REDD+ Database (Fundaeco VM0015 Accounting Model v1.57.xlsm), with Fundaeco properties being assigned to Risk Area A and

non-Fundaeco owned properties participating in the project in Risk Area B. Of the 54,157 hectares of the Project Area, the land area in Risk Area A totals 11,121 hectares, and the land area in Risk Area B totals 43,036 hectares. The total risk rating for each risk area is summarized in Table 11 and individual non-permanence risk reports have been provided separately to validators (see Fundaeco REDD+ Non-Permanence Risk Report_Risk Area A v2.10.doc and Fundaeco REDD+ Non-Permanence Risk Report_Risk Area B v2.10.doc). Descriptions of the different risk areas are also provided below.

Risk Area A

Risk Area A is defined by properties that are owned through clear title by FUNDAECO.

Risk Area B

Risk Area B is defined by properties that are owned through clear title by national entities, municipal entities, private owners, and *possedores*.

Risk Category	Risk Area A Rating	Risk Area B Rating
a) Internal Risk	14	14
b) External Risk	0	0
c) Natural Risk	0	0
Overall Risk Rating (a + b + c)	**14**	**14**

Table 11. Non-Permanence risk rating for each defined risk area within the Grouped Project Area.

2.3.5 MANAGEMENT OF RISK BEYOND PROJECT LIFETIME

The project lifetime is 30 years; however, the project is designed to create benefits and impacts that are expected to last far beyond this time frame. Through activities to support land titling FUNDAECO is ensuring community rights and also access to projects, funding, and stability for benefited communities.

Through the support and technical assistance for productive alternatives –ecotourism, agroforestry, handcrafts-, FUNDAECO expects to contribute to family livelihoods and welfare.

FUNDAECO will also support access to education, and sexual and reproductive health, especially for young women and women in order to raise opportunities for the whole family.

It is expected all these joint interventions to generate impacts at the local development dynamics and patterns in the project zone, beyond project lifetime.

2.4 MEASURES TO MAINTAIN HIGH CONSERVATION VALUES (G1)

2.4.1 COMMUNITY HIGH CONSERVATION VALUES (CM1 & CM2)

According to Richards and Panfil (2011), Social or Community HCV are those that provide critical ecosystem services or are of cultural importance. In the project region both of them are founded.

A network of sacred sites where Queqchi and Garifuna communities practice religious rituals have been identified; each site is composed by several points, specially caves or small mountains called "*cerros*":

- Tameja River and caves
- Rio Quehueche River and Caves
- Cerro Sarstun and Sartun River
- Rio Cocoli
- Siete altares
- Caves and cerros at the north of Sierra Santa cruz (Rubel Ho, Rubel Cacao, Sesaquipec and Sesaquisuib)

Ten watersheds were identified as HCVs that provide critical ecosystem services; **Las** Escobas, Tamejá, San Marcos, Juan Vicente, Sumaché, Cienega, Chahal, Bobos, Negro and Chiquito.

The project is dedicated to maintaining these community HCVs through several targeted project activities. HCV management areas have been identified (see Figures 9 and 10) in order to focus HCV conservation efforts within the project area. The primary measure taken to maintain HCVs is the reduction of deforestation within the sites identified as HCVs, through the voluntary integration of some of these forests to the project area and the implementation of protection activities. By reducing deforestation and degradation, the project will avoid threats within these areas, and their environmental services and cultural uses can be guarantee.

FUNDAECO is implementing forest protection measures through the deployment of forest patrols, the enrollment of landowners along watersheds in PROBOSQUE and PINPEP programs, conservation education initiatives, and support to preserve awareness and respect for traditional, cultural, spiritual and religious identities of communities within the project area.

A map of community HCV Values can be seen in Figure 9 below.
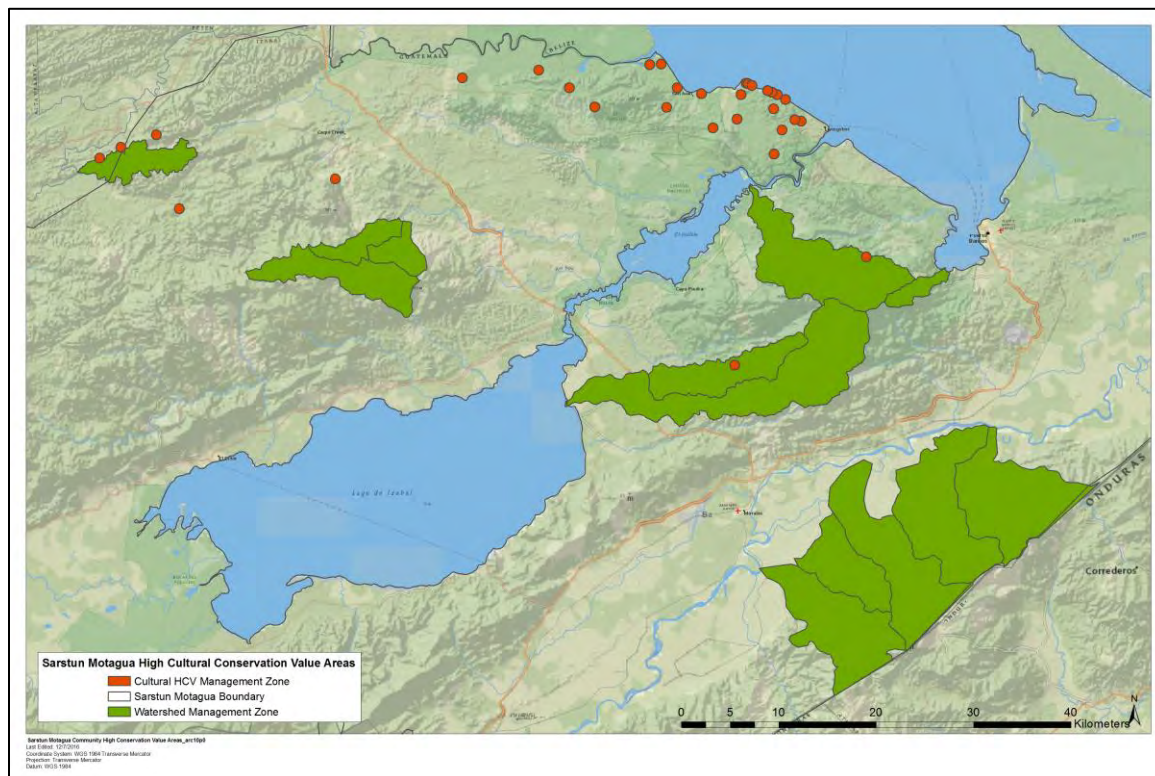
Figure 9. Map of community HCV management areas.

2.4.2 BIODIVERSITY HIGH CONSERVATION VALUES (B1 & B2)

Biodiversity High Conservation Values for the Project as detailed in Section 1.3.8 are:

HCV 1: Concentrations of biological diversity:

> Protected areas
> Threatened species: numerous IUCN Red List threatened species
> Endemic species: high endemism in the region
> Migratory corridors

HCV 2: Landscape level ecosystems and mosaics

> Intact and partially intact forest area sufficient to support naturally occurring species in natural patterns of distribution and abundance

HCV 3: Rare, threatened or endangered ecosystems

> Lowland forests
> Mangroves

The project is dedicated to maintaining these biodiversity HCVs through numerous targeted project activities. Several HCV management areas have been identified (see Figure 10) in order to focus HCV

conservation efforts within the project area. The primary measure taken to maintain biodiversity HCVs is through the reduction of deforestation within the project area. As is discussed in Section 7, biodiversity is highly correlated with forest cover (Richards and Panfil, 2011), and many of the identified biodiversity HCVs consist of forested areas within the project area and project zone, including protected areas, migratory corridors, landscape level ecosystems, and threatened ecosystems. By reducing deforestation and degradation threats within these areas, both the ecosystems and the threatened species within those ecosystems will be protected and maintained. FUNDAECO is implementing forest protection measures through the deployment of forest patrols, the enrollment of landowners in PINFOR and PINPEP programs, conservation education initiatives, and agroforestry systems. These project activities and their direct biodiversity benefits are described in more detail in Section 7.

Additionally, FUNDAECO is implementing specific measures to protect endangered amphibian species within the project area through the training of park guards in measures to prevent the spread of deadly amphibian fungal diseases. See Figure 10 for a map of amphibian protection zones.
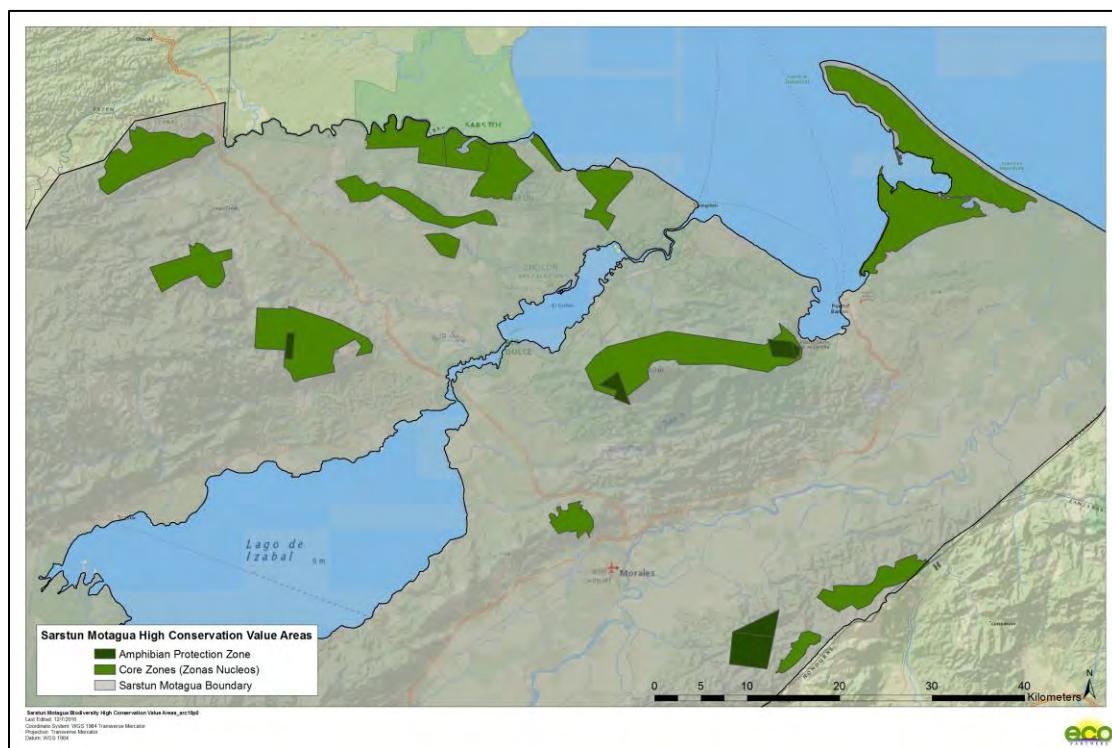
Figure 10. Map of biodiversity HCV management areas.

2.5 PROJECT FINANCING (G4)

FUNDAECO is committed to cover project operation costs, initially through an investment from Althelia climate Fund that covers development expenses. During the rest of the project lifetime FUNDAECO is committed to sell carbon credits with the support from ACF. Also a VCUs marketing unit will be stablished in Guatemala to reach local companies. However considering the carbon market uncertainty, to guarantee project cashflow. FUNDAECO continue to seek funds from international cooperation. FUNDAECO will work with recognized sustainable development and conservation funds and agencies to cover costs from the different project components.

2.6 EMPLOYMENT OPPORTUNITIES AND WORKER'S SAFETY (G3)

Since its foundation in 1990 FUNDAECO, has complied with legal and administrative provisions on labor and social security and work rights; this practice is implemented throughout all of FUNDAECO Programs and Projects.

The rights and obligations of workers are contained in the Labor Code (Decree 1441 of the Guatemalan Congress). The state agency that enforces workers rights respect is the Ministerio de Trabajo y Previsión Social, and the social security is in charge of the Instituto Guatemalteco de Seguridad Social –IGSS-. FUNDAECO is registered as an employer with both entities, and can receive evaluations as required by the law. In addition to social security coverage, the institution establish an aggregate insurance policy with life insurance and medical expenses coverage.

FUNDAECO -in compliance with the content on civil, commercial and labor- enacts a Human Resources Policy, as part of Manual for Policies, Rules and Procedures, including in Chapter 1 among others items: types of recruitment, recruitment processes, wages and salaries, interpersonal relations and performance evaluations.

2.6.1 EMPLOYMENT TRAINING

In order to build local useful skills and knowledges to increase success in the project implementation and goals, a significant amount of training and capacity building its being implemented by FUNDAECO, and is provided in different level to field technicians and community beneficiaries.

Through workshops, filed technicians, and project beneficiaries will be trained to implement several types of agro-ecological products (black pepper, cardamom, rambutan, forestry amount others) and ecotourism in an environmentally low-impact manner. Through these activities economic opportunities can be improved in different area, see the next table.

Training opportunities		
SAF	**ECOTOURISM**	**HANDCRAFTS**
Plant Production	Development of tourism product	Quality and added value
Grafting	Community Tourism Guides	New designs
Soil preparation and nutrition	Provision of food services	Material costing and small business mangement
System establishment	Management of groups and tourism culture	
Crop Management	Provision of lodging services	
Harvest		
Post harvest		
Processing		
Packing		
Biofertilizers		
BPAs		

Table 12. Training opportunities.

Specific training for the project:
FUNDAECO trains all staff in the different aspects of the project components. For new employees, training period (induction process) will be provided in a 4 week term, immediately after beginning employment. The Induction process starts with identifying relevant topics to train the new employee. This process will include field visits looking to integrate the technician in ongoing efforts with project stakeholders and communitarian leaders. Also periodical training can be made with project staff, covering relevant topic that are new to the staff or that needs to be improved and updated.

Directors and Coordinators will ensure that additional training is provided to staff, where needed, with efforts from FUNDAECO or from external support.

Communities:
FUNDAECO implements capacity-building activities with communities all over Caribbean Guatemala. When working with community members, the community itself will select the people participating in the proposed activities.

FUNDAECO divides 3 different levels of development in staff training systems:
-1st level: FUNDAECO technical staff receives training in productivity, organization and legal subject; these technical teams are the ones that have the job to replicated -with knowledge transfer and generation of capabilities- across project organizations (Producers Organizations, Local Committees and COCODES)

-2nd level: FUNDAECO technical staff, along with the accompanied of organizations leaders, provides technical assistance to producers at an individual plot level.

-3rd level: For the different products will feature and deliver technical manuals containing the minimum "technology package" for the productive development of each of the production initiatives; all contents and tools provide by the technology package and deliver for capacity building activities, are designed to be culturally appropriate.

If FUNDAECO lacks of the specific skills, specialized consultants will contacted.

Efforts with external support:
Regarding agroforestry systems, specific training will be provided to support project productive activities including agroforestry systems and ecotourism. In addition, will be engaging in technical assistance activities with Special Purpose Vehicle (SPV) partnerships and allied companies that will be in charge of adding value to the crops, through processing at special facilities. These partners and allies (most of this relationships will be generated by product) will also provide formal training to perform tasks such as agriculture techniques, grown harvesting, product processing, and packaging among others.

Other trainings includes PINFOR, PINPEP, protected areas management, Law Enforcement, monitoring and conflict resolution; the Geographic or thematic coordinator is responsible on detecting training need and opportunities and the Regional Director for external support in this trainings.

Finally trainings on Human Rights, Sexual and Reproductive Health and Rights, and other issues covering community rights and empowerment, will be organized by the Social and Gender Director. The project is constantly supporting midwives and health promotors and volunteers in related trainings.

The next table shows partner institutions and organizations that are previously identified to support the implementation of the training programs, other institutions can be included along the project life:

External organizations supporting training programs	
INTECAP	"Instituto Tecnologico de Capacitacion" supports Agroforestry Systems and Ecotourism
AGEXPORT	"Asociación de Exportadores de Guatemala" supports Agroforestry Systems and Ecotourism
AGREQUIMA	Agrequima it's an technical company that's specializes in Best Practice implementation
INAB	"Instituto Nacional de Bosques"with support in agroforestry and forestry
INGUAT	"Instituto Guatemalteco de Turismo" supports Ecotourism
MSPAS	"Ministerio de Salud Pública y Asistencia Social" Health and Sexual and Reproductive Health
OSAR	"Observatorio de Salud Sexual y Reproductiva"Sexual and Reproductive Health and Rights
AME Guatemala	"Asociación Movimiento por la Equidad" Fundamental Human Rights, Sexual and Reproductive Health and Rights, Gender

Table 13. External organizations supporting training programs.

2.6.2 EQUAL OPPORTUNITIES FOR EMPLOYMENT

FUNDAECO requires specialist services in natural resources management, agriculture, forestry, social work, laws and politics, communications, nurses, biology, accounting, administration and finance, educators, rangers, farmers and field workers.

High value for work stability:
FUNDAECO maintains a low staff turnover rate; this policy values the interest towards nature and communities, experience, and dedication of the staff. In the case of the REDD+ Project for Caribbean Guatemala, FUNDAECO will retain existing staff in order to harness already acquired experience in: REDD + topic; the knowledge of the project area, and its social and natural conditions and dynamics; and the contacts with local communities and stakeholders. The staff hired by the project are local people with important experience in the area. Additional staff will be hired for areas requiring professional profiles that currently are not counted within the institution.

Hiring procedures:
FUNDAECO procedures are stablished in section one of the institutional Manual for Policies, Rules and Procedures, see MANUAL DE POLITICAS NORMAS Y PROCEDIMIENTOS jul 2015.pdf. According to this manual when a new position or task is required, first opportunity is given to existing staff. The Technical Administrative Council or CTA "Consejo Tecnico Administrativo" will report internally in the institution for new opportunities or vacancies by inner communication channels. Employees may submit their aspirations to be reclassified or promoted, once the profiles required have been published and their skills are commensurate with the position available.

When the skills are not founded inside the organization the position is announced trough different channels,   such local radios, local newspapers, universities, web page etc.; the resumes will be evaluated following the procedures in the manual.

Hiring additional plant personnel such as consultants, or other professionals, specialized personnel is carried out within the framework of each specific project and according to the Terms of Reference required by the project, which include term, functions, products, fees, or other services.

Induction process:

All new and promoted employees, prior to assuming the fulfillment of their responsibilities, must receive from the Administrative Director or administrative assistants an induction on institutional manuals, FUNDAECO mission and vision, policies and other administrative documentation. Procedures aspects, information on monthly salary, delivery of relevant documents and signing of pertinent documentation. The immediate superior will directly give induction on the position tasks.

2.6.3 WORKER'S RIGHTS

The rights and obligations of workers are observed and enforced in accordance with Labor Code of Guatemala. These provisions are developed in FUNDAECOs manual of Internal Working Regulation and Procedure which was presented to the Ministry of Labor and Social Security for review and approval by a representative of the employer and two representatives of the workers, having been approved by the Ministry through the 179-2002 resolution, regulating the conditions of working hours, salary payments, holidays, requests and claims, obligations of the employer and employees, safety and health.

In compliance with the established regulations, this manual has to be available to workers at each office in printed form and in digital form. Besides this regulations when hired, the employee receives the institutional Code of Ethics and Values, which contained general and mission related values to be observed by our staff. More recently FUNDAECO has developed it Policy on Gender, No Discrimination and Violations against Fundamental Human Rights. All manual and regulations are to be implemented under the concepts and criteria stated along this Policy.

- On Non-Discrimination:
  Every employee has the right not to be discriminated directly or indirectly for employment, or once employed, for reasons of gender, marital status, age within the law limits, racial or ethnic origin, social status, religion or belief, political ideas, sexual orientation, membership or not to a labor union.
- Employment benefits to personal:
- All employees are entitled to benefits prescribed by Guatemalans labor laws. The Technical Administrative Council (CTA) can define additional benefits, if required.
- FUNDAECO recognized as institutional policy the payment of a universal indemnity after 4 years of working with the institution when the employee has accumulated a favorable record of conduct and performance, the termination is on friendly terms and under no circumstances for reasons of serious faults against the rules of the institution or the existing labor law in Guatemala. If any employee resigns before the four years, it will be the Technical Administrative Council (CTA), who will assess whether or not the universal compensation takes place.
- Health Suspension by the Guatemalan institute of Social Security: Any worker can be temporally suspended from his job duties because of illness or accident, remuneration shall be in

accordance with the provisions of the organic law of IGSS. A copy of the suspension certificate is sent to the employee's personnel file and payroll manager.

- Life and health insurance.
- FUNDAECO recognized the concept of a "performance bonus", up to a maximum of 25% of the base salary. For the worker to enjoy this benefit, it must be stated in the employment contract.
- Field expenses: allocation of funds will be made for personnel who need to travel outside their workplace as part of their job functions.

2.6.4 WORKER'S SAFETY

General procedures:

FUNDAECO in fulfilment of Guatemalan law is registered with a patronal number, and compliance with the established benefits covering registered employees with the following social security programs:

- Common disease
- Accidents
- Maternity
- Age Disability

In addition to the benefits of the Guatemalan Social Security Institute, FUNDAECO in a common agreement with employees, hires a collective life and medical expenses insurance coverage. The medical expense coverage can be extended at the request of the employee to his family.

Within the regulations of the Guatemalan Social Security Institute conducted in coordination with the Ministry of Labor, FUNDAECO applies the following regulations:

- The Regulation on Health and Safety at Work, contained in the Government Agreement No. 229-2014 and its amendments contained in No.33-2016, which contains regulations regarding work environment, vehicle driving, handling and operation of machinery, infrastructure and facilities, hazardous substances, infectious diseases and first aid kits.

- Regulation on Accident Protection, published by the Guatemalan Social Security Institute board (Agreement no. 1002) that regulates issues relating to accident prevention and first aid measures.

Specific procedures related to FUNDAECO field work are included in the institutional Policy and Plan for Health and Safety. FUNDAECO has also adopted the Security and Risk Manual at the Herpetarium from the Guadalajara Zoo Herpetarium, to manage its local herpetarium at Cerro San Gil, this herpetarium is registered at CONAP, and personnel has been trained by the Director of the National History Museum herpetarium (see manual de serpentarios.pdf).

The body responsible for ensuring compliance with all laws and regulations is the Technical Administrative Council or CTA, and at the same time operates as the Health and Safety Committee supplying security protocols and issued several tools for each employee, among some of this tools we can mention the instructive for Safety on Emergency Situations, instructional use of water and land

vehicles; Chapter XIII of the Internal Work Regulations containing the Hygiene and Safety at Work guidelines.

Risks to workers Safety:

FUNDAECO Technical and Administrative Council, together with the Geographic and Thematic Coordinators, has identified three main safety risks:

- Use of land vehicles:

The work of FUNDAECO requires the constant transfer of personnel in land vehicles of the institution, either to be transported from Guatemala City to the project zone, or inside the project zone. This safety risk may be related to mechanical damage on the road, vehicle theft, or traffic accidents. In order to prevent these risks, FUNDAECO's Manual de Políticas, Normas y Procedimientos indicates the procedures to guarantee vehicles optimal conditions, as well as responsibilities in driving. For more details on the administrative procedures for repair and maintenance, the assignment of responsibilities, and accidents prevention and reaction, the Vehicle Use Instructions section of the manual may be reviewed.

- Use of boats:

Staff working in marine and coastal areas must use boats for transportation. FUNDAECO have several boats and research vessel for these purposes. The main safety hazards identified in relation to the use of such vehicles are mechanical damages, collisions with other vehicles or fire accidents in the case of the research vessel, as well as crew falling into the water.

In order to prevent accidents, the Manual de Políticas, Normas y Procedimientos usage rules in the section Vehicle Use Instructions, also more specific procedures are included in the boats and vessel specific manuals: Normas de Comportamiento a bordo del Barco de Investigaciones La Garza; Manual de Uso y mantenimiento de lanchas de 16 pies; y Manual de Uso y Mantenimiento de lanchas de 25 pies. It is important to mention that Fundaeco has a license for all its maritime vessels. In the case of the Investigation Boat "La Garza", FUNDAECO complies with the requirements established by the Army through the Naval Command of the Caribbean of Guatemala.

- Snake Bite:

Due to the work in rural and natural areas the snake bite has been identified as a risk. In that sense a protocol has been prepared to prevent such bites and to act in case they occur, as detailed below:

- In nature, snakes will be manipulated only for the purpose of biological studies and will only be carried out by trained personnel who is able to recognize poisonous species of venomous species. The manipulation will only be done to non-poisonous snakes.
- In the case of institutional collections, only trained personnel will manage the collection. Collection is established under the guidance of the specialist of the Museum of Natural History of Guatemala, who has also trained the staff of FUNDAECO in charge. The collection has been established according to the norms and procedures established in the Handbook of Safety and Risk in a Herpetario, of the Zoo of Guadalajara.

- Project staff manages information on how to act in case of snake bite. Including first aid and emergency phone, and hospital location.

- Other risks:

Other risks related to project activities are falls and insects bites. All offices, biological stations and ecotourism sites are provided with first aid kits in order to respond in case of these injuries.

2.7 STAKEHOLDERS (G3)

2.7.1 STAKEHOLDER ENGAGEMENT STRUCTURE

FUNDAECO has worked in the project region for over twenty years, and during this period, it has designed, promoted and supported different mechanisms and structures that ensure the active participation of all stakeholders – particularly communities- in consultation, decision making, and implementation of field activities across the project region. These formal structures – established both under the Development Councils Legislation, and the Protected Areas Legislation- will ensure the active engagement and participation of all stakeholders throughout the project implementation period. Communities in particular, will participate not only as Forest owners, but also as members of protected area management bodies, as project beneficiaries and as direct participants in the implementation of project activities.

From the local to the regional level, the following structures have been involved in project consultation and planning, and will also ensure project implementation, follow-up and oversight:

- **COCODEs (Comités Comunitarios de Desarrollo),** or Community Development Councils, are the basic unit for consultation, planning and implementation; The General Assembly of each COCODE – in which all community members (both men and women) participate- elects a Board of Directors and a President, who in turn represents his/her community in regional bodies.

- **Local Regional Indigenous and Community Associations and Protected Area Community Assemblies (Asambleas o Consejos Intercomunitarios de Áreas Protegidas):** Local Associations representing a group of communities, usually associated with the management of land and natural resources in a particular region or protected area, are also an important mechanism for community stakeholders engagement. The Associations Aj Rihonel Re li Ch´och in Río Sarstún, Aj Ilol Quiché in Chocón Nacional, San Antonio Aj Awinel in Jalauté, Asociación Cerro 1019 in Sierra Santa Cruz, have been key partners in all FPIC processes, and will also participate in the protection and community development activities throughout project implementation.
These Associations also represent the communities within a particular protected area, and are consulted and engaged in all field activities and key management decisions, including the consultation and implementation of the REDD+ project. These participatory bodies will be strengthened in each protected area during project implementation.

- **Protected Area Executive Councils or Boards of Directors ("Consejos Ejecutivos Locales de Áreas Protegidas")** will also be a key participatory body for the active engagement of all stakeholders in project implementation. These Councils, which preside over the management of specific protected area, integrate key stakeholders at the local level, including the National Council of Protected

Areas, Municipalities, Private Landowners and/or Private Sector representatives, Governor, relevant government agencies, and Local Community Representatives.

- **COMUDEs (Comités Municipales de Desarrollo)** or Municipal Development Councils, are participatory bodies at the Municipal level; Presided by local Mayors, they also incorpórate private landowners, community representatives, local representatives of Government Agencies, and NGOs. The REDD Project has been extensively socialized with COMUDEs, as a key administrative body that ensures wide engagement of all stakeholders in a particular Municipality.

- **Consejo Departamental de Desarrollo (CODEDE), the Development Council for the Department of Izabal,** presided by the local Governor, is the regional body that ensures the engagement of stakeholders at the regional level. The REDD+ project has been submitted for its review during the FPIC process, and the CODEDE will ensure regional level support to project implementation.

Additionally, a wide array of local producer associations, women associations, and other local organized groups have been consulted during the FPIC process, and will be actively involved in project implementation (Please refer to REDD Socialization Plan for a full list of partner community associations).

These different participatory governance structures have been engaged during project preparation and consultation, and will be actively engaged in project implementation by FUNDAECO´s local field teams, deployed across the region in five field offices and three Field Stations. In each office, a Technical Coordinator and a team of environmental educators, social workers, agronomists, naturalists, and field extensionists will ensure a close, intensive and active engagement of communities, forest owners, agroforestry producers, women and youth in the implementation of all project activities. All project implementation activities will be closely coordinated in each level with the appropriate participatory bodies, and a Regional Project Coordinator will ensure regional coordination with the Governor of Izabal, and the Regional Coordinator of the National Council of Protected Areas. FUNDAECO, as project proponent, will ensure administrative support, operational planning, oversight, coordination with all relevant partners and stakeholders for project activities implementation, and Auditing and MRV requirements for the project.

Additionally, a **"General Assembly of Carbon Rights Holders" ("Asamblea General de Tenedores de Derechos de Carbono")** will be established, in which all landowners within the project area will participate - including community forest owners, private forest owners, and institutional forest owners-. This Assembly of Forest Owners will meet at least once a year, and FUNDAECO will report on project implementation, VCU generation, Sales and Income, and will transparently report on benefit share allocations, as established in the Benefit Share structure in the Carbon Contracts for the Project.

In order to ensure the active integration of Indigenous Peoples, during the consultation period FUNDAECO has worked closely with local Q´eqchí Associations Aj Rihonel Re li Ch´och in Río Sarstún, Aj Ilol Quiché in Chocón Nacional and San Antonio Aj Awinel in Jalauté, and these associations will also be key project implementation partners. Over 72 Q´eqchí Village COCODES participated in the FPIC process, and meetings with women focal groups were organized to guarantee women participation, - representing 13 Queqchi associations within the Project Region-.

During the consultation phase, FUNDAECO´s team of Social workers, Nurses, and Health workers made a focused effort in order to ensure the participation of women and youth in project presentations and consultations, using local Q´eqchí speakers. Using FUNDAECO´s network of "Women Clinics" across the region, over 821 women participated directly in consultation activities. This consultation process will continue during project implementation in order to ensure a gender perspective in follow-up to project activities. This network will also foster the active engagement of women in project activities, particularly in access to sexual and reproductive health services, education and training opportunities, alternative income generating activities (handicrafts and others), and participation in protected areas governance bodies.

A Gender and Non Discrimination Policy will be enacted, socialized, and implemented - based on FUNDAECO´s Code of Ethics- in order to ensure compliance with CCB Standards and in order to avoid discrimination of harassment based on gender, race, religion, sexual orientation and other habits.

Also, FUNDAECO will carry out periodic communications in order to inform on project activities, implementation issues and relevant information for landowners participating in the project and other relevant stakeholders.

2.7.2 STAKEHOLDER IDENTIFICATION

Through its five regional offices in Izabal and the knowledge and experience of their field technicians, FUNDAECO has identified the key actors (stakeholders) of the REDD+ project.
The Izabal regional offices held identification activities and meetings in which the following key actors were identified:

- Community Development Councils (COCODES) and their Assemblies
- Local Regional Indigenous and Community Associations and Protected Area Community Assemblies (Asambleas o Consejos Intercomunitarios de Áreas Protegidas)
- Protected Area Executive Councils or Boards of Directors ("Consejos Ejecutivos Locales de Áreas Protegidas")
- Departmental and Municipal Coordination Instances: CODEDE and COMUDES
- Farmers associations
- Local leaders

Please consult Document "*Plan de Comunicacion Final.docx*" for more details of the stakeholders identification.

2.7.3 STAKEHOLDER CONSULTATION

During the 25 years of working in Izabal, FUNDAECO has succeeded in maintaining a strong relationship with several groups and local associations involved in all the programs implemented in the region. Through this connection efforts FUNDAECO has acknowledged the needs of the local communities. In addition, the Deforestation Agents and Drivers Analysis, developed for the project, has identified the activities of community interest to tackle drivers and threats related to deforestation, including those referred to community needs. (See document "*Informe de analisis de causas y agentes de deforestación.pdf*" and "*Using exploratory factor analysis to explore the drivers of deforestation in the Sarstun-Motagua region of Guatemala.pdf*"). According to both analysis, communities identified lack of

access to economic opportunities and lack of employment opportunities, between the main factors for deforestation in the project region. In response, the project includes direct actions to support local communities to cover these needs.

FUNDAECO has implemented different actions such as meetings and assemblies with the organized and unorganized groups, individuals, Departmental Development Councils (CODEDE), Municipal Development Councils (COMUDES), Community Development Councils (COCODES), Women Rights Groups and governmental institutions. These community structures have been used to implement the consultation processes of the project. (See point 3.7 of the document).
The "Social and Gender Participation Assistants" (APSG in Spanish) are the social figure responsible of strengthen the capacities of the organized community groups and accompany the conformation of community groups when needed. For the project design, APSG had helped to identify possible beneficiaries and to socialize the project. (See document "*Base socioeconomica.pdf*").

2.7.4 PUBLIC COMMENT PERIOD

The PDD will be published in English at CCB website at the same time that FUNDAECO will make public the project Implementation Plan in Spanish. FUNDAECO will organize socialization activities with associations and community groups, in order to ensure understanding and obtain comments. When needed a Q'eqchi' translator will participate to guarantee comprehension of Q'eqchi' communities. All comments will be centralized by FUNDAECO and will presented to CCB and project validator.

2.7.5 STAKEHOLDER CONFLICTS AND GRIEVANCES

Based on its past experience in the Project Region, FUNDAECO will strengthen and expand its existing procedures to ensure access to information, response to complaints and grievances, and conflict prevention and resolution -from the community to the regional level-.

Reception, registration, response, resolution and/or referral of grievances will be executed at different geographical and organizational levels, according to their gravity and urgency, ranging from requests of access to information, operational and administrative complaints, grievances and disputes over rights of access, collective conflicts, and potential violations of Legislation and Fundamental Rights. Different and specific channels of communication and complaint will be used, based on current practices, in order to ensure that all stakeholders, particularly vulnerable populations – such as indigenous women- have rapid access to complaints and grievance redress.

At the community level, the Boards of Directors of Local Community Councils (COCODEs) will act as Grievance and Mediation Bodies, directly receiving operational complaints from community farmers and individual project participants, and channeling them directly to Local Agroforestry Technicians assigned to their villages. Also, at the community level, a separate and specific channel of communication will be established in order to channel requests for information and complaints from local indigenous women, through the network of Social Workers and Nurses assigned to their village, using our "Women Clinics" as "safe spaces" for the expression of concerns and complaints by women and youth. In the past, this network has proven an effective mechanism to receive insightful and honest opinions and complaints that may go unnoticed by male technicians and farmers. At this level, requests for information or complaints related to administrative and operational issues will be addressed within one week.

At the protected area level Presidents of Regional Community Associations and Presidents of COCODEs will directly channel their requests for information and complaints to Protected Area Coordinators. If the protected area coordinator cannot solve the complaint, Presidents of Regional Community Associations, will directly address the Regional Coordinating Office of the Project, located in Santo Tomas de Castilla. At this level, the Regional Coordinator and FUNDAECO´s Gender and Social Participation Coordinator will receive and register all complaints, and will follow-up on appropriate responses and resolutions to grievances and disputes over rights of access and potential collective conflicts.

If disputes over rights of access and potential collective conflicts cannot be solved by regional staff, three official instances for conflict Mediation that have proven effective in the past will be used: The Local Representative of the Human Righs Ombudsman ("Procuraduría General de Derechos Humanos"); The Local Representative of the Presidential Commission on Human Rights (COPREDEH); ant the Regional Inter-Institutional Roundtable for the Resolution of Agrarian Conflicts. The Governor Office will be used as a Regional Mediation and Arbitration body, particularly in cases were collective conflicts might arise. Complaints related to inequity of resource allocation and/or distribution of benefits will be addressed at the regional level within two weeks.

In the case of conflicts related to lands, project ownership, and other collective rights, claims will be firstly addressed by the Regional Coordinating Office, and will be presented for mediation by regional official bodies if needed, and responses and appropriate actions shall be taken within a month. If regional staff and regional implementation bodies of the project are themselves subjects of complaints and grievances, or in the cases of grave conflicts or complaints, the Project Directive Committee and FUNDAECO´s Ethics Committee will intervene, and will take appropriate actions in order to correct and redress complaints.

If grievances cannot be resolved through these internal bodies, mediation and arbitration will be referred to Judicial Arbitration in a Court of Law, and to competent courts of relevant jurisdiction, particularly in the case of violations of Legislation and Fundamental Rights, without prejudice to a party´s ability to submit the Grievance to a competent superior national or international body. Requests for Information, Complaints and Grievances will be received and channeled through the following channels:

- Direct interviews with local Agroforestry Technicians and Social Workers
- Direct Interviews with Protected Area level Coordinators
- Direct interviews with the Regional Project Coordinator and the Regional Gender and Social Participation Coordinator
- Direct Calls to Project Staff
- Direct Participation in Meetings of Protected Area Community Assemblies
- Direct Participation in Meetings of COCODEs, and COMUDES
- Direct Participation in Protected Area Executive Councils
- All institutional communication channels
- Other new channels can include: SMS to project staff, anonymous complaints through a specific Telephone Number and Complaints Box located in each Local Municipality within the Project Region.

A registry of complaints, responses and referrals will be kept at the Regional Level by the Gender and Social Participation Direction, at the National Level by the Project Directive Committee, and at the Institutional Level by FUNDAECO´s Ethics Committee.

In order to improve the Project´s performance as related to proper and effective response to complaints and grievances, the following mechanisms will be implemented:

- Quarterly Monitoring of requests for information, complaints and grievances, in order to identify areas if improvement and correction of procedures and/or operational methodologies
- Annual stakeholder satisfaction surveys, to be carried out by the Gender and Social Participation Direction of FUNDAECO,
- Annual Risk Assessment and identification of Potential Conflicts, and development of a Project Contingency Plan, in order to address issues that might develop into collective conflicts or grievances.

2.8 COMMERCIALLY SENSITIVE INFORMATION

The following document and information are commercially sensitive and not publically available. This information will be presented to the validator:

- Project budget
- Financial projections
- FUNDAECO Manuals, Policies and regulations
- Contracts between FUNDAECO and forest owners
- Any other agreements or contacts related to the project

3 LEGAL STATUS

3.1 COMPLIANCE WITH LAWS, STATUES, PROPERTY RIGHTS AND OTHER REGULATORY FRAMEWORKS (G3 & G5)

FUNDAECO is compliant with all relevant local and national laws, including those listed in Table 14 below.

Law	Summary and Relevance to Project
Decree 07-2013. Framework for the Regulation of the Reduction of Vulnerability, the Mandatory Adaptation to the effects of Climate Change and the Mitigation of the effects of Greenhouse Gases.	This law establishes right of use for landowners.
Law for Forestry Incentives for Posessors of Small Extensions of Land for Forestry or Agroforestry Use (PINPEP). Decree 51-2010	This law creates economic incentives for posessors of small parcels to participate in agroforestry or forest conservation activities.
Draft of the Law for Promoting the Establishment, Recovery, Restoration,	This bill proposes to continue the forestry incentive program in Guatemala from 2017 for

Management, Production, and Protection of Forests in Guatemala (PROBOSQUE)	another 30 years. PROBOSQUE also extends the scope of the original PINFOR to be more socially inclusive.
Protected Areas Act	The National Commission for Protected Areas and the Guatemalan System for Protected Areas (SIGAP) were created to ensure the optimal functioning of essential ecological processes and of vital natural ecosystems for the benefit of all Guatemalans. This act designates specific areas of Guatemala as protected areas with specific land use restrictions.
Forestry Law	The law deems reforestation and forest conservation as matters of national urgency and of social importance. It also promotes the idea of sustainable management for forest development and is the law that first established the National Forestry Institute and the Program for Forestry Incentives (PINFOR).
Law on Land Registry	Established the registry for cadastral data on the national level. The law also defines different types of property and land ownership such as community lands, and possessors.
Law for the Public Access to Information	The objective of this law is to guarantee that all interested parties, free from discrimination, have the right to request and access public information in the possession of the central authorities and local government. This is a key tool for the dissemination process of both the project and the national ER program.
Forestry Policy	The objective of this policy is to increase the socioeconomic benefits derived from the goods and services produced in forest ecosystems and to contribute to land management in rural areas through productive management and the conservation of natural resources.
Agricultural Policy	The agricultural policy aims to transform the agrarian situation of Guatemala by promoting legal possession and land tenure, as well as the resolution of land conflicts so that together with the use of other productive assets, conditions are improved of the population lives in rural areas and integrated rural development is fostered, in a multicultural society
National Policy for Integral Rural Development (PNDRI)	This policy's objective is to achieve improvements in the quality of life for people in rural areas through equitable access and sustainable use of productive resources, means

	of production, and natural and environmental goods and services.
Policy for Biological Diversity	It aims to promote effective management of biodiversity in Guatemala by emphasizing conservation and sustainable resource use as a crucial factor in sustainable development.
National Policy for Climate Change	The Climate Change policy's objective is to have Guatemala adopt risk prevention measures on a national and municipal level in order to reduce vulnerability and improve adaptation to climate change. It also aims to reduce GHG emissions in order to improve the quality of life of Guatemala's citizens and to strengthen Guatemala's influence in international climate change discussions.
National Strategy and Action Plan for Biodiversity 2012-2022	This is a tool developed to implement the national Policy for Biological Diversity and to complement article 64 of the Constitution, which declares that conservation, protection and improvement of the country's natural resources are topics of national concern.
National Development Plan Katun 2032	A national development plan with goals for sustainable development throughout Guatemala by 2032.
Plan of Action for the Prevention and Reduction of Illegal Logging in Guatemala	This plan aims to strengthen institutional actions to prevent and reduce illegal logging, while fostering responsible participation of related stakeholders to design and implement a long term strategy
Forestry Concessions	Established zones for forestry use and management for both communities and industry. Management units are defined by CONAP and are approved for a specific type of use or management of the area's natural resources, which can involve sustainable management, protection, conservation, and improvement. Concessions are granted for long periods of time and require the development of management plans, environmental impact assessments, and land use plans, which are approved by CONAP to ensure compliance with regulations. CONAP has granted a total of fourteen different concessions, twelve of which are community-managed and two of which are for industrial use.
National Strategy for the Sustainable Production and Efficient Use of Firewood	

Table 14. Applicable laws and regulations.

3.2 EVIDENCE OF PROJECT OWNERSHIP (G5)

Based on the VCS Standard Section 3.11.1, the project demonstrates that the proponents have Right of Use over the emission reductions under subsection 4:

"Project ownership arising by virtue of a statutory, property or contractual right in the land, vegetation or conservational or management process that generates GHG emission reductions and/or removals (where such right includes the right of use of such reductions or removals and the project proponent has not been divested of such project ownership)"

As a grouped project the REDD+ Project for Caribbean Guatemala has a number of landholders with different land tenure arrangements where project activities are implemented and emission reductions can be claimed. Different tenure arrangements include private property, private property holders without formal title termed *poseedores*, community lands, State lands administered by CONAP, State lands given in concession to communities and industries and other users. With the exception of *poseedores* all of the tenure arrangements present in the grouped project area arise from either formal titles or formal management agreements with the State. These formal agreements are catalogued by the Cadastral Information Registry (RIC) following the Cadastral Information Registry Act of 2005 (Decree 41-2005).

In the case of *poseedore*s, land titles are recognized by the State through municipal certificates. A *poseedore* is defined as a land holder who without being land owner exercises some or all of the usual property rights over a piece of land (Article 23 of Decree 41-2005). PINPEP furthers the definition of a *poseedore* in the context of forests and delineates clear statutes of property rights and required documentation. PINPEP rules hold that to be recognized as a land holder without title (i.e. *poseedore)* a certificate provided by the mayor of the relevant municipality is required declaring that the person concerned is known as the local occupier of the land in a way that is peaceful, public, permanent and in good faith and that no competing claim on the land is known.

With established rights to property, Article 22 of the *Framework for the Regulation of the Reduction of Vulnerability, the Mandatory Adaptation to the effects of Climate Change and the Mitigation of the effects of Greenhouse Gases* (Decree 07-2013) furthers the project ownership of legal owners or *poseedores* to emission reductions generated in either voluntary or compliance markets. For the REDD+ Project for Caribbean Guatemala, all participating properties have transferred their emissions reductions project ownership to FUNDAECO. A database of confidential contracts with each land owner will be provided to auditors upon request. Each contract transfers carbon rights for a minimum of 30-years.. Where project activities have been implemented since the project start date carbon rights are transferred retroactively and land owners have declared to not participate in any other emissions trading programs.

3.3 EMISSIONS TRADING PROGRAMS AND OTHER BINDING LIMITS (G5)

Guatemala submitted an Intended Nationally Determined Contribution (INDC) to the UN Framework Convention on Climate Change's (UNFCCC) Paris Agreement in 2015. The Paris Agreement will not take effect until 2020 and as such no emissions trading programs currently exist within Guatemala. Currently a national REDD+ program is under development but is not yet operational.

3.4 PARTICIPATION UNDER OTHER GHG PROGRAMS (G5)

The project has not been registered, nor is it seeking registration under any other GHG program.

3.5 OTHER FORMS OF ENVIRONMENTAL CREDIT (G5)

Carbon credits are currently the only environmental credit being generated from this project. In addition, the appropriate legal agreements are in place between project participants to ensure credits are not sold more than once.

3.6 PROJECTS REJECTED BY OTHER GHG PROGRAMS (G5)

The project has not been rejected by any other GHG program.

3.7 RESPECT FOR RIGHTS AND NO INVOLUNTARY RELOCATION (G5)

The project does not require or involve the involuntary relocation of people or of activities important for their livelihoods or culture. The project is designed respecting and supporting people rights, in this sense the project includes land legalization actions that allow interested communities, with historical rights but without land titles, to include their forest in the grouped project area.

3.7.1 RIGHT TO LAND AND FREE, PRIOR AND INFORMED CONSENT (G5)

The Free Prior and Informed Consent process was implemented by FUNDAECO with the identified stakeholders mentioned in point 2.6.2. The project team and field technicians developed more than a 100 meetings, workshops and assemblies to present the project to the communities and institutions involved in the project, and to discuss their support or consent.

The information presented and discussed during the FPIC process explained: the fundamental knowledge about Climate Change and the environmental services of the forest; the deforestation rates of the Caribbean Guatemala; the concepts and elements related to REDD+, and the objectives, strategies and benefits of the REDD+ Project.

With the purpose of performing a FPIC process that meets the criteria of the international conventions, the project was launched by the Department Governor, through a meeting request with the main institutions and coordination groups, including interinstitutional coordination groups, development Councils, and regional associations. The launching call and invited institutions and groups are presented in the *Informe de Proceso FPIC.*

The strategy followed during the implementation of the FPIC process (detailed in document "*Informe de Proceso FPIC*") looked to cover all the coordination and organization levels within the project region starting with: the Governor presentation; then meetings with governmental institutions, interinstitutional coordination groups, and development Councils; meetings with key community groups and leaders and finalized with workshops with private forest owners and other stakeholders.

More than 100 consultation and socialization events where held from November 2015 to May 2016 (meetings, workshops, assemblies, etc.) in which more than 2400 people participated (between community groups, governmental institutions, community leaders, private stakeholders, women rights groups, etc.).

The free and previous consultation process developed with the communities involved in the REDD+ project was made in order to obtain the community participation and validation of the proposed project, it also helped –in an indirect way- to obtain the communities' main concerns regarding the implementation of the project and the activities that FUNDAECO should develop to support the REDD+ project. (Document "*Informe de Proceso FPIC*").

3.7.2 CONFLICTS OR DISPUTES OVER RIGHTS TO LANDS

Since the signing of the Peace Accords in 1996, the Government of Guatemala has established a comprehensive institutional framework that seeks to solve agrarian conflicts and support access to land and secure legal tenure rights for communities.

The Agrarian Affairs Secretariat (SAA) is the Government agency in charge of monitoring, reporting, and solving agrarian conflicts in Guatemala. It seeks to mediate and resolve conflicts, and to pursue administrative solutions to agrarian conflicts within the Public Administration.

The National Lands Fund (FONTIERRAS) is the Government Agency in charge of ensuring access to land and secure legal tenure rights for communities, either through subsidized loans or through an administrative process that transfers National lands to communities.

The Cadastral Registry Office provides technical support and cadastral information to these institutions, in order to inform and support the resolution of conflicts.

Additionally, The Human Rights Ombudsman Office and the Human Rights Secretariat of the Presidency ensure oversight and provide support to communities affected by conflict, seeking to ensure that Government Institutions respond efficiently and rapidly to cases that could give rise to conflicts, from a Human Rights approach.

At the regional level, Regional Roundtables for the Resolution of Agrarian Conflicts ensure the close coordination among the key Government Institutions dealing with these issues, and usually include representatives from the Governor´s Office, the Agrarian Affairs Secretariat, FONTIERRA, CONAP, local Municipalities, and FUNDAECO (in the case of Izabal).

The Agrarian Affairs Secretariat, the Government agency in charge of monitoring, reporting, and solving agrarian conflicts in Guatemala, ensures follow-up to between 1,300 to 1,500 cases per year in Guatemala. Of these, between 75 and 150 are reported on average for Izabal, of which an average of 20 to 25 have been located within the project zone. At the national level, an average of 50 to 90 conflicts are successfully resolved each year.

These conflicts are classified under four categories:
"Disputa de Derechos": Disputes over land rights
"Limites Territoriales": Boundary disputes

"Ocupación de Tierras": disputed occupations of land
"Regularización": Legalization of community ownership in National Lands

All these types of conflicts have one point in common: All participating parties seek to claim, obtain or recover their legally recognized right to land property.

Over the past fifteen years, FUNDAECO has worked closely with all these government institutions, in order to support the resolution of agrarian conflicts and in order to ensure access to secure land rights of local communities in the project region. Through formal agreements with FONTIERRA, FUNDAECO has supported the legalization of over 16,000 hectares of lands and forests in favor of 30 local indigenous and non-indigenous communities in the project region. Additionally other organizations including Pastoral de la Tierra had supported legalization of 15,000 hectares, benefitting 22 communities.

In this regard, FUNDAECO has developed a proactive strategy in order to tackle and defuse agrarian conflicts and in order to support the legalization of community lands and forests throughout the project region. This strategy includes the following elements:

Participation in the Regional Roundtable for the Resolution of Agrarian Conflicts of Izabal. This Roundtable have monthly meetings, as well as field visits and non-ordinary meeting as needed.

Negotiation of Formal Inter-Institutional working agreements with FONTIERRA in order to support the legalization of communities within the project region

Support to lobbying, legal and technical procedures in FONTIERRA, CONAP, and the Cadastral Registry, in order to advance the legalization of community lands

Regular meetings and open communication channels with local agrarian organizations, including CUC, CODECA, Pastoral de la Tierra, and others

Inclusion of community land legalization demands in Laws, management plans and other legal management tools for protected areas

Technical and financial support to land legalization processes required by FONTIERRA – including the mapping of community lands; cadastral and registry studies; socio-economic studies; soil analysis; and land management plans.

In this regard, it is important to point out that the REDD+ Project for Caribbean Guatemala includes a Land Legalization component, which will seek to support the legalization of 25 communities across the project region.

Finally, it is important to point out that the National Climate Change Law (Decree 7-2013) – assuming the fact that many community managed forests do not have a legal registry of property - specifically indicates that carbon rights are held by the owners or possessors of land, thus recognizing the right of communities that have managed and possessed their lands and forests, to participate in Emission Reduction projects.

In this regard, FUNDAECO has integrated community forests as they have identified by communities themselves, and recognized by their local Municipalities, thus ensuring their transparent and equitable participation in the project. This in itself has been an important strategy in order to avoid further agrarian conflicts in the project region.

3.8 ILLEGAL ACTIVITIES AND PROJECT BENEFITS (G5)

Illegal activities that have historically occurred within the project area include deforestation for land use change purposes, and illegal logging. The project does not benefit from deforestation for subsistence

agriculture or cattle grazing purposes or the removal of timber through illegal logging. These activities result in negative impacts to project benefits, and as a result the project has several ways of minimizing illegal activities with in the area, as shown in Table 15 below.

Illegal activity	action	Benefit
Illegal logging	Support to law enforcement	Support to Guatemalan institutions in charge of law enforcement, especially CONAP, INAB and MP.
		Support to communities or individual forest owners in legal following in case of illegal activities committed by a third part.
		Support in forest patrols especially to communities or individual forest owners that do not have the resources to deploy this action.
	Forestry plantations	Access to resources
deforestation	Law enforcement	Support to Guatemalan institutions in charge of law enforcement, especially CONAP, INAB and MP.
	Forest patrols	Support to communities or individual forest owners in legal following in case of illegal activities committed by a third part.
	Support for access to forestry incentives program PINFOR and PINPEP, and incomes from VCUs	Access to resources as they will not have to pay for a professional to prepare files to be presented to incentives Programs PINFOR and PINPEP, alternative incomes from incentives and VCUs
	Support for agroforestry plantations and access to markets	Access to resources (plantations supplies, technical assistance, marketing support) and alternative incomes

Table 15. Potential illegal activities affecting the project.

Since the signing of the Peace Accords in 1996, the Government of Guatemala has established a comprehensive institutional framework that seeks to solve agrarian conflicts and support access to land and secure legal tenure rights for communities.

The Agrarian Affairs Secretariat (SAA) is the Government agency in charge of monitoring, reporting, and solving agrarian conflicts in Guatemala. It seeks to mediate and resolve conflicts, and to pursue administrative solutions to agrarian conflicts within the Public Administration.

The National Lands Fund (FONTIERRAS) is the Government Agency in charge of ensuring access to land and secure legal tenure rights for communities, either through subsidized loans or through an administrative process that transfers National lands to communities.

The Cadastral Registry Office provides technical support and cadastral information to these institutions, in order to inform and support the resolution of conflicts.

Additionally, The Human Rights Ombudsman Office and the Human Rights Secretariat of the Presidency ensure oversight and provide support to communities affected by conflict, seeking to ensure that Government Institutions respond efficiently and rapidly to cases that could give rise to conflicts, from a Human Rights approach.

At the regional level, Regional Roundtables for the Resolution of Agrarian Conflicts ensure the close coordination among the key Government Institutions dealing with these issues, and usually include representatives from the Governor´s Office, the Agrarian Affairs Secretariat, FONTIERRA, CONAP, local Municipalities, and FUNDAECO (in the case of Izabal).

The Agrarian Affairs Secretariat, the Government agency in charge of monitoring, reporting, and solving agrarian conflicts in Guatemala, ensures follow-up to between 1,300 to 1,500 cases per year in Guatemala. Of these, between 75 and 150 are reported on average for Izabal, of which an average of 20 to 25 have been located within the project zone. At the national level, an average of 50 to 90 conflicts are successfully resolved each year.

These conflicts are classified under four categories:
"Disputa de Derechos": Disputes over land rights
"Limites Territoriales": Boundary disputes
"Ocupación de Tierras": disputed occupations of land
"Regularización": Legalization of community ownership in National Lands

All these types of conflicts have one point in common: All participating parties seek to claim, obtain or recover their legally recognized right to land property.
Over the past fifteen years, FUNDAECO has worked closely with all these government institutions, in order to support the resolution of agrarian conflicts and in order to ensure access to secure land rights of local communities in the project region. Through formal agreements with FONTIERRA, FUNDAECO has supported the legalization of over 16,000 hectares of lands and forests in favor of 30 local indigenous and non-indigenous communities in the project region. Additionally other organizations including Pastoral de la Tierra had supported legalization of 15,000 hectares, benefitting 22 communities.
In this regard, FUNDAECO has developed a proactive strategy in order to tackle and defuse agrarian conflicts and in order to support the legalization of community lands and forests throughout the project region. This strategy includes the following elements:

Participation in the Regional Roundtable for the Resolution of Agrarian Conflicts of Izabal. This Roundtable have monthly meetings, as well as field visits and non-ordinary meeting as needed.
Negotiation of Formal Inter-Institutional working agreements with FONTIERRA in order to support the legalization of communities within the project region
Support to lobbying, legal and technical procedures in FONTIERRA, CONAP, and the Cadastral Registry, in order to advance the legalization of community lands
Regular meetings and open communication channels with local agrarian organizations, including CUC, CODECA, Pastoral de la Tierra, and others
Inclusion of community land legalization demands in Laws, management plans and other legal management tools for protected areas

Technical and financial support to land legalization processes required by FONTIERRA – including the mapping of community lands; cadastral and registry studies; socio-economic studies; soil analysis; and land management plans.

In this regard, it is important to point out that the REDD+ Project for Caribbean Guatemala includes a Land Legalization component, which will seek to support the legalization of 25 communities across the project region.

Finally, it is important to point out that the National Climate Change Law (Decree 7-2013) – assuming the fact that many community managed forests do not have a legal registry of property - specifically indicates that carbon rights are held by the owners or possessors of land, thus recognizing the right of communities that have managed and possessed their lands and forests, to participate in Emission Reduction projects.

In this regard, FUNDAECO has integrated community forests as they have identified by communities themselves, and recognized by their local Municipalities, thus ensuring their transparent and equitable participation in the project. This in itself has been an important strategy in order to avoid further agrarian conflicts in the project region.

4 APPLICATION OF METHODOLOGY

4.1 TITLE AND REFERENCE OF METHODOLOGY

Approved VCS Methodology VM0015, Version 1.1, Methodology for Avoided Unplanned Deforestation.

4.2 APPLICABILITY OF METHODOLOGY

The project is using the VCS-approved methodology VM0015, v1.1, "Methodology for Avoided Unplanned Deforestation" for quantification of GHG emission reductions and removals generated from avoided unplanned frontier deforestation.

In combination with the methodology, the latest version of the following approved tools and modules are used by the project:

- CDM A/R Methodological Tool Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities.
- CDM A/R Methodological Tool 03 Calculation of the number of sample plots for measurements within A/R CDM project activities.
- CDM A/R Methodological Tool 06 Procedure to determine when accounting of the soil organic carbon pool may be conservatively neglected.
- CDM A/R Methodological Tool 09 Estimation of GHG emissions related to displacement of grazing activities in A/R CDM project activity.
- CDM Tool for testing significance of GHG emissions in A/R CDM project activities.
- VM0003 Methodology for Improved Forest Management Through Extension Rotation Age (IFM ERA), v1.2
- VCS Tool VT0001 Tool for the demonstration and assessment of additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) project activities.

- VCS Tool for calculating deforestation rates using incomplete remote sensing images.
- VCS Module VMD0033 Estimation of emissions from market leakage.

Finally, the project meets all of the requirements for models and default factors set forth in the VCS Standard v3.6, issued October 19th, 2016, and the VCS AFOLU Requirements v3.5, issued October 19th, 2016.

Per the VM0015 eligibility requirements, the project meets the following conditions:

Condition (a):
"Baseline activities may include planned or unplanned logging for timber, fuel-wood collection, charcoal production, agricultural and grazing activities as long as the category is unplanned deforestation according to the most recent VCS AFOLU requirements."

The agents and drivers of deforestation study (see CNCG SM drivers of deforestation_final_1.pdf and Brief on Agents and Drivers v2.docx) found that the primary drivers of deforestation in the baseline are the conversion of forest land to annual agriculture, permanent agriculture, and pasture by small-scale farmers and large to medium scale cattle ranchers who are displace due to agro-industrial development in the reference region (See Section 5.3.1.1). These activities are unplanned as defined by Section 4.2.9 of the VCS AFOLU Requirements v3.5. No drivers of deforestation are planned.

Because the agents and drivers of deforestation identified in Section 5.3.1.1 are spread out across the landscape, the drivers are considered to be mosaic in nature in accordance with Section 4.2.9 of the VCS AFOLU Requirements v 3.5.

Condition (b):
"Project activities may include one or a combination of the eligible categories defined in the description of the scope of the methodology."

Project activities include protection of forest without logging activities and thus meets eligible category **A** as defined by the scope of the VM0015 Methodology, v1.1, see Section 2.2.

Condition (c):
"The project area can include different types of forest, such as, but not limited to, old-growth forest, degraded forest, secondary forest, planted forest, and agro-forestry systems meeting the definition of 'forest'."

The project area includes two types of forest, specifically Very Humid Forest and Humid Forest, and harmonizes with the Guatemala National Emissions Reduction Program. The forest definition is as follows:

Land with tree canopy cover of at least 30% with a minimum area of 0.5 hectares. Trees are woody plants with a stem and defined crown that reach a minimum height of 5 meters and a minimum diameter of 10 cm at maturity.

Condition (d):

"At project commencement, the project area shall include only land qualifying as "forest" for a minimum of 10 years prior to the project start date."

The project proponent has obtained satellite imagery from ten years before the project start date to demonstrate that land in the project area parcel qualified as forest in accordance with the Guatemala National Emission Reduction Program definition of forest: Land with tree canopy cover of at least 30% with a minimum area of 0.5 hectares. Trees are woody plants with a stem and defined crown that reach a minimum height of 5 meters and a minimum diameter of 10 cm at maturity.

Condition (e):
"The project area can include forested wetlands (such as bottomland forests, floodplain forests, mangrove forests) as long as they do not grow on peat. Peat shall be defined as organic soils with at least 65% organic matter and a minimum thickness of 50-cm. If the project area includes a forested wetlands growing on peat (e.g. peat swamp forests), this methodology is not applicable"

The coastal areas of Izabal contain mangrove forests with organic matter that in some plots exceed 65% and fit the definition of peat soil according to a study carried out by Garcia Chacon (2015). To meet the applicability conditions of the VM0015 Methodology v1.1 the extent of mangrove areas were removed from the project area. Mangrove areas were defined by a technical analysis using remote sensing techniques conducted by CATHALAC and MARN (see Mangroves_Mangle_Atlantic.shp).

4.3 METHODOLOGY DEVIATIONS

First Deviation	
Source:	VM0015 v1.1 Section 6.1.1 and Appendix III – Estimate of carbon stocks in the harvest wood products carbon pool
Criteria and Procedures:	The criteria and procedures described in Appendix III for the *Estimation of carbon stocks in the harvest of wood products* under *Method 2: Commercial inventory estimation.*
Relation to Monitoring or Measurement:	This procedure is related to measurement. To estimate the wood products at the time of deforestation an estimate of extracted biomass using an indirect measure of commercial volume, medium-term wood products, and long-term wood products are required following VM0015 v1.1.
Requested Deviation:	A modified version of the VM0003 Methodology for Improved Forest Management Through Extension Rotation Age (IFM ERA), v1.2 was applied for the estimation of wood products only if it provides a conservative and/or more accurate estimate of wood products.
Justification:	The modified version of the VM0003 Methodology for Improved Forest Management Through Extension Rotation Age (IFM ERA), v1.2 is provided in section 5.3.6.1. The estimate for extracted biomass carbon in VM0003 (EXC_{WP}) is more accurate than the estimate in VM0015 (CXB_{icl}). This latter estimate of extracted biomass carbon uses an indirect measurement of commercial

	volume relying on multiple estimators including above-ground biomass and commercial volume regressions. Whereas the estimate of EXC_{WP} relies only upon volume regressions for commercial species to estimate extracted biomass carbon reducing the uncertainty. Additionally, the modified version of the VM0003 v1.2 omits medium-term wood products. This leads to a more conservative estimate of wood products in the baseline as the release of emissions to the atmosphere as a result of wood products decay over the specified 20-year decay period are not accounted for.
Quantification Impact:	This methodology deviation meets the VCS Standard v3 principles of accuracy and conservativeness. Because the medium-term wood products are omitted from the overall wood products estimate resulting in a lower estimate of the forest carbon stocks, the impact on GHG emissions reductions and removals is conservative.

Second Deviation	
Source:	VM0015 v1.1 Section 6.1.1(e)
Criteria and Procedures:	Calculate the long-term (20 years) average carbon stocks of post deforestation classes.
Relation to Monitoring or Measurement:	This procedure is related to measurement and conflicts with the measurement methods for the decay of below-ground and deadwood biomass in Section 6.1.2.
Requested Deviation:	The project proponent has randomly sampled initial and final LULC classes to arrive unbiased estimates of carbon stocks. The project proponent applies the unbiased estimates of carbon stocks in accounting and uses a linear decay model per the requirement of Section 6.1.2 rather than a 20-year average.
Justification:	The carbon stocks estimates for each selected carbon pool are unbiased because the carbon stock samples for each LULC classes were randomly selected. The project proponent conservatively accounts for the uncertainty in the carbon stock estimates according to the requirements of Section 6.1.1(f). Because the deviation is unbiased, it is more accurate than using (potentially) bias models to predict the flux within each carbon pools over a twenty-year prediction period. Relative to the VCS AFLOU Requirements for the decay of carbon over time, it is more accurate to account for the decay of biomass in below-ground and deadwood using a linear 10-year decay model rather than a 20-year average. By taking an average over time, the methodology allows for non-conservative "forward crediting" in the baseline scenario where

	emissions reductions for decay are accounted for before they otherwise would have occurred. This deviation is more accurate and conservative than the prescribed methodology methods.
Quantification Impact:	This methodology deviation meets the VCS Standard v3 principles of accuracy and conservativeness. Because the deviation avoids instances of forward crediting, emissions in the baseline are conservatively estimated and meet the AFOLU Requirements.

4.4 PROJECT BOUNDARY (G1)

4.4.1 CARBON POOLS

Carbon Pools	Included/ Excluded	Justification
Above-ground	Tree: Included	Carbon stock change in this pool is always significant
	Non-tree: Excluded	Conservatively excluded, expected to decrease in the baseline scenario
Below-ground	Included	A significant carbon pool
Dead wood	Excluded	Not a significant carbon pool
Harvest wood products	Included	A significant carbon pool
Litter	Included	A significant carbon pool
Soil organic carbon	Excluded	Conservatively excluded, expected to decrease in the baseline scenario

Table 16. Carbon pools included or excluded within the boundary of the proposed AUD project activity.

4.4.2 SOURCES OF GHG EMISSIONS

Source	Gas	Included/ Excluded	Justification
Biomass burning	CO_2	Excluded	Counted as carbon stock change
	CH_4	Excluded	Not a significant source (<5%) according to the revised LULUCF IPCC GL 1996 document.
	N_2O	Excluded	Considered insignificant according to VCS Program Update of May 24th, 2010
Livestock Emi	CO_2	Excluded	Not a significant source

ssio ns			
	CH$_4$	Excluded	Not an included activity
	N$_2$O	Excluded	Not an included activity

Table 17. Sources and GHG included or excluded within the boundary of the proposed AUD project activity.

4.5 BASELINE SCENARIO (G2)

Per VM0015, the most plausible baseline scenario for the project is continued unplanned deforestation for timber, agriculture and grazing activities resulting in removal of old growth/ primary forest. The project area would be deforested in the absence of the REDD project activity. The deforested areas are mosaic in nature.

Deforestation of old-growth/ primary forest without logging (A)

This option applies because under the mosaic typology of deforestation, the historical changes in land-use are representative of the most likely future changes in land-use.

4.5.1 WITHOUT-PROJECT SCENARIO FOR COMMUNITIES (CM1)

FUNDAECO made a scenario exercise based on methods proposed by Richards and Panfil (2011). Focal questions were related to access to land and natural resources in both the baseline and project scenarios. The focal issues within the community were tied directly to the agents and drivers analysis, as is described in section 4.5.3.

Six main focal issues for communities were identified:
- Access to land
- Maize production/crop lands
- Access to livelihoods other than maize
- Rains and water
- Education
- Sexual and Reproductive education and health

a. Access to land: access to land is one of the main focal issues, and it means access to croplands, pasture land, and other natural resources including wood, fuelwood, and water sources. At the community level, access to land also means access to sacred sites.

In absence of the project, it is expected that communities will continue the fight for the establishment of agricultural and pastoral land in forested areas due to factors such as the expansion of industrial agriculture in previously cultivated low-land areas and increasing population. However they are aware of the need they have for external support such as provided by FUNDAECO and the project, due that the process for land titling requires the preparation of technical and social files, as well as administrative procedures and lobbying with FONTIERRAS headquarters in Guatemala. They are aware that without land, there is no food security, but they also preview other situations such as migration and social conflict.

b. Maize production: Maize crop is considered focal issue since it means food security to families that cultivate it for consumption. During the exercise, the issue was analyzed from the production perspective; sufficient yield and a not sufficient yield, to feeding family needs. Production is related to quality of grain, agricultural practices, and quality of soil.   When adding other driver forces such as quality soil and land, and population growth the scenario shows that this is a multi-variable force, that then need to be addressed considering all other identified forces.

In the present, quality lands are scarce and peasants lack of best agricultural practices; so to get enough yield peasant needs to use more land, in shorter fallow cycles.

Without the project, communities will stay in present conditions, meaning they will need to expand croplands eliminating forests, but also getting into others lands when their land is not producing enough. When added population growth factor, situation turns into social conflicts. Other envisaged situations are related to lack of rains ("the forest produces rains"), erosion and disasters.

c. Access to livelihoods other than maize: Livelihoods other than maize can include other crops, but also activities such as ecotourism, or work opportunities. However, this driver force relies on some other forces such as access to markets, best organization and entrepreneurial capacities.

Without the project, there will be less access to project activities and then less support to diversified and alternative livelihoods. It is recognized that the government have some programs, but lack of capacities to identify priorities, reach communities and make a good follow-up of their program beneficiaries. In this scenario, communities will need to turn to unsustainable wood extraction, unsustainable maize expansion and migration to uncertain conditions; poverty will increase.

d. Rains and water: Considered as contributing forces since crops and domestic consumption rely on them, rain and water are an uncertain driver force since there are no specific models for the region. However local have started to feel difference between previous patterns and present rain patterns, in the last years yields were affected by longer dry seasons, at the same time that disasters have occurred with heavy unusual rains over deforested lands, and river flows are reduced compared to before volumes.

When analyzing this driver force it is clear that there is a local knowledge on the influence on forest in the rivers flows and rains. Without project, there will be no law enforcement or access to incentives that guaranteed watersheds protection, that will be deforested leading to reduced river flows and competition for its use.

c. Education this is a driver force related with livelihoods but also to general community welfare. In the present communities, do not have access to high school, or to technical education levels. This reduces their work opportunities. In addition, the situation is worst for women that in many cases do not finish even elementary school. Without the project education opportunities for women area reduced.

e. Sexual and reproductive education and health: In the present women need to walk long distances to the nearest public health services, and they can die during pregnancy or birth from causes that can be prevented; rural and isolated communities in the project region have high mortality rates, compared just to the ones from Africa. There is also no access to family planning methods which impacts in the health of women and children, but also in the family economy, and resources such as croplands.

Without the project, mortality rates for pregnant women will remain the same, but also their health conditions in general. Moreover, population growth will affect scarce resources, especially land and cropland.

4.5.2 WITHOUT-PROJECT BIODIVERSITY SCENARIO (B1)

Biodiversity conditions in the baseline scenario were analyzed based on the observed and predicted land use changes taking place in the project region. As discussed in Richards and Panfil (2011), changes in biodiversity are strongly correlated with changes in forest cover, making it possible to measure and analyze biodiversity health by using proxy indicators within the environment. The fact that biodiversity abundance is directly correlated with habitat (i.e. forest cover), and ecosystem health is possible to determine impacts on biodiversity from broader-scale assessments on an ecosystem or regional level. This method of analysis was used for the FUNDAECO Project to inform the development of the theory of change model for biodiversity, including project objectives and activities geared towards bringing about biodiversity benefits (see Section 7 and TOC Activity Matrix v1.14.xlsm).

Through an understanding of the biodiversity that has historically been supported within the project region (see Section 1.3.7), and an analysis of trends in forest loss in this area, the trajectory of ecosystem health can be accurately predicted. The project region consists of a network of threatened forest areas that provide invaluable habitat for an abundance of endemic species, as well as numerous migratory species. These forests also provide large-scale ecosystem services such as nutrient enrichment, erosion control, and hydrological function that benefit both communities and biodiversity within the region.

The ecological integrity of these forests, however, has been severely impacted by anthropogenic land use change over the past several decades. An analysis of deforestation within the Sarstun Motagua reference region from the period of 2001-2010 showed an annual rate of deforestation of 3.41% (see Fundaeco VM0015 Accounting Model v1.57.xlsm for details). This translates to a loss of roughly 20,503 hectares of forest per year in the reference region.

The problem flow analysis for biodiversity in Table 18, shows how the drivers of deforestation create a causal chain of events that result in the loss of forest area and have negative effects on biodiversity throughout the region. Not only have these drivers already contributed to huge losses in forest area throughout the reference area in the past decade, but there were no direct actions being taken in the absence of the project to address any of these threats. Without the project's intervention, there are no indications that measures would be taken to protect and maintain biodiversity within the Sarstun-Motagua region, which would result in the further fragmentation and loss of forest habitat as well as the decline in health and abundance of forest and marine species.

Project Intervention Areas	Contributing Factors	Contributing Factors	Direct Threat	Conservation Target, Focal Issues
Governance and resource protection (strengthening enforcement of the law, legal framework, land title, land-use planning & implementation)	Limited local resources, legal framework, governance and capacity for land-use planning	Little to no enforcement of laws against forest clearing	Conversion to crop land	In-tact forest area (diminished forest area, fragmentation, degradation of forest composition, structure, function and habitat) Marine life Biodiversity HCVs
		Lack of clarity & definition of individual / family land rights.	Conversion to pasture for cattle ranching	
		Ineffective land-use planning	Illegal settlement of land	
Providing access to resources, alternative livelihoods	Limited local resources , and limited alternatives to land clearing, timber extraction, and fishing	Unmet economic, sustenance needs for families. High demand and price for timber and seafood.	Logging, fuelwood collection, and fishing for local enterprise, domestic use	
Education and community empowerment		Limited local capacity for environmental leadership project implementation	Commercial sale of fuel wood, charcoal, and fish	

Table 18. Biodiversity problem flow analysis.

The model of the baseline scenario also corroborates the biodiversity problem flow analysis, in that large-scale deforestation is predicted to affect biodiversity throughout the reference region and project area were the project not in place. The ex-ante estimates of deforestation in the project area show a devastatingly high rate of deforestation, which eventually stops in 2037 due to all primary forest having been lost (see Figure 11 and Fundaeco VM0015 Accounting Model v1.57.xlsm). A loss of forest of this magnitude would result in dramatic negative effects on biodiversity through the loss, and degradation of habitat and ecosystem functions. These predicted outcomes highlight the necessity of effective conservation measures throughout the region.

Ex Ante Deforestation (ha/year)

4.5.3 WITHOUT-PROJECT CLIMATE SCENARIO (CL1)

Under the defined baseline scenario (see Section 4.5), the project area would be deforested at existing or historical rates in the absence of the project. This scenario would result in significant emissions of carbon dioxide when compared to the expected decrease in emissions from project activities under the with-project scenario. For a more detailed analysis of the climate baseline scenario, see Section 5.3.

4.6 ADDITIONALITY (G2)

The project has used the VCS Tool for the Demonstration of Additionality in VCS AFOLU Project Activities (VT0001) version 3.0 to assess the additionality of the project and select the baseline scenario.

Step 1: Identification of alternative land use scenarios to the proposed VCS AFOLU project activity

> ***Sub-step 1a(a): Identify credible alternative land use scenarios to the proposed VCS AFOLU project activity***
> i.   Continuation of pre-project land use. The following land uses occurred in the project area prior to project initiation:
>
> > 1.   Unplanned expansion of small-scale commercial agriculture, subsistence agriculture, and cattle grazing – As stated above, the *Ladino* and *Q'etchi* communities are relocating from fluvial valleys to protected areas due to heavy investment for large-scale commercial production of timber species, palm oil, and cattle-grazing. The remaining forested areas and protected areas of the region are located in the region's mountains that are generally above 300m in altitude with steep slopes and are unattractive for agro-industrial cultivation. As a result, agents of deforestation are typically small-scale farmers growing annual or permanent crops and farming livestock. This land use results in deforestation (unplanned).

ii.   Project activity on the land within the project boundary performed without being registered as the VCS AFOLU project

   2. It is possible, though highly unlikely, that FUNDAECO could prevent deforestation from small-scale farming and cattle-grazing that result in the project area without registering the activity as a VCS project and by financing alternative livelihood and other project activities through aid agencies, philanthropy, or grants.
   3. It is possible, though highly unlikely, that national or international development or non-governmental organizations could implement similar alternative livelihood, governance, and capacity building activities to reduce deforestation.

iii.   Activities similar to proposed project activity on at least part of the land within the project boundary resulting from legal requirements or observed similar activities

   4. PINFOR and PINPEP are established forest protection programs by INAB that include payments for conservation or protection of forest resources on private lands. It is possible, although highly unlikely, that landowners could pursue these payments individually in the project area to protect or conserve forested areas and prevent unplanned deforestation.

Sub-step 1a(b): Credibility of identified land use scenarios

Scenario 1 was present in the project area prior to project initiation and is thus credible. The drivers of deforestation study carried out by the CNCG working group (CNCG SM drivers of deforestation_final_1.pdf) confirm that these land uses were present in the project area prior to the project start dates and are likely to continue unabated in absence of the project. Scenario 2 above is considered credible since FUNDAECO has been operating in the Izabal region for over 20 years through various financing strategies including donors. Scenario 3 is considered credible because while aid and non-governmental organizations have implemented sustainable development projects in the region before, they have been markedly different in scale. Scenario 4 is considered credible as there are existing regulations for PINFOR and PINPEP (see Section 3) that are managed by INAB and these activities are present in the project area prior to project initiation.

Sub-step 1a(c): List of credible alternative land use scenarios

1. Unplanned expansion of small-scale commercial agriculture, subsistence agriculture, and cattle grazing, see number 1 above.

2. Implementation of alternative livelihood and other activities to reduce of deforestation due to small-scale agriculture and cattle-grazing by FUNDAECO through financial resources other than carbon credits, see number 2 above

3. Implementation of alternative livelihood, governance, and capacity building activities to reduce deforestation by an international or national non-profit, see number 3 above.

4. Application for conservation payments through the PINFOR or PINPEP programs by individual landowners resulting in reduced deforestation.

Sub-step 1b(a): Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

i.   Scenario 1 is legal within the project area except for within the *Zona Nulceos* of protected areas that according to the *Planes Maestros* (see Plan Maestro Cerro San Gil.pdf, plan maestro Parque Nacional Rio Dulce.pdf, Plan Maestro Parque Regional Municipal Montana Chiclera.pdf, Plan Maestro Punta de Manabique.pdf, Plan Maestro Río Sarstún 200709.pdf, and Decreto 16-2014_Sierra Caral.pdf) does not allow for the use of natural resources or any production system including agriculture, livestock, or forestry. Around the *Zona Nucleos* within protected areas are *Zona de Uso Multiplo*, *Zona de Amortiguamientos*, and *Zona Recreativas* where natural resources use or productions systems including agriculture, livestock, and forestry are permitted. Outside of the protected areas Scenario 1 meets applicable laws. Land use scenarios 2 & 3 involve the action of local or international NGOs and it is assumed that their activities would be in compliance with regulatory requirements. Land use scenario 4 is based on the regulatory framework of the PINFOR and PINPEP laws, described above in Section 3, and is this in compliance with all regulatory requirements.

ii.   In the case of Scenario 1, an analysis of current practice with *Zona Nucleos* is presented demonstrating that the mandatory laws with these areas are not enforced and non-compliance within these areas is widespread. As discussed below, an exploratory factor analysis of 501 questionnaires concerning the regional population's views on the cause of deforestation found that a "Lack of Laws, Enforcement and Capacity" is the second factor in explaining the quantity of deforestation in the region. This suggests that the regional population recognizes that mandatory laws within the region are not enforced and non-compliance often passes with no oversight from the legal authority of CONAP.

In addition to this evidence, the rate of deforestation was analyzed during the historical reference period based on LULC maps for 2001, 2006, 2010. Over that time period the *Zonas Nucleos* had a deforestation rate of 1.16% while within the Reference Region the deforestation rate was 3.41% (see fundaeco_deforestation_rate_v1.4.xlsx and Fundaeco Deforestation Rate - Zona Nucleos v1.1.xlsx).   Although the deforestation rate appears low to that of the reference region, this remains a relatively high deforestation rate that results in 2,260-ha of forest loss per year in areas where deforestation is illegal. Moreover, an analysis of the spatial drivers of deforestation (see Section 5.3.3.2.2) demonstrated that elevation, slope, distance to forest edge, distance to secondary roads, and distance to navigable hydrology were the variables that explained the greatest variance in locations of forest loss, where lower values explained greater deforestation. The average of each of these variables over forested areas for 2010 is presented in Table 19 across two areas: 1) the Grouped Project Area with *Zona Nucleos* removed and 2) the *Zona Nucleos*.
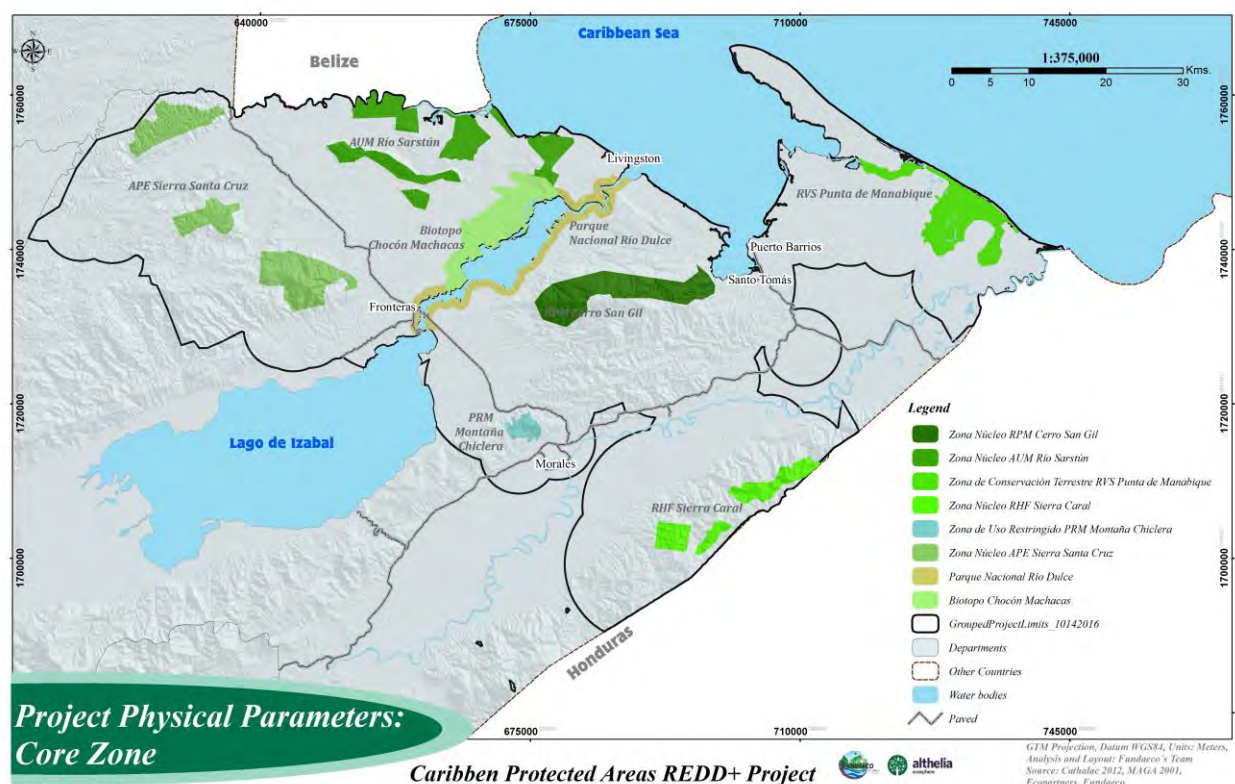
Figure 12: Map of the Core Zone (Zonas Nucleos)

Spatial Variable	Grouped Project Area	Zonas Nucleos	Grouped Project Area san Zonas Nucleos
Elevation (meters above sea level)	301.012	340.22	247.69
Slope (Percent rise)	27.531	24.90	28.08
Distance to Forest Edge (meters)	0.229	0.0967	0.3699
Distance to Hydrology (meters)	4268.83	5818.19	5138.75
Distance to Navigable Hydrology (meters)	7131.2	6347.0	7862.66
Pop Density (people per square meter)	106.984	105.673	116.63
Distance to Secondary Roads (meters)	4268.83	5818.19	3153.18
Distance to Tertiary Roads (meters)	1701.42	2363.07	1227.0
Distance to Primary Roads (meters)	11780.8	12729.4	10987.6
Farm coverage (coverage metric, higher = more coverage in region)	2844.35	1958.7	3575.26

Pasture coverage analysis (coverage metric, higher = more coverage in region)	34115.5	30543.1	36200.69

Table 19. Average values of explanatory spatial variables of deforestation with the Grouped Project Area, the Grouped Project Area san *Zonas Nucleos,* and the forest area in the *Zona Nucleos*.

Table 19 demonstrates that the identified spatial variables in the *Zonas Nucleos* are greater than that of the average of the Grouped Project Area and provide explanation for outside governance and oversight by CONAP for a lower deforestation rate. As *Zonas Nucleos* are often contained within the upper reach of mountain ranges in Izabal and within the interior of protected areas, this result is expected.

Lastly, the seven protected areas within the Project Zone are co-managed between FUNDAECO and CONAP. This is demonstrated in the Plan Maestros where FUNDAECO is listed as a management partner. This points to the fact that if FUNDAECO were not to receive additional funds through the REDD+ Project for Caribbean Guatemala, the capacity of an important management partner would be compromised proving that despite the illegality of deforestation in *Zonas Nucleos*, Scenario 1 remains additional.

Together, this evidence demonstrates that the local population recognizes the lack of enforcement within protected areas which is demonstrated by the 2,260-ha of forest loss per year in *Zonas Nucleos.* Although this deforestation rate is low compared to that of the reference region, this can be explained by location rather than governance or legal authority.

iii.   Based on above, no land use scenarios have been removed.

Sub-step 1b(b): Outcome of Sub-step 1b
1. Unplanned expansion of small-scale commercial agriculture, subsistence agriculture, and cattle grazing, see number 1 above.

2. Implementation of alternative livelihood and other activities to reduce of deforestation due to small-scale agriculture and cattle-grazing by FUNDAECO through financial resources other than carbon credits, see number 2 above

3. Implementation of alternative livelihood, governance, and capacity building activities to reduce deforestation by an international or national non-profit, see number 3 above.

4. Application for conservation payments through the PINFOR or PINPEP programs by individual landowners resulting in reduced deforestation.

Sub-step 1c: Selection of baseline scenario

Due to the continued displacement of *Ladino* and *Q'etchi* into protected areas and the lack of adequate governance and resources to limit land conversion for agriculture and cattle-grazing within the project area as demonstrated in Section 4.5.3 the most plausible baseline scenario is the continuation of previous and current land use scenario (scenario 1 above). This scenario has

been ongoing in the project area and reference area over the last decade and is unlikely to cease without effective intervention.

The project activities described in this document require substantial financial resources and long-term presence in the project area to manage the activities. Without significant financial returns to ensure project longevity, aid and non-governmental projects cannot operate at the scale described above. Because of these limitations on potential regional, national, and NGO activities, scenarios 2 and 3 were not selected.

PINFOR and PINPEP offer an alternative revenue source for forest protection and conservation that has existed in the project area prior to project initiation. Application to PINFOR and PINPEP, however, involves several technical steps including mapping of property and forest boundaries, forest inventory, and completion of technical forms. In Izabal this technical expertise has been primarily provided by FUNDAECO to private landowners and is not carried out by individual landowners. In addition, PINFOR and PINPEP payments are only provided to landowners for several years, after which they receive no additional benefits and cannot re-enroll in the program. This makes PINFOR and PINPEP unviable as long-term economic opportunities for landowners. For this reason scenario 4 was not selected.

Step 2: Investment Analysis
The VCS Additionality Tool requires that either step 2 (investment analysis) or step 3 (barrier analysis) be undertaken (or both). The barrier analysis was selected and is completed below.

Step 3: Barrier analysis
This section shows how project activities would not take place without the revenues arising from the sale of GHG credits.

Step 3a: Identify barriers that would prevent the implementation of the type of proposed project activity

Investment barriers. Similar activities to the Resource Protection, Governance, and Monitoring, Sustainable Enterprise, Education, Community Empowerment & Inclusiveness, and Increased Access to Resources activities identified in the Theory of Change document (TOC Activity Matrix v1.14.xlsm) have only taken place with the aid of grants from international cooperation, the national government, or international donors. Previously FUNDAECO received international aid to finance project activities that ended in April 2011 (Finalizacion CONTRATO JADE 2010-2011.pdf). With a slowdown in international aid FUNDAECO deliberately pursued a new financing strategy through REDD+ and forest carbon credits demonstrated by entering a Memorandum of Understanding with the Althelia Fund on August 8th, 2010 (MOU BNP PARIBAS_Complete.pdf). To overcome the lack of international aid and investment barriers FUNDAECO pursued a new financing strategy under REDD+.

Other forms of finance such as debt funding are not available for these types of project activities, unless under a REDD+ project that is conditional on the returns in the form of VCUs. As a non-profit organization that directs income towards management costs and project activities, seeking credit is inherently risky without producing a scalable commodity such as carbon credits. The REDD+ project enables the carbon streams to be used as guarantee.

Institutional barriers. There are risks related to changes in government policies, as the Guatemalan National Emissions Reduction Program is being developed, and there are on-going discussions about the adoption of a jurisdictional framework. Early REDD+ initiatives are being promoted by the Government, and will help bring down the barrier. The main institutional barrier, though, is the lack of enforcement within protected areas by national entities due to following shortcomings identified in Guatemala's Readiness Preparation Proposal(RPP) a)the existence of significant regulatory loopholes; b) cross competencies among different institutions, which often means that none of the institutions take responsibility; c) regulations that lack sufficient coercion; d) few formal areas for public participation in the design and control of institutions and policies; and e) a lack of inter-institutional coordination (Guatemala Final RPP_March 2012.pdf).

Barriers related to local tradition. Traditional use of resources and agriculture is very basic, not linked with broader markets, and relies on the harvest potential of a combination of subsistence crops.

Barriers due to prevailing practice. The REDD+ project promoted by FUNDAECO is the first of its kind in the Izabal Department of Guatemala. There are three other REDD initiatives in the Tierras Baja del Norte region of Guatemala in the Maya Biosphere Reserve, Sierra del Lacandon National Park, and in the eco-region of Lachua. Two of these projects have achieved validation under VCS and CCBA.

Barriers due to social conditions and land-use practices. Important drivers of deforestation in the area include increasing population and investment in agro-industrial activities in Izabal creating demographic pressure on land.

Barriers related to Land tenure and property rights. The prevailing communal land ownership limits the incentives for conservation, as property rights on the timberlands are not clearly defined. The internal informal tenure systems present a risk of land fragmentation.

Barriers related to markets, transport and storage. There are infrastructure barriers, including lack of transportation, energy and waterways to generate stock piling or processing of agricultural goods in the territories. It is difficult to transport products included in project activities to market as infrastructure is scarce or nonexistent.

Unregulated and informal markets. The markets for products related to the project activities do not allow the transmission of effective information to the communities proposing the project.

Remoteness of AFOLU activities. The project occurs in an area with underdeveloped road and infrastructure resulting in high transportation costs, eroding competitiveness and profitability of non-timber forest products

Lack of infrastructure. There are no facilities to convert, store, or add value to production from proposed project activities. This lack of infrastructure limits the possibilities for communities to profit from the goods produced through the proposed project activities.

Step 3b: Show that the identified barriers would not prevent the implementation of at least one the alternative land use scenarios (except the proposed project activity):

All barriers identified above will not prevent the land use scenarios identified in Step 1.

Step 4: Common practice analysis

Due to the lack of governmental and community resources, there are no operational projects or initiatives to reduce deforestation and forest degradation on this scale in the region. Several REDD+ projects do exist within other regions of Guatemala. These include:

- A project in the Forest Concessions of the Maya Biosphere Reserve, run by *Concesionarios Forestales de Petén* and the Rainforest Alliance. It covers an area of nearly 500,000 ha and aims to strengthen existing activities in sustainable forestry management in the face of future deforestation pressures. It has achieved VCS and CCBA validation and is currently seeking verification.
- A project in the *Sierra del Lacandón* National Park, run by the *Fundación Defensores de la Naturaleza*. It covers an area of 202865 ha and aims, amongst other objectives, to reduce the advancement of agricultural land into the park, illegal logging, and forest fires. The project is estimated to reduce CO2 emissions by the equivalent of 1,238 million tons over 20 years. It has achieved VCS and CCBA validation and verification.
- A project in the eco-region of Lachuá, run by the *Fundación Lachuá* and the IUCN. The ecoregion of Lachuá consists of 33000 ha of native forests, 14000 ha of which are located within the Lachuá national park. This project has not experienced any recent deforestation, but it is expecting a strong increase in deforestation in the future due to the tarmacking of the road known as the *Franja Transversal del Norte*, a road that crosses Guatemala from east to west. The results of the subnational reference scenario appear to confirm the feasibility of developing a REDD project in this region. It is seeking a VCS and CCBA certification.

While FUNDAECO has supported similar project activities in the region previously, the traditional source of FUNDAECO's financing, international donors, ended in April 2011 (Finalizacion CONTRATO JADE 2010-2011.pdf). In response to this FUNDAECO pursued a new financing strategy through REDD+ forest carbon credits and entered an MOU with the Althelia Fund to initiate the due diligence of this financing strategy (MOU BNP PARIBAS_Complete.pdf). FUNDAECO has been the principal group who has implemented the outline project activities above (see Section 1.4) in Izabal at a regional scale.

The region is predominately comprised of private landowner, community landowners, and non-titled right holders, who do not have the financial capacity to implement activities similar in scope to those presented here. Therefore, efforts to reduce deforestation and forest degradation through Resource Protection, Governance, and Monitoring, Sustainable Enterprise, Education, Community Empowerment & Inclusiveness, and Increased Access to Resources, are not common practice in the region. As a result of this analysis, the project activities are determined to be additional.

5 QUANTIFICATON OF GHG EMISSION REDUCTIONS AND REMOVALS (CL2 & CL4)

5.1 PROJECT SCALE AND ESTIMATED GHG EMISSION REDUCTIONS OR REMOVALS

Project	

Large project	X

The GHG emissions reductions and removals as a result of the project technologies and activities are measured by Net Emissions Reductions (NERs) and are given in Table 20. NERs are calculated using equation 19 of VM0015 v1.1 and have not been adjusted to reflect an allocation to or release from the buffer account (see Section 5.6.3).

Years	Estimated GHG emission reductions or removals (tCO2e)
2012	277,446
2013	513,676
2014	542,299
2015	627,698
2016	708,317
2017	756,196
2018	809,884
2019	880,979
2020	969,825
2021	1,076,243
2022	1,150,920
2023	1,135,414
2024	1,101,832
2025	1,098,758
2026	1,098,159
2027	1,019,100
2028	907,372
2029	883,939
2030	974,763
2031	1,011,540
2032	986,247
2033	1,123,309
2034	867,397
2035	548,846
2036	230,595
2037	151,879
2038	125,579
2039	108,507
2040	89,280
2041	68,842
Total estimated ERs	21,844,843
Total number of crediting years	**30**
Average annual	**728,161**

ERs	

Table 20. Estimated Net Emission Reductions (NERs)

5.2 LEAKAGE MANAGEMENT (CL3)

As part of the leakage management strategy, FUNDAECO plans to combine educational initiatives, land tenure support, increased landowner enrollment, and increased access to resources as tools to implement within the Leakage Management Area to prevent deforestation within the Leakage Area and Grouped Project Area. As there exists considerable overlap between forested areas contained within the Leakage Area and the Grouped Project Area, FUNDAECO plans to employ these tools across a wide area to reach a variety of households and communities.

Educational initiatives will not only increase awareness of the opportunities presented by the REDD+ Project for Caribbean Guatemala, but they will also provide landowners with greater perspective of the environmental, biological, and social benefits of their forest lands. FUNDAECO will also minimize the risk of activity-shifting leakage to areas of land with loose or nonexistent land tenure by promoting the legalization and title of land within the Leakage Area. Finally, an increase in the access to resources for agroforestry programs, and reforestation initiatives will be implemented to lessen the pressure or shift of illegal logging and deforestation activities to areas outside of the Project Area.

5.3 BASELINE EMISSIONS (G2 & CL1)

5.3.1 DELINEATING A REFERENCE REGION

The reference region is delineated using the REDD+ regions defined by Guatemala's National Emission Reduction Program described in the latest Emission Reductions Program Idea Note (ER-PIN) proposed to the Forest Carbon Partnership Facility (FCPF) (Guatemala ER-PIN Version Sept 2014.pdf). The Guatemala National Emissions Reduction Program is also pursuing validation under VCS's Jurisdictional Nested REDD+ standard in 2016-2017 and the REDD+ Project for Caribbean Guatemala seeks to align with the national program in the future. In order to best align itself with the national program, the REDD+ Project for Caribbean Guatemala has used agents and drivers studies, historical land use data, and carbon stock data that have been collected as part of the Guatemala National Emissions Reduction Program for the department of Izabal.

The REDD+ Project for Caribbean Guatemala falls within the Sarstun-Motagua region (Figure 13) that was determined by a series of workshops conducted by IUCN that included using biophysical parameters (altitude, rainfall, slope, soils, hydrology, life zones, etc), consideration of existing proposed projects, and socioeconomic criteria (INFORME_FINAL_REGIONES_SUBNACIONALES.pdf). VM0015 requirements were then applied to the Sarstun-Motagua region to reach the final reference region and are described below.

5.3.1.1 Agents and Drivers of Deforestation

As discussed above in Section 4.5.3, the agents and drivers of deforestation were determined over the Sarstun-Motagua region and subsequently the proposed Reference Region below. The study of agents and drivers was conducted as part of the Guatemala National Emissions Reduction Program for the department of Izabal. In particular, several workshops were held by UVG-CEAB in the communities of Morales, El Progreso, Puerto Barrios, and Rio Honda that lie within Sarstun-Motagua to understand local

perceptions of agents of deforestation.   From these workshops it was found that small-scale farmers, medium to large cattle ranchers, loggers, and mining operations are considered the main agents of deforestation in Sarstun-Motagua.

Mining activity is present within the Sarstun-Motagua region but is not found within the Grouped Project Area nor are project activities aimed at preventing this driver. Mining area concessions are authorized by the Ministerio de Energia y Minas that titles three types of licenses according to the Ley de Mineria: *"Licencia de Reconocimiento"*, *"Licencia de Exploracion"*, *"Licencia de Explotación"* (see mines_exploitation.shp). In accordance with VM0015, observed areas of deforestation during the reference period (2000-2010) within mining concessions under the title *"Licencia de Explotacion"* were removed from the reference region.

Both the spatial and underlying drivers of deforestation were also determined across Sarstun-Motagua (see Section 4.5.3). In the case of spatial drivers, it was found that elevation, slope, distance to forest edge, distance to secondary roads, and distance to navigable hydrology determines the suitability of land for agents of deforestation. Underlying drivers of deforestation were determined using an exploratory factor analysis based on 501 surveys taken from the Sarstun-Motagua region.

5.3.1.2 Landscape Configuration and Ecological Conditions

The landscape configuration and ecological conditions of both the Grouped Project Area and Reference Region area summarized and compared below to meet the requirements of VM0015. As required by the methodology, three of the four conditions (forest/vegetation classes, elevation, slope, rainfall) are satisfied.

Forest/vegetation classes: Both the Reference Region and Grouped Project Area were limited to observed forest cover. For the Reference Region, the Sarstun-Motagua region was limited to forest area observed in 2001. For the Grouped Project Area, the extent was limited to forest area observed in 2010 and that existed as forest for at least 10-years as described above. The forest and vegetation classes in the resulting Reference Region (2001) and Grouped Project Area (2010) were compared from Land-Use/Land-Cover maps. It was found that at 100% of the Grouped Project Area was defined by Very Humid Forest and Humid Forests that also defined 100% of the Reference Region.

Elevation: Using 100% of the Grouped Project Area the elevation range was found to be 0 – 1464 meters. Similarly, using 100% of the reference region the elevation range was found to be 0 - 2983 meters.

Rainfall: Using data from WorldClim (Hijmans et al, 2005) the average annual rainfall of the Grouped Project Area and Reference Region were calculated. 100% of the Grouped Project Area has an average annual rainfall of 351.06 mm per year, which is within +/- 10% of the average annual rainfall of the Reference Region (376.82 mm per year).

5.3.1.3 Socioeconomic and Cultural Conditions

The socioeconomic and cultural conditions of both the Grouped Project Area and Reference Region area summarized and compared below to meet the requirements of VM0015.

Legal Status of the Land:

As a grouped project, the REDD+ Project for Caribbean Guatemala has land designated with several different legal statuses. The Grouped Project Area includes 8 protected areas that designate zoning restrictions for private and national land within those areas. The Reference Region also contains 2 protected areas known as Parque Nacional Sierra de las Minas and the Rio Motagua Cerro Azul that represent a similar zoning structure as those in the Grouped Project Area.

In addition, the Grouped Project Area contains land outside of protected areas that are considered free-hold private property. This legal status of land also exists within the Reference Region.

Land Tenure:
As a grouped project the REDD+ Project for Caribbean Guatemala has a number of landholders with different land tenure arrangements (see Section 1.2.1). Different tenure arrangements include private property, private property holders without formal title termed *poseedores*, community lands, State lands administered by CONAP, State lands given in concession to communities and industries and other users. The mosaic of land tenure arrangements within Guatemala are all represented within the Grouped Project Area and consequently the Reference Region as well.

Land Use:

The current and projected land-uses within the Grouped Project Area include Annual Agriculture, Permanent Agriculture, Pasture, Urban, Shrubs (*guamil*), and Other non-forest. These same land-uses are found within the Reference Region during the reference period (see Section 5.3.1.2).

Enforced Policies and Regulations:
The policies and regulations defined in Section 3 are enforced across the mosaic of land tenure arrangements found in the Reference Region.

5.3.1.4 Map of the Reference Region
As a result of the analyses above the total area of the Reference Region is 606,477 ha and includes the Grouped Project Area. Figure 13 below shows a map of the Reference Region.
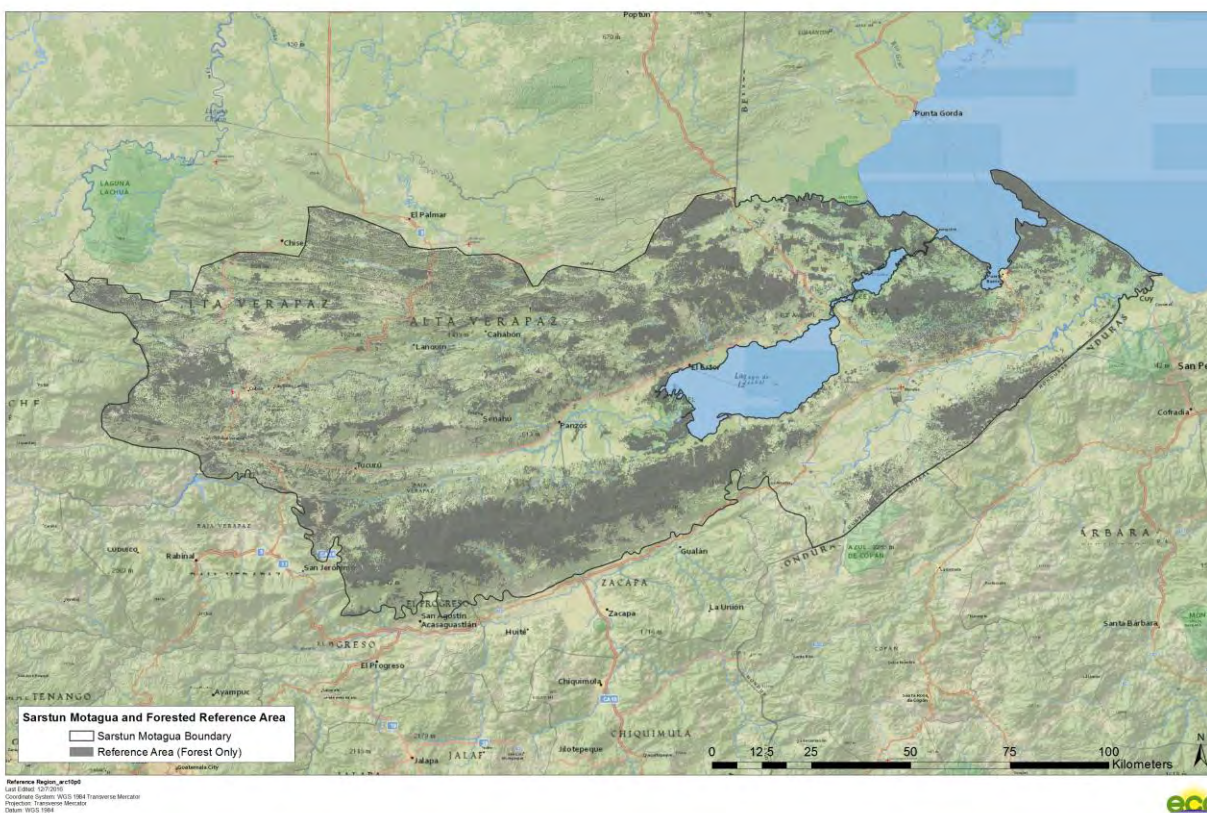
Figure 13. Map of the Reference Region.

Stratum ID		Description	Area at year (ha)
IDᵢ	Name		1+
1	Sarstun-Motagua	Sub-National Jurisdiction	1,635,426

Table 21. Stratification of the reference region.

5.3.2 ANALYSIS OF HISTORICAL LAND-USE AND LAND-COVER CHANGE (STEP 2 - VM0015)

The first step to estimating the baseline emissions includes collecting and analyzing available spatial data to identify both historical land-use/ land-cover (LULC) changes Three LULC maps were created covering the extent of the Sarstun-Motagua region and subsequently the Reference Region. The study of agents and drivers was conducted. The analysis was undertaken by the CNCG working group, with UVG as the lead analytical team, as part of the Guatemala National Emissions Reduction Program for the department of Izabal. The project used this data in order to align itself with the national program in the future. The following describes how LULC changes were detected over the historical reference period from 2000-2010 using remote sensing techniques, available satellite imagery, and other available spatial datasets for validation.

To analyze the historical LULC change over the historical reference period in Sartstun-Motagua, two data sources were merged including a high-resolution LULC product developed by the Grupo Interinstitucional de Monitoreo de Bosques y Uso de la Tierra (GIMBOT) for 2012 and a historical analysis of forest cover created by the Universidad del Valle de Guatemala (UVG) for 2001, 2006, and 2010. The primary LULC classifications utilized were those from UVG that included a rigorous forest cover assessment along with a number of land classes specifying plantation (palm oil, rubber, coffee), urban, wetland, and water areas. In addition, a "non-forest" class was specified within the UVG data product. For the purposes of carbon accounting and to follow the guidelines presented by the IPCC, a more detailed non-forest class (e.g. agriculture, pasture) was sought in order to produce more accurate estimates of emission factors. To this end, the non-forest class in the UVG dataset was replaced and refined with the LULC dataset from GIMBOT for 2012. In addition, a forest stratification map was determined by Winrock International over the Reference Region using Holdridge Life Zones and a variety of statistical tests. This forest stratification was used to refine forest classes within the reference region to Very Humid Forest, and Humid Forest. The land-use classes used from each data product including the final LULC output for the analysis of historical LULC change are summarized below in Table 22.

Original UVG Classification	Final Classification (UVG + GIMBOT + Forest Strat.)	
Class Name	Class Name	Source
No Data	*(removed)*	*(removed)*
Forest	Very Humid Forest	Forest Strat. + UVG
Forest	Humid Forest	Forest Strat. + UVG
Water	Water	UVG
Urban	Urban	UVG
Wetland	Wetland	UVG
Rubber	Permanent agriculture	UVG
Coffee	Permanent agriculture	UVG
Oil Palm	Permanent agriculture	UVG
Nonforest	Annual agriculture	GIMBOT
Nonforest	Pasture	GIMBOT
Nonforest	Shrubs	GIMBOT
Nonforest	Other non-forest	GIMBOT
Cloud	*(removed)*	*(removed)*

Table 22. Land-use classes used from the UVG, GIMBOT and Forest Stratification data sources to create a final land-use classification.

5.3.2.1 Collection of appropriate data sources (2.1 VM0015)

5.3.2.1.1 Historical Analysis of LULC for 2001, 2006, 2010
Both medium resolution imagery available throughout the historical reference period to detect LULC change and high-resolution imagery to provide training data and accuracy of change detection were used as data sources for the historical LULC study undertaken by UVG. For medium resolution images Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM) were selected. These satellite sensors provide visible wavelength and non-visible wavelength radiometric resolution as well as a

consistent historical library of images that can be queried for suitable images. The suitability of these images were determined by the following:

- Minimum requirements established in the methodology VM0015 VCS
    1. The spatial resolution of Landsat images are 30x30m;
    2. Images were collected over three time points that are about 3-5 years apart
- Availability of processed historical data with documentation
- Less than 15% cloud cover
- Similarity of annual dates (December to April)

Landsat images were downloaded for free using the Global Visualization Viewer (http://glovis.usgs.gov/) and the images used to generate LULC maps are summarized in Table 23 and Figures 14-16.

Vector	Sensor	Resolution		Coverage	Acqusition Date	Scene or point identifier	
		Spatial	Spectral	(km²)	(DD/MM/YY)	Path/ Latitude	Row/ Longitude
Satellite	Landsat 7 ETM+ SLC ON	30	7	34,931	23/01/2000	20	49
Satellite	Landsat 7 ETM+ SLC-off	30	7	34,983	12/08/2000	20	50
Satellite	Landsat 5 TM L1T	30	7	35,197	31/03/2001	19	49
Satellite	Landsat 5 TM	30	7	35,266	31/03/2001	19	50
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,501	13/01/2005	19	49
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,454	25/03/2005	20	49
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,502	16/01/2006	19	50
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,497	21/03/2006	19	49
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,474	21/03/2006	19	50
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,507	04/06/2006	19	49
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,450	23/11/2006	20	50
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,473	03/12/2006	20	49
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,462	03/12/2006	20	50
Satellite	Landsat 7 ETM+ SLC-off	30	7	27,506	27/02/2007	20	49
Satellite	Landsat 7 ETM+ SLC-	30	7	27,496	27/02/2007	20	50

	off						
Satellite	Landsat 7 ETM+ SLC-off	30	7	35,426	23/03/2011	20	50
Satellite	Landsat 5 TM L1T	30	7	11,421	27/03/2011	19	49
Satellite	Landsat 7 ETM+ SLC-off	30	7	35,610	26/04/2011	20	49
Satellite	Landsat 7 ETM+ SLC-off	30	7	35,692	26/04/2011	19	50

Table 23. Data used for historical LU/LC change analysis from the UVG study for 2000, 2006, and 2010.
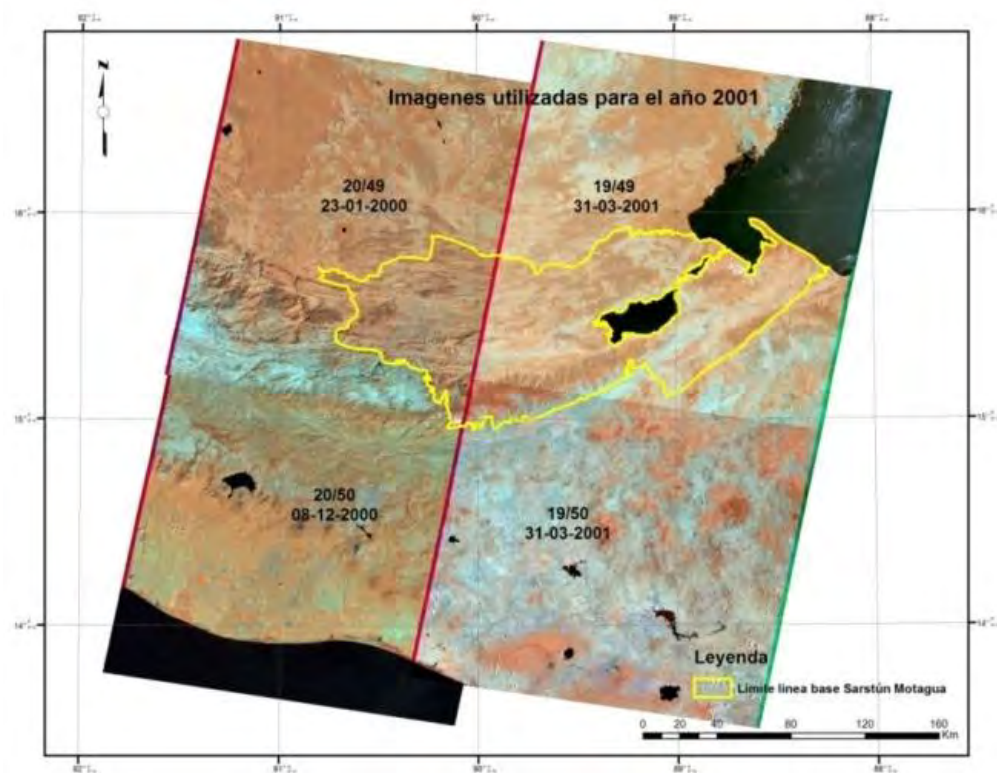
Figure 14. Landsat images used for training and classification for the UVG LULC analysis in 2001
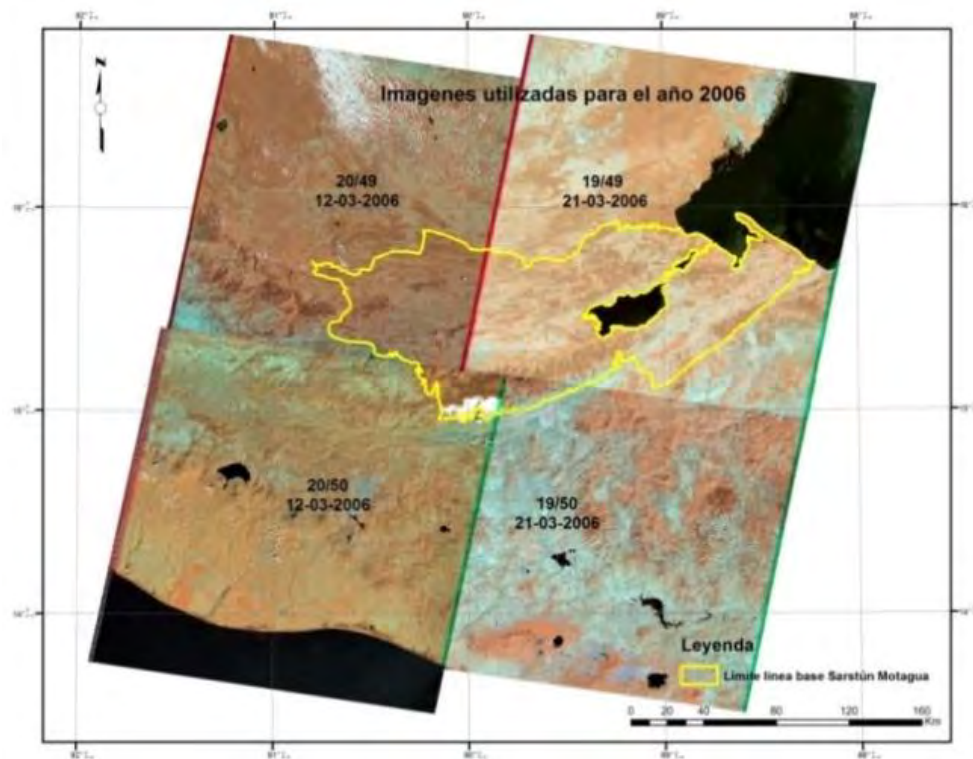
Figure 15. Landsat images used for training and classification for the UVG LULC analysis in 2006
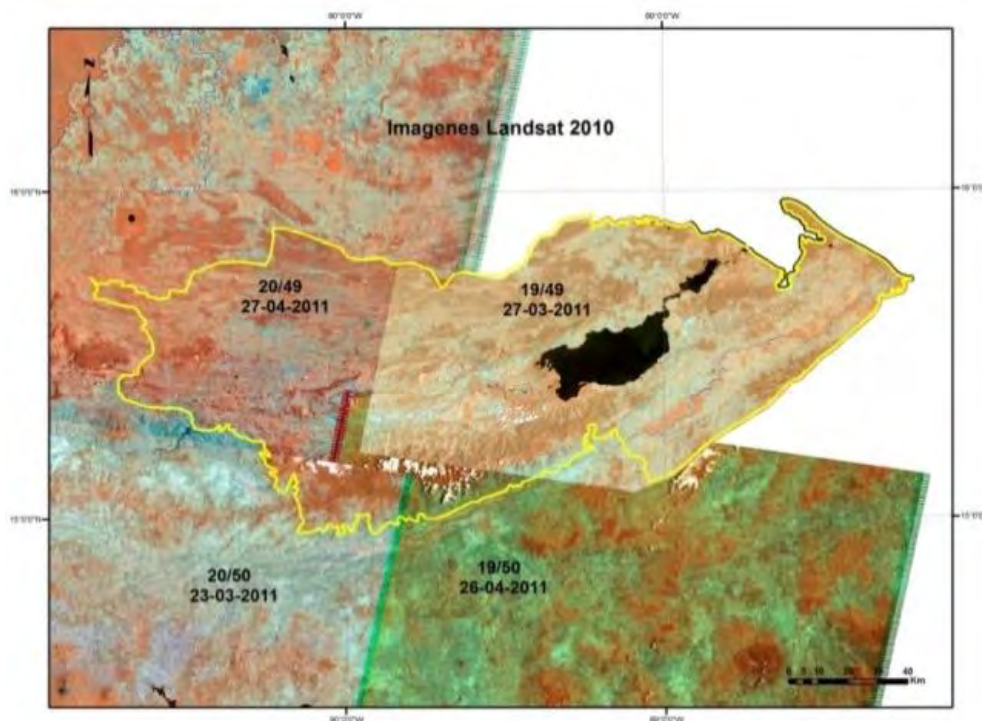
Figure 16. Landsat images used for training and classification for the UVG LULC analysis in 2010

High spatial resolution images between 0.5-meters and 5 meters resolution were used for training and verification of classifications. Data sources for training and accuracy assessment included Indian Remote Sensing (IRS) satellites and orthophotos and are summarized in Table 24 and Figures 17-18.

Vector	Sensor	Resolution		Coverage	Acqusition Date	Scene or point identifier
		Spatial	Spectral	(km^2)	(DD/MM/YY)	
Satellite	IRS 1/C PAN, LISS-III, WiFS	5	1	5,287	13/03/2001	D2920622001072PAOCPE 292-62-A-2001
Satellite	IRS 1/C PAN, LISS-III, WiFS	5	1	4,808	21/12/2000	C2820632000356PC0N0K 282-63-C-2000
Satellite	IRS 1/C PAN, LISS-III, WiFS	5	1	5,256	21/12/2000	C2820632000356PA0NOK 282-63-A-2000
Satellite	IRS 1/C PAN, LISS-III, WiFS	5	1	5,279	21/12/2000	C2820622000356PC0NOK 282-62-C-2000
Satellite	IRS 1/C PAN, LISS-III, WiFS	5	1	5,305	21/12/2000	C2820622000356PA0NOK 282-62-D-2000
Satellite	IRS 1/C PAN, LISS-III, WiFS	5	1	5,286	15/04/2001	C2810622001105PD0NOK 281-62-D-2001
Satellite	IRS 1/C PAN, LISS-III, WiFS	5	1	5,302	15/04/2001	C2810622001105PB0NOK 281-62-B-2001
Satellite	IRS 1/C PAN, LISS-III, WiFS	5	1	5,256	16/12/2000	C281062000351PA0NOK 281-62-A-2000
Airplane	Ortofotos	0.5	1	22,032	2006	N/A

Table 24. High-resolution data used for historical LU/LC change analysis from the UVG study for 2001, 2006, and 2010
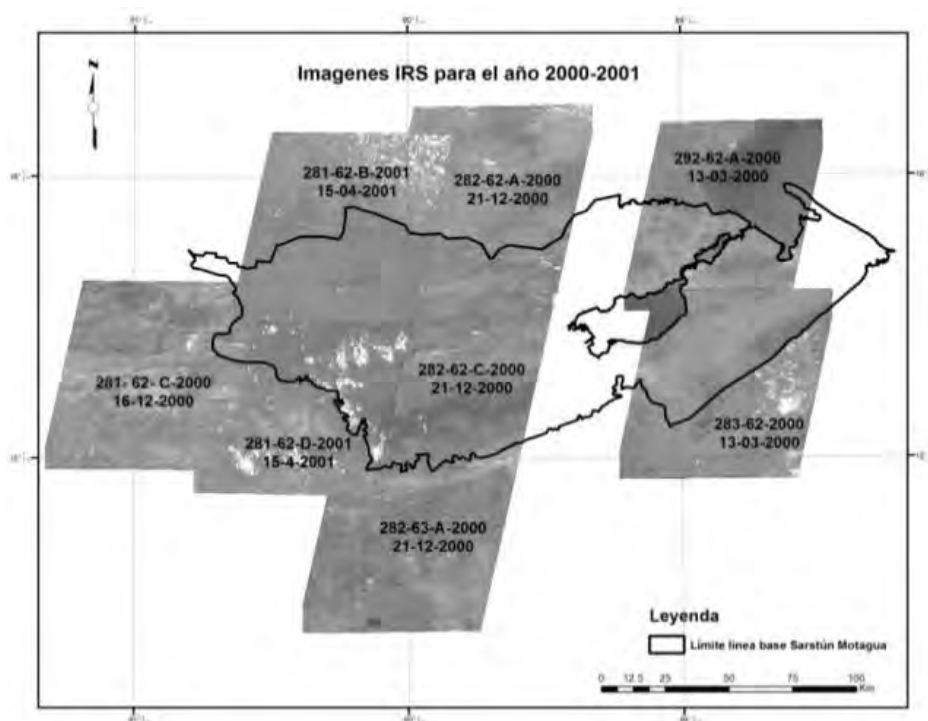
Figure 17. IRS images used for training and verification for the 2001 LULC analysis
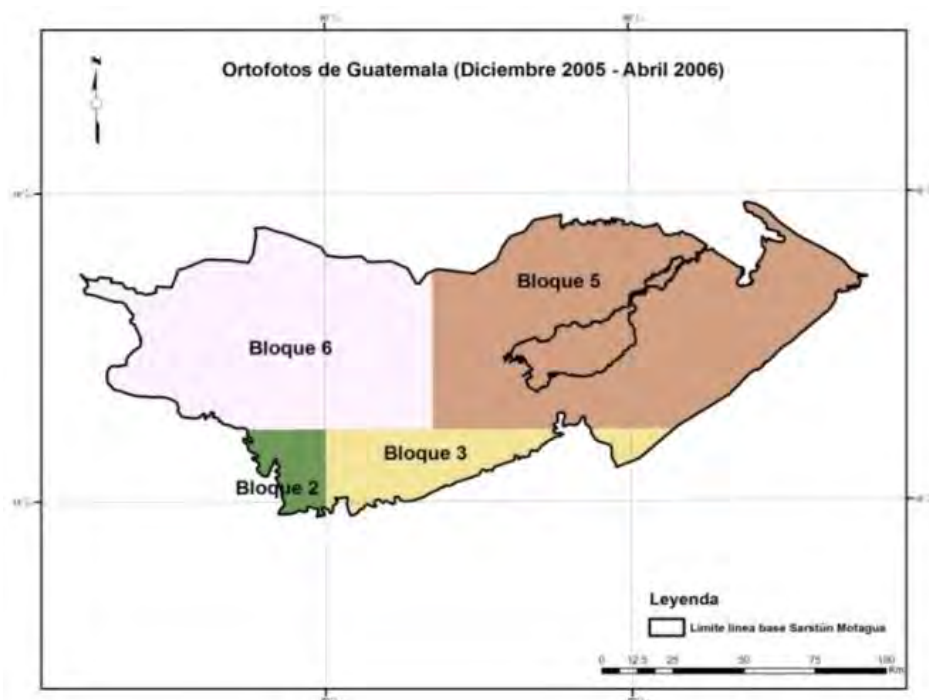
Figure 18. Orthophotos used for training and verification for the 2006 LULC analysis

Other spatial data sources from various sources were also used to support the historical analysis LULC change and are shown below in Table 25.

Name	Organization	Scale	Data Type	Year
Cobertura Vegetal y Uso de la Tierra	MAGA	1:50,000	.img	2003
Cobertura Vegetal y Uso de la Tierra	MAGA	1:50,000	.img	2010
Cobertura Forestal	INAB, CONAP, UVG, URL	1:50,000	.shp y .img	2010
Dinámica de la Cobertura Forestal	INAB, CONAP, UVG, URL	1:50,000	.img	2006-2010
Dinámica de la Cobertura Forestal	INAB, CONAP, UVG, URL	1:50,000	.img	2001-2006
Café	INAB, CONAP, UVG, URL	1:50,000	.img	2007
Palma Africana	URL	1:50,000	.shp y. img	2006, 2010

Table 25. Additional data sources used for the historical LULC analysis done by UVG for 2001, 2006, and 2010

5.3.2.1.2 High Resolution LULC Map for 2012

In coordination with the German Society for International Cooperation (GIZ) 308 RapidEye images were obtained across the extent of Guatemala. The images ranged from 2010-2012, have a spatial resolution of 5-meters, and are multispectral including visible and near-infrared bands. The RapidEye images were provided by BlackBridge LLC and covered reference region of Sarstun-Motagua. The processing and production of this LULC map is described in Section 5.3.2.4.3.

5.3.2.2 Definition of class of land-use land-cover (VM0015 Section 2.2)

The LULC cover classes present in the reference region at the project start date were determined by combining the Historical LULC Analysis for 2010 (UVG data set – see Section 5.3.2) and replacing all non-forest areas in the UVG classification with more detailed LULC data from the High-Resolution LULC Map for 2012 (GIMBOT dataset). Forest areas in the 2010 UVG dataset were not altered, and if non-forest UVG pixels overlapped with GIMBOT forest pixels, the nearest non-forest cell type was used instead. Once this hybrid map was complete, the numerous detailed categories were collapsed down into a smaller number of broad categories. Lastly, an additional forest biome dataset with two forest classes defined was used to further stratify the forest areas. The post-processing workflow of these datasets is described below. The final LULC classifications present in the reference region can be seen in Table 26 and are described below.

Very Humid Forest (ID_{cl} - 1)

Homogeneous cover of vegetation with a minimum crown diameter of 2-meters, a minimum height of 5-meters, and a crown cover of at least 30%. This land class corresponds with the IPCC category of "Forest Land".

Humid Forest (ID_{cl} - 2)

Homogeneous cover of vegetation with a minimum crown diameter of 2-meters, a minimum height of 5-meters, and a crown cover of at least 30%. This land class corresponds with the IPCC category of "Forest Land".

Water (ID_{cl} - 4)

Natural or artificial stretches of water and water courses serving as water drainage channels. This classification includes canals and dams.

Urban (ID_{cl} - 5)

Most of the land is covered by structures and transport networks. Buildings, roads and artificially surfaced areas cover more than 80% of the total surface. This land class corresponds with the IPCC category of "Settlements".

Wetland (ID_{cl} - 6)

Low-lying land usually flooded in the rainy-season and more or less saturated by water all year round. This land class corresponds with the IPCC category of "Wetlands".

Permanent Agriculture (ID_{cl} - 7)

Land characterized by crops cultivated for long periods of time and need not be replanted after each harvest, such as palm oil, coffee, and rubber. This land class corresponds with the IPCC category of "Croplands".

Annual Agriculture (ID$_{cl}$ - 8)
Defined by land under temporary crops that are harvested and sowed annually (i.e. maize). This land class corresponds with the IPCC category of "Croplands".

Pasture (ID$_{cl}$ - 9)
Land characterized by a dense grass cover of floral composition dominated by graminaceae. Mainly for grazing but the folder may be harvested mechanically. This land class corresponds with the IPCC category of "Grassland".

Shrubs (ID$_{cl}$ - 10)
Woody plants with one or more trunks or main stems but vegetation does not reach above 5 meters height at maturity. This land class corresponds with the IPCC category of "Other Land".

Other non-forest (ID$_{cl}$ - 11)
Other non-forest is defined as land that occurs at the juxtaposition of small parcels of diverse annual crops, pasture, and/or permanent crops. It includes annual crops or grazing land under the wooded cover of forestry species, Areas principally occupied by agriculture, interspersed with significant natural areas. This land class corresponds with the IPCC category of "Other Land".

ID_{cl}	Name	Trend in Carbon stock	Presence in	Baseline Activity			Description
				LG	FW	CP	
1	Very Humid Forest	constant	RR, PA, LK	Yes	Yes	No	Homogeneous cover of vegetation with a minimum crown diameter of 2-meters, a minimum height of 5-meters, and a crown cover of at least 30%.
2	Humid Forest	constant	RR, PA, LK	Yes	Yes	No	Homogeneous cover of vegetation with a minimum crown diameter of 2-meters, a minimum height of 5-meters, and a crown cover of at least 30%.
4	Water	constant	RR	No	No	No	Natural or artificial stretches of water and water courses serving as water drainage channels. This classification includes canals and dams.
5	Urban	constant	RR	No	No	No	Most of the land is covered by structures and transport networks. Buildings, roads and artificially surfaced areas cover more than 80% of the total surface.
6	Wetland	constant	RR	No	No	No	Low-lying land usually flooded in the rainy-season and more or less saturated by water all year round.
7	Permanent agriculture	constant	RR	Yes	Yes	No	Land characterized by crops cultivated for long periods of time and need not be replanted after each harvest, such as palm oil, coffee, and rubber.
8	Annual agriculture	constant	RR	Yes	Yes	No	Defined by land under temporary crops that are harvested and sowed annually (i.e. maize)
9	Pasture	constant	RR	Yes	Yes	No	Land characterized by a dense grass cover of floral composition dominated by graminaceae.
10	Shrubs	constant	RR	No	No	No	Woody plants with one or more trunks or main stems but vegetation does not reach above 5 meters height at maturity.
11	Other non-forest	constant	RR	No	No	No	Land that occurs at the juxtaposition of small parcels of diverse annual crops, pasture, and/or permanent crops.

Table 26. List of all land use and land cover classes existing at the project start data within the reference region

5.3.2.3 Definition of categories of land-use and land-cover change (VM0015 Section 2.3)

There is no land within the reference region that is considered unstocked forest. Reforestation is accounted for as a land transition and is only considered reforestation if the transition from a small carbon stock density to a larger carbon stock density has persisted for three years. For descriptions of expected land transitions, see Tables 27 and 28. For a list of complete land transitions observed in the reference period, see Section 5.3.2.1.1 for the historical land transition matrix.

		Initial LU/LC class	
IDcl		I1	I2
Final LU/LC class	F4	I1/ F4	I2/ F4
	F5	I1/ F5	I2/ F5
	F6	I1/ F6	I2/ F6
	F7	I1/ F7	I2/ F7
	F8	I1/ F8	I2/ F8
	F9	I1/ F9	I2/ F9
	F10	I1/ F10	I2/ F10
	F11	I1/ F11	I2/ F11

Table 27. Potential land-use and land-cover change matrix.

ID$_{ct}$	Name	Trend in Carbon stock	Presence in	Baseline Activity		
				LG	FW	CP
I1/ F4	Very Humid Forest to Water	decrease	RR, PA, LK	No	No	No
I1/ F5	Very Humid Forest to Urban	decrease	RR, PA, LK	No	No	No
I1/ F6	Very Humid Forest to Wetland	decrease	RR, PA, LK	No	No	No
I1/ F7	Very Humid Forest to Permanent agriculture	decrease	RR, PA, LK	Yes	Yes	No
I1/ F8	Very Humid Forest to Annual agriculture	decrease	RR, PA, LK	Yes	Yes	No
I1/ F9	Very Humid Forest to Pasture	decrease	RR, PA, LK	Yes	Yes	No
I1/ F10	Very Humid Forest to Shrubs	decrease	RR, PA, LK	No	No	No
I1/ F11	Very Humid Forest to Other non-forest	decrease	RR, PA, LK	No	No	No
I2/ F4	Humid Forest to Water	decrease	RR, PA, LK	No	No	No
I2/ F5	Humid Forest to Urban	decrease	RR, PA, LK	No	No	No
I2/ F6	Humid Forest to Wetland	decrease	RR, PA, LK	No	No	No
I2/ F7	Humid Forest to Permanent agriculture	decrease	RR, PA, LK	Yes	Yes	No
I2/ F8	Humid Forest to Annual agriculture	decrease	RR, PA, LK	Yes	Yes	No
I2/ F9	Humid Forest to Pasture	decrease	RR, PA, LK	Yes	Yes	No
I2/ F10	Humid Forest to Shrubs	decrease	RR, PA, LK	No	No	No
I2/ F11	Humid Forest to Other non-forest	decrease	RR, PA, LK	No	No	No

Table 28. List of land-use and land-cover change categories.

5.3.2.4 Analysis of historical land-use and land-cover change (VM0015 Section 2.4)

5.3.2.4.1 Pre-processing (VM0015 2.4.1)
All remote sensing data was pre-processed before conducting the LULC analysis. Pre-processing steps included converting the raw digital number data into ground reflectance values and correcting for differing atmospheric conditions. Images with excessive cloud cover or haze were rejected, and remaining pre-processed imagery was mosaicked together. Average RMSE between images was less than one pixel and cloud cover across each mosaicked image was calculated to be less than 15%. The 2010 LULC map was used as the Forest Benchmark Map for the project area and leakage area. For a more detailed description of the pre-processing of Landsat imagery for the Historical LULC Analysis and Rapid Eye imagery for the High-Resolution Map for 2012, see Memoria Tecnica Completa.pdf.

5.3.2.4.2 Interpretation and classification (VM0015 Section 2.4.2)
Post-classification change detection techniques were used in this LULC change analysis.

5.3.2.4.2.1 Forest Cover Benchmark Maps – 2001, 2006, 2010
Only pre-processed Landsat data was used to conduct the LULC classification provided by UVG. Image pixels were classified as one of the following eight land cover classes: *bosque, hule, café, palma africana, no bosque, urbano, humedal, y agua*. Any areas that were classified as cloud or cloud shadow were masked out of all classified images. The classifications were performed by first using the ISODATA unsupervised classifier to obtain distinct spectral signature of classes of interest. Using available Landsat imagery, high resolution imagery outlined in Table 24, and additional data sources outlined in Table 25 training regions were built to define spectral signatures for each class. A Support Vector Machine classifier was applied using the developed training data and the result was converted to vector format for editing of classes of interest. As all land cover change analyses were performed at 30 m resolution, the minimum mapping unit for LULC classes is less than 1 ha. For detailed procedures on the LULC classification and forest stratification, see Memoria Tecnica Completa.pdf.

5.3.2.4.2.2 Land-Use and Land-Cover Map
Only pre-processed Rapid Eye imagery was used to conduct the high-resolution LULC classification provided by GIMBOT. Image pixels were classified as one of the following eight land cover classes: *bosque de conferas, bosque latifoliado, bodque mixto, bosque manglar, bosque seco, bosque secundario, humedales, arbustal-matorral, hule, no bosque, urbano, café, agua, arboles disperses, suelo desnudo*. Any areas that were classified as cloud or cloud shadow were masked out of all classified images. As a first step for classification, images were segmented into groups of pixels with similar spectral signatures. Using a number of national datasets and geospatial layers, spectral signatures in relation to available Rapid Eye bands were collected for areas that were considered to be "pure" examples for the classes of interest. Using a method developed by GIZ and adapted to the context of Guatemala, segments were classified according utilizing the training data. The result was converted to vector format to for editing. As all land cover change analyses were performed at 5 m resolution, the minimum mapping unit for LULC classes is less than 1 ha. For detailed procedures on the LULC classification and forest stratification, see Memoria Tecnica Completa.pdf.

5.3.2.4.3 Post-processing (VM0015 Section 2.4.3)

5.3.2.4.3.1 Historical LULC Analysis for 2001, 2006, 2010
The use of non-spectral data was used to further classify the forest class within the UVG dataset based on a delineation of forest biomes in the Sarstun-Motagua reference region. Using Holdridge Life Zones(Holdridge and Grenke 1971), the distribution of carbon stocks (see Section 5.3.2), a confidence index, and Mann-Whitney U-Test, two distinct forest classes in the reference region were identified including Very Humid Forest and Humid Forest. Forest pixels that fell within each biome type were further classified. Forest areas in the 2010 UVG dataset were not altered, and if non-forest UVG pixels overlapped with GIMBOT forest pixels, the nearest non-forest cell type was used instead. Once this hybrid map was complete, the numerous detailed categories were collapsed down into a smaller number of broad categories. Lastly, an additional forest biome dataset with two forest classes defined was used to further stratify the forest areas.

5.3.2.4.3.2 High-Resolution LULC Map for 2012
The high-resolution LULC map for 2012 included a *no bosque* class upon the finalization of the image classification step discussed above. Following the classification of Rapid Eye imagery, non-spectral data was used to further classify the *no bosque* class into several agricultural classes that captured annual crops (e.g. grains, rice), permanent crops (e.g. sugar cane, hule, café), areas of mixed use, and pastures.

A classification system based on the CORINE Land Cover harmonization system established by the European Envrionment Agency and was contextualized to the region of Guatemala (Figure 19).

Map attributes from the Ministerio de Agricultura Ganaderia y Alimentacion's (MAGA) 2010 Mapa de Cobertura Vegetal y Uso de la Tierra (USOT) were joined with the segmented Rapid Eye images described in above. A matrix of segment products from Rapid Eye and the USOT data layer was then created and interpreted against the CORINE Land Cover classification described above. Classes were assigned on the basis of this interpretation and editing of the classes was undertaken using Rapid Eye and Google Earth imagery.

Nivel 1	Nivel 2		Area (Ha)	(%)	Nivel 3		Area (Ha)	(%)	Nivel 4		Area (Ha)	(%)
1.Territorios artificializados	1.1	Urbano	139,470	1.28								
2.Territorios agrícolas	2.1	Agricultura anual	1,207,446	11.09								
	2.2	Agricultura permanente	1,235,079	11.34	2.2.1	Cultivos permanentes herbáceos	51,907	0.48	2.2.1.1	Banano-plátano	49,627	0.46
					2.2.2	Cultivos permanentes arbustivos	3,592	0.03	2.2.2.1	Café	457,284	4.20
					2.2.3	Cultivos permanentes arbóreos	31,195	0.29	2.2.3.1	Hule	82,405	0.76
									2.2.3.2	Palma africana	111,939	1.03
					2.2.4	Cultivos permanentes de plantas o tallos	96,922	0.89	2.2.4.1	Caña de azúcar	350,205	3.22
	2.3	Pastizales	1,651,807	15.17								
	2.4	Zonas agrícolas heterogéneas	54,227	0.50								
3. Bosque y medios seminaturales	3.1	Bosques	3,674,728	33.74								
	3.2	Medios con vegetación arbustiva y/o herbácea	2,557,914	23.48	3.2.1	Sabanas	23,596	0.22				
					3.2.2	Vegetación arbustiva baja (guamil-matorral)	2,465,031	22.6				
					3.2.3	Arboles dispersos	69,287	0.63				
	3.3	Espacios abiertos, sin o con poca vegetación	35,861	0.33								
4. Zonas húmedas	4	Humedales	107,197	0.98								
5. Superficie de agua	5	Cuerpos de agua	179,095	1.64								
6. Sin información	6		47,232	0.45								
Total			10,890,056	100								

Figure 19. Classification system to further refine the non-forest areas within the high-resolution LULC map for 2012 (area values for Guatemala).

5.3.2.4.3.3 Combination of Forest Benchmark Maps and Land Use Map
The final post-processing step for the creation of three historical LULC maps (2001, 2006, 2010) was the combination of the Historical LULC Analysis (UVG dataset) and the High-Resolution Map for 2012 (GIMBOT dataset). This was done by replacing the *no bosque* class in the UVG dataset with a resampled (30-m) version of the USOT data. Forest areas in the 2010 UVG dataset were not altered, and if non-forest UVG pixels overlapped with USOT forest pixels, the nearest non-forest cell type was used instead. Once this hybrid map was complete, the numerous detailed categories were collapsed down into a smaller number of broad categories described in the previous section. Table 29 below shows how LULC classes defined across the data products were used, yielding a final classification for three time periods: 2001, 2006, and 2010.

Original UVG Classification	Final Classification (UVG + GIMBOT + Forest Strat.)	
Class Name	Class Name	Source

No Data	*(removed)*	*(removed)*
Forest	Very Humid Forest	Forest Strat. + UVG
	Humid Forest	Forest Strat. + UVG
Water	Water	UVG
Urban	Urban	UVG
Wetland	Wetland	UVG
Rubber	Permanent agriculture	UVG +GIMBOT
Coffee		
Oil Palm		
Nonforest	Annual agriculture	USOT
	Pasture	USOT
	Shrubs	USOT
	Other non-forest	USOT
Cloud	*(removed)*	*(removed)*

Table 29. Merged classification system of the UVG LULC Maps, GIMBOT data, USOT High-Resolution LULC Maps, and Forest Stratification Maps

5.3.2.4.3.4 Forest Cover Benchmark Map
The result of the LULC analysis presented above includes a Forest Cover Benchmark Map for 2001 and 2010. The dates of the Forest Cover Benchmark Maps fall within ±2 years for the most recent date (2010) and ±10 years for the oldest date (2001) from the project start date (2012). Below Figures 20-23 show the Forest Cover Benchmark Maps in the Reference Region and the Grouped Project Area for the years 2001 and 2010. These maps distinguish only "forest" and "non-forest" classes.

5.3.2.4.3.5 Land-Use and Land-Cover Maps
The LULC analysis presented in Section 5.3.2 also resulted in a Land-Use and Land-Cover Map for three time periods: 2001, 2006, and 2010. Figures 24, 25, and 26 below shows the result for 2001, 2006, and 2010.

5.3.2.4.3.6 Deforestation Maps
By comparing LULC maps from each year, determination of deforestation locations and rates over each sub-period (2001-2006 and 2006-2010) is possible. For the 2001-2006 the deforestation rate was calculated to be 2.86%, corresponding to 86,864-ha of forest loss (Figure 27). For the 2006-2010 the deforestation rate was calculated to be 3.96%, corresponding to 94,535-ha of forest loss (Figure 28, fundaeco_deforestation_rate_v1.4.xlsx). The average deforestation rate over time within the reference region was calculated to be 3.41%.

5.3.2.4.3.7 Land-Use and Land-Cover Change Map
In addition to deforestation, other LULC change can be detected across time periods where LULC was defined. Figure 29-30 depict LULC change categories that correspond with Section 5.3.2.4.3.5 above for the 2001-2006 and 2006-2010 sub-periods.
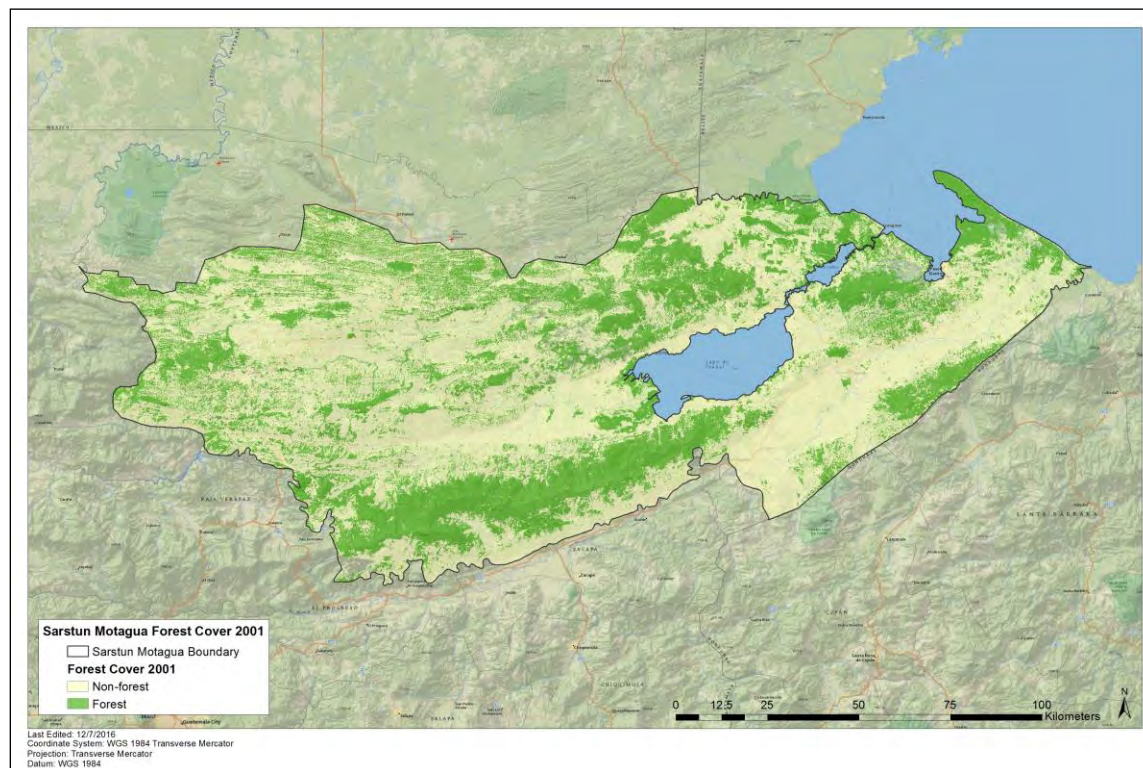
Figure 20. Forest Cover Benchmark Map for 2001 of the Reference Region
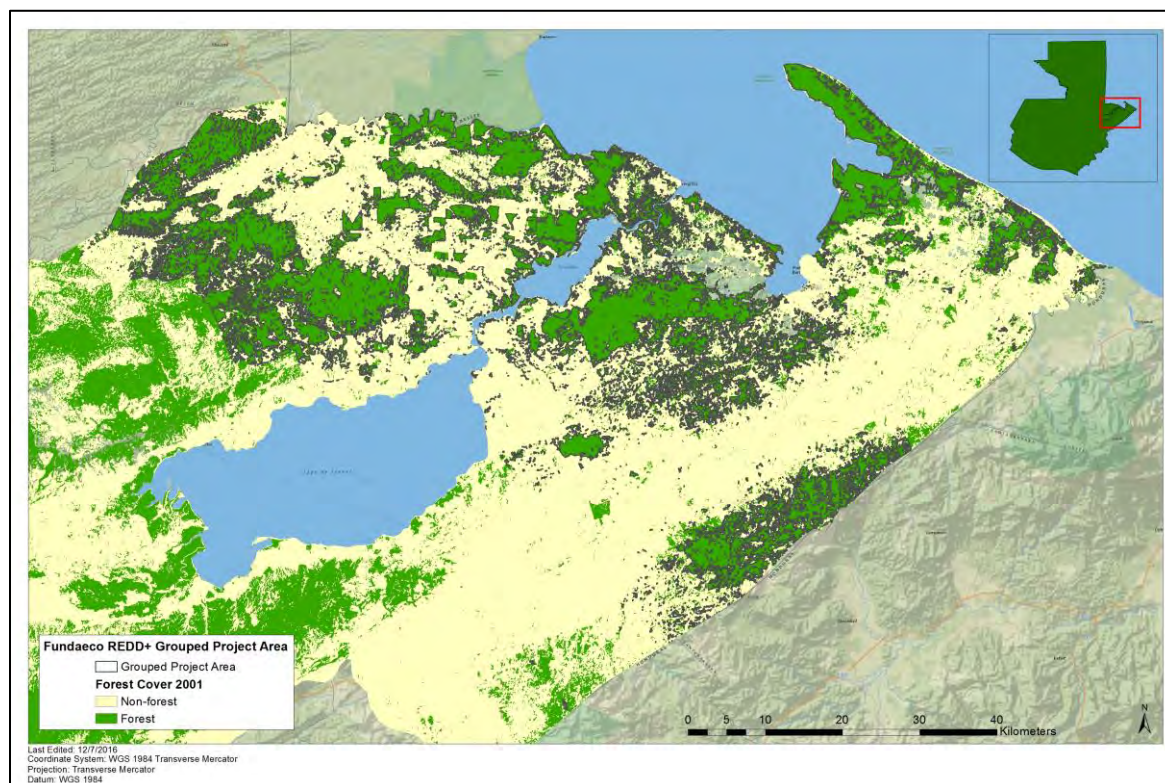
Figure 21. Forest Cover Benchmark Map for 2001 of Grouped Project Area
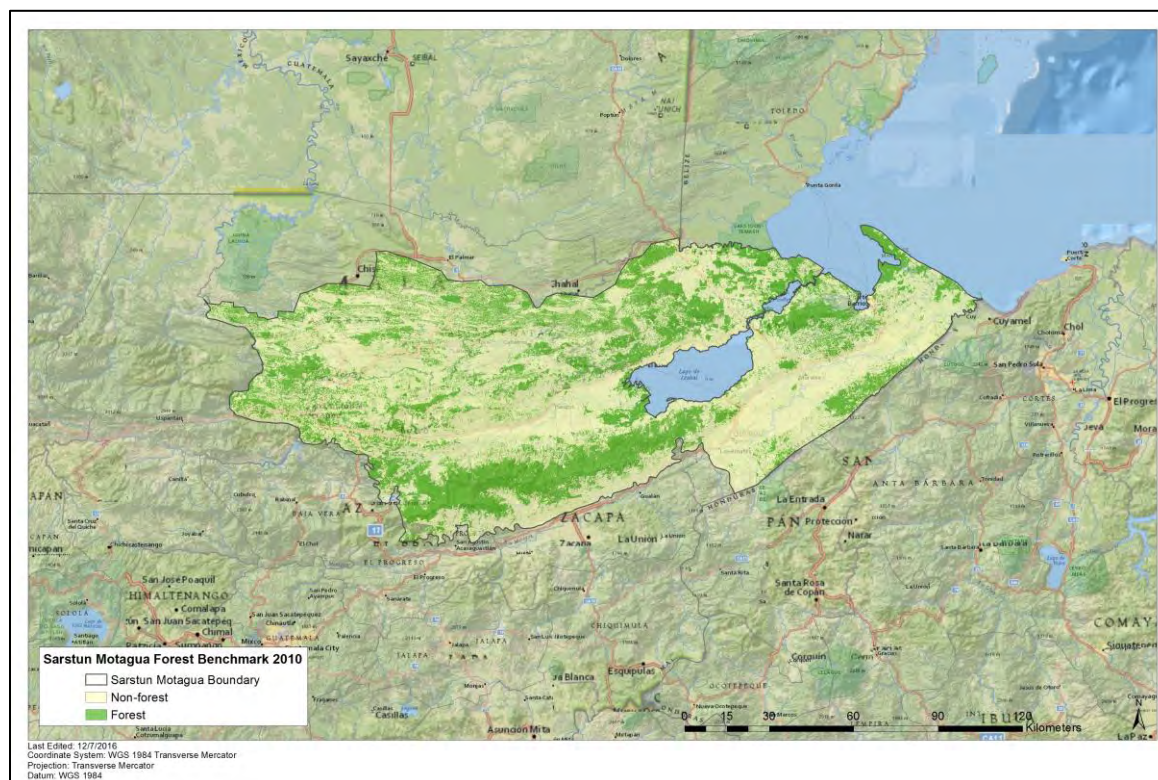
Figure 22. Forest Cover Benchmark Map for 2010 of the Reference Region
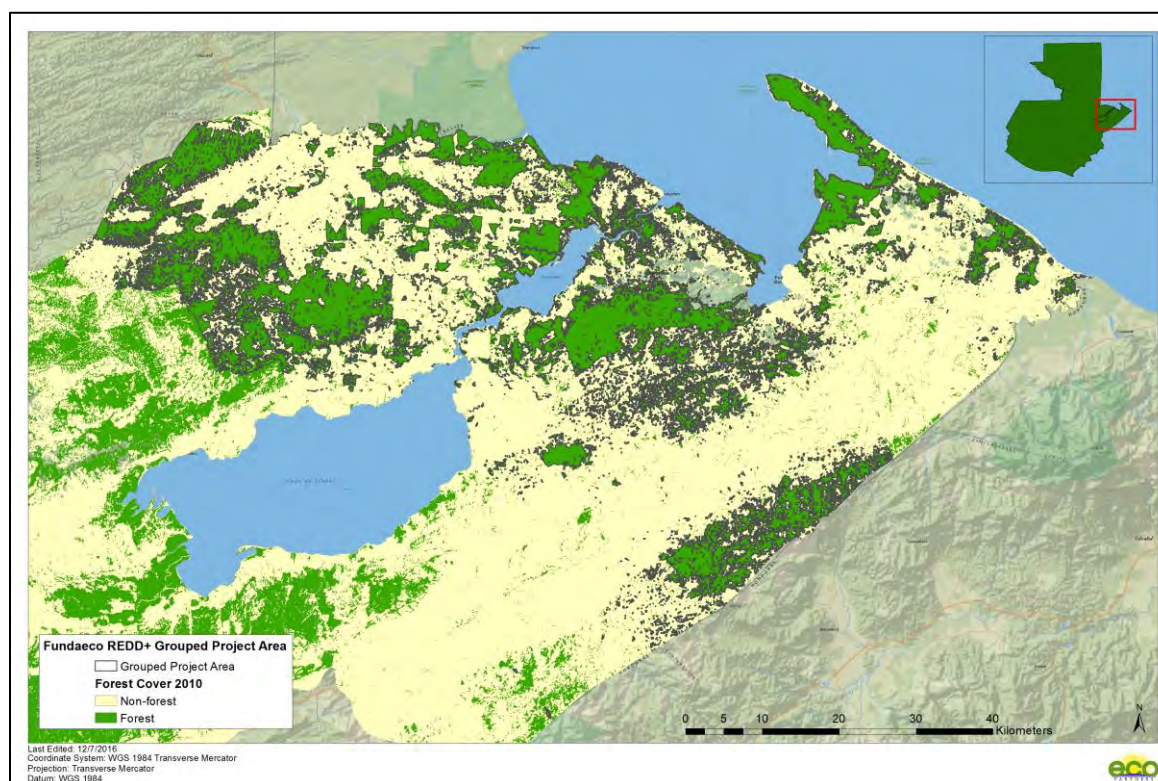
Figure 23. Forest Cover Benchmark Map for 2010 of the Grouped Project Area
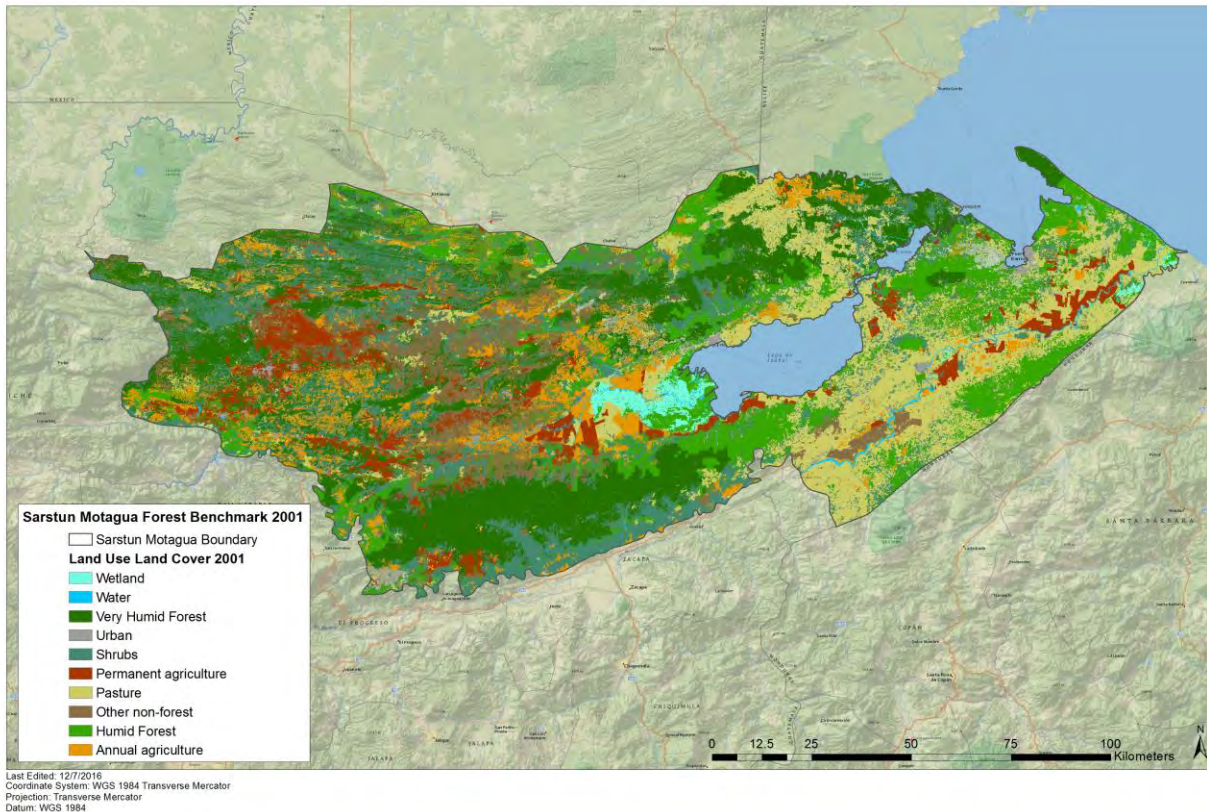
Figure 24: Land-Use and Land-Cover Map for 2001.
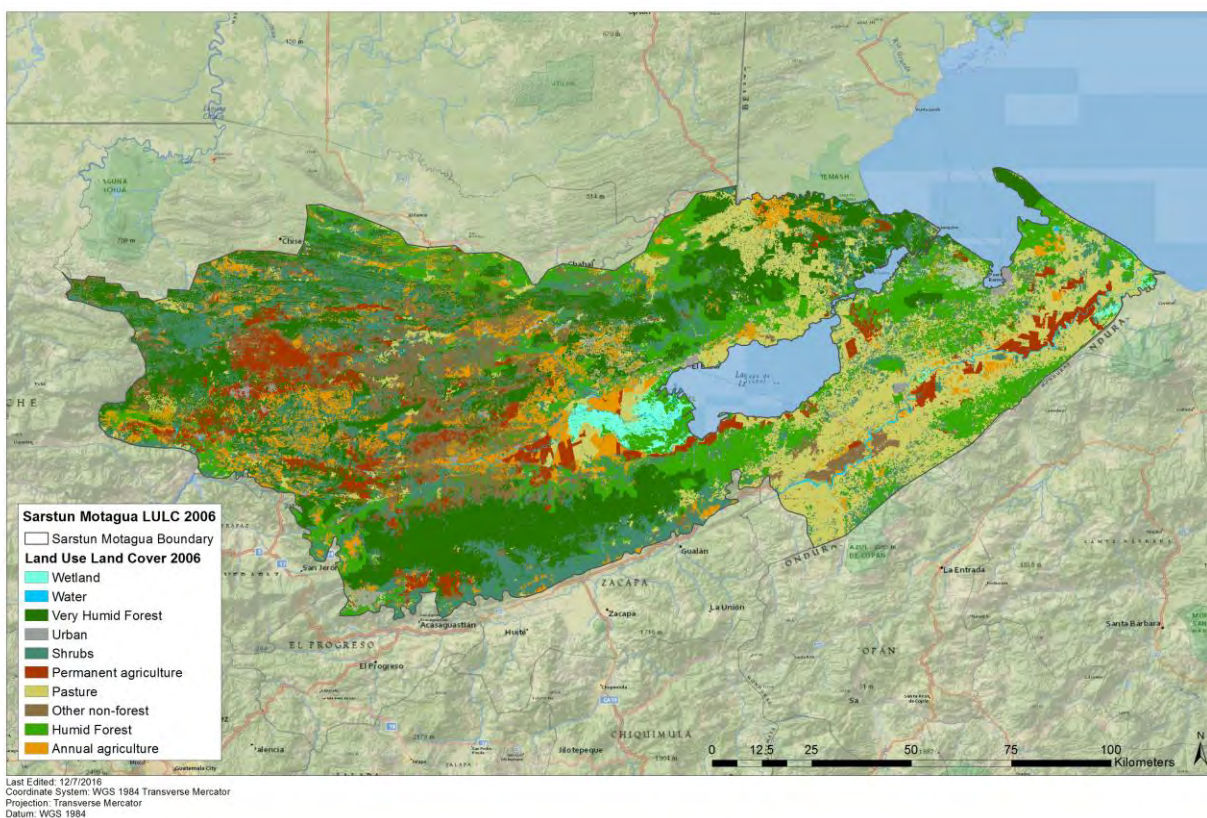
Figure 25: Land-Use and Land-Cover Map for 2006
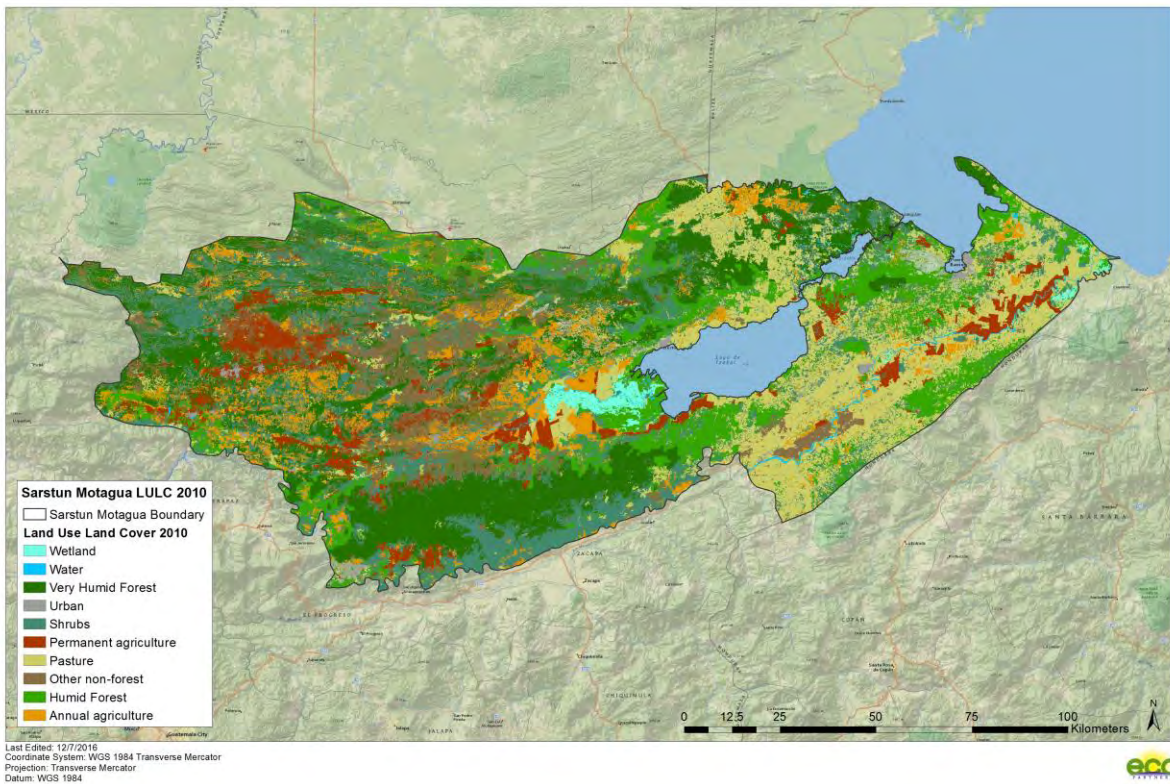
Figure 26. Land-Use and Land-Cover Map for 2010.
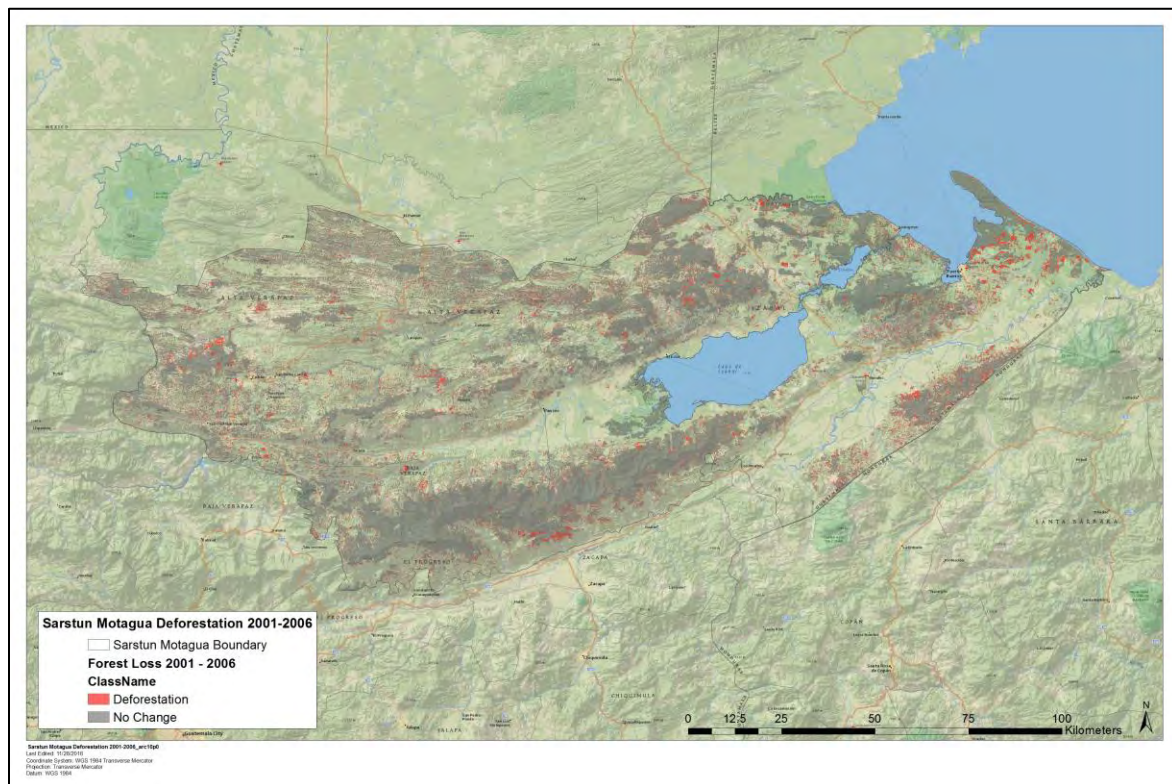
Figure 27. Deforestation map for 2001-2006
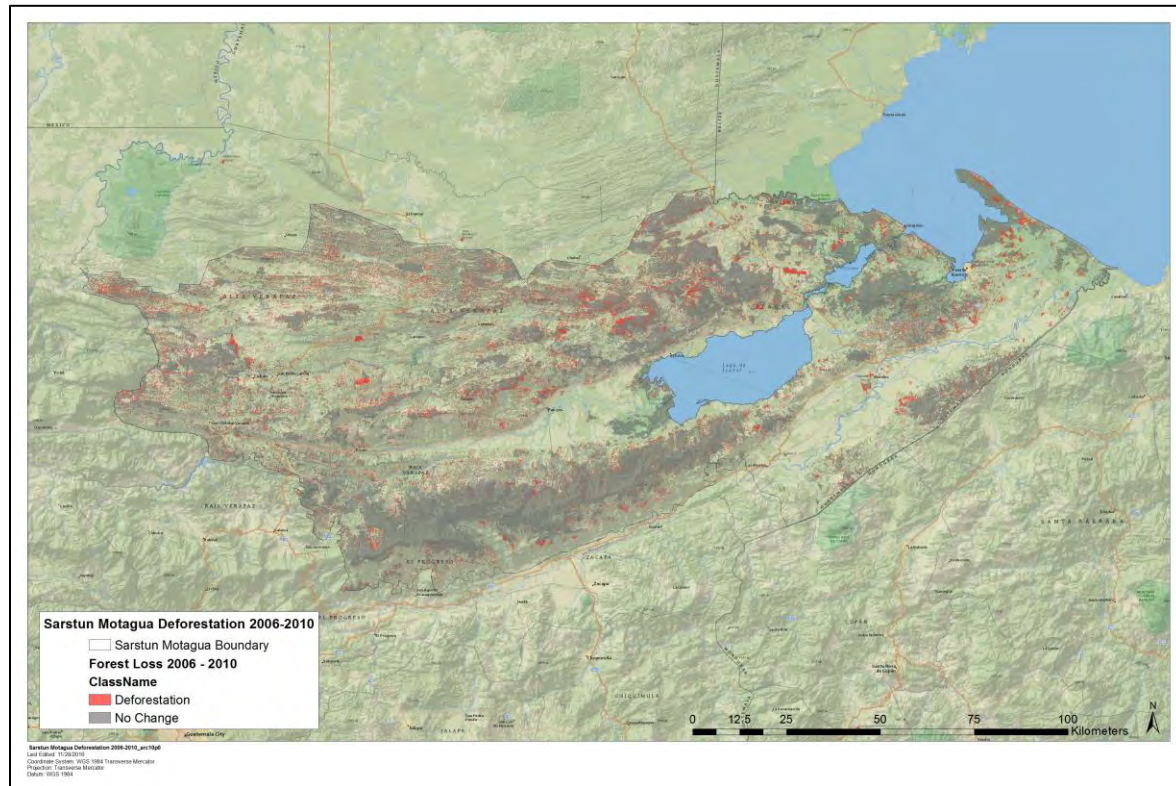
Figure 28. Deforestation map for 2006-2010
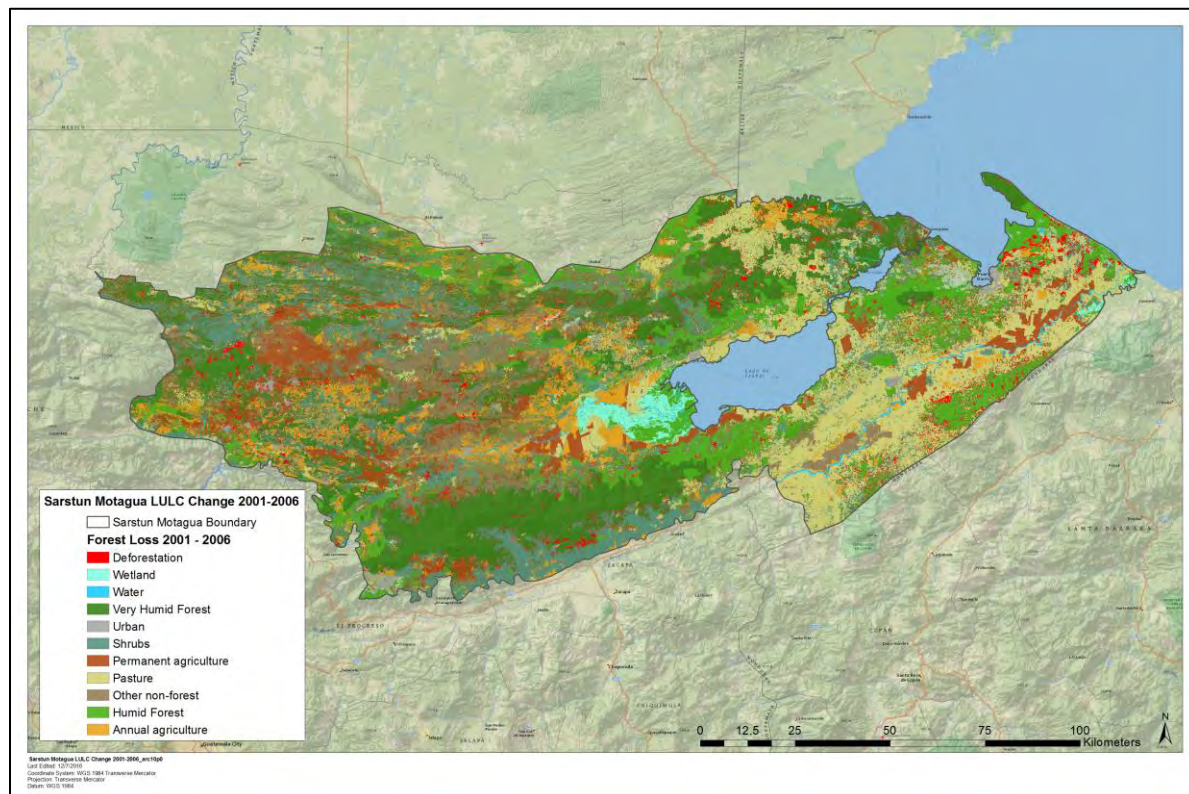
Figure 29. LULC Change Map from 2001-2006
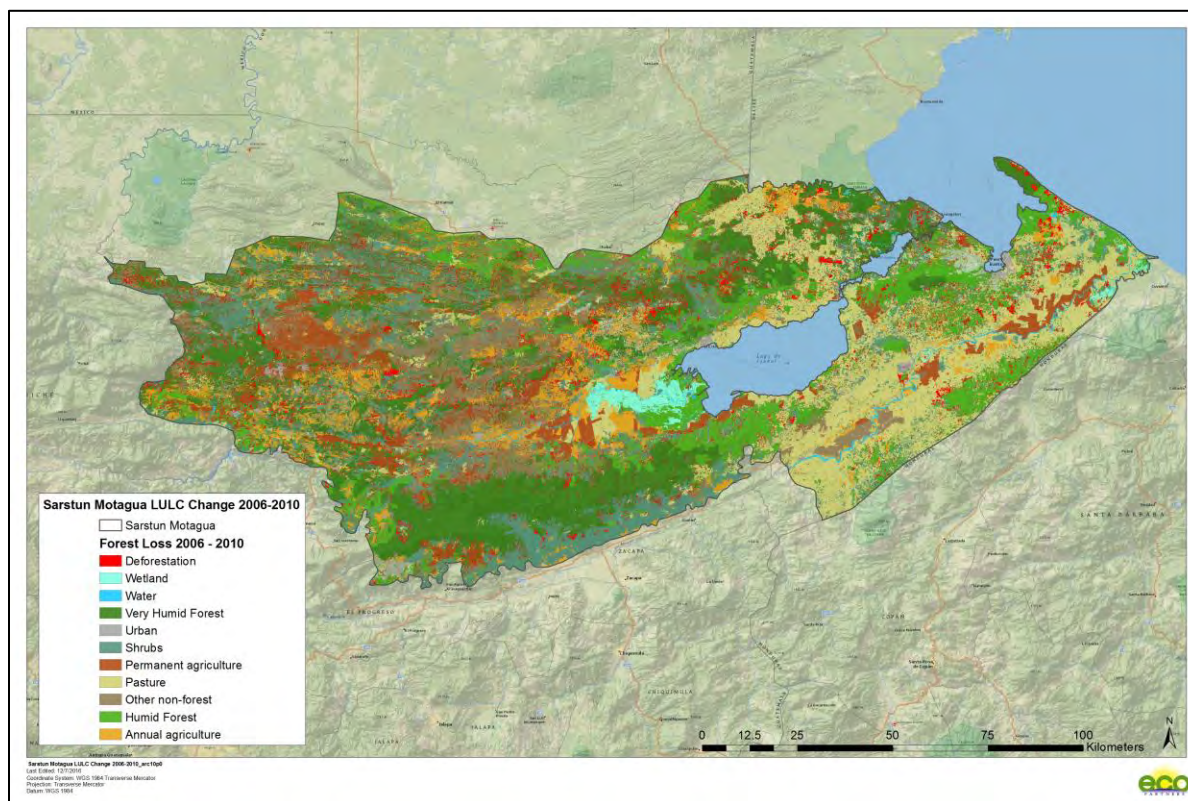
Figure 30. LULC Change Map from 2006-2010

5.3.2.4.3.8 Land-Use and Land-Cover Change Matrix

Table 30-31 below summarizes the LULC change area observed across the historical reference period for 2001-2006 and 2006-2010.

2001 to 2006	
Transition	Ha
Non-Deforestation Transition	1,015,086
Very Humid Forest to Other Non-Forest	6,547
Very Humid Forest to Shrubs	23,971
Very Humid Forest to Pasture	3,942
Very Humid Forest to Annual Agriculture	5,563
Very Humid Forest to Permanent Agriculture	3,205
Very Humid Forest to Urban	109
Humid Forest to Other Non-Forest	3,317
Humid Forest to Shrubs	18,750
Humid Forest to Pasture	14,801
Humid Forest to Annual Agriculture	4,339
Humid Forest to Permanent Agriculture	2,157
Humid Forest to Urban	165

Table 30. LULC Change Matrix for 2001-2006

2006 to 2010	
Transition	Ha
Non-Deforestation Transition	1,025,383
Very Humid Forest to Other Non-Forest	9,011
Very Humid Forest to Shrubs	28,856
Very Humid Forest to Pasture	5,387
Very Humid Forest to Annual Agriculture	7,679
Very Humid Forest to Permanent Agriculture	3,137
Very Humid Forest to Urban	135
Humid Forest to Other Non-Forest	4,018
Humid Forest to Shrubs	17,635
Humid Forest to Pasture	11,308
Humid Forest to Annual Agriculture	4,846
Humid Forest to Permanent Agriculture	2,314
Humid Forest to Urban	210

Table 31. LULC Change Matrix for 2001-2010

5.3.2.5 Map Accuracy Assessment (VM0015 Section 2.5)

An accuracy assessment was conducted on the LULC maps produced by UVG through the allocation of verification points across the reference region. The number of points allocated to reach a 90% accuracy, as required by the VM0015 methodology was determined through the following equation from Gongalton & Green (2009):

$$n = \frac{B * \pi i * (1 - \pi i)}{bi * bi}$$

Where:

B = the upper percentile (σ/k) x 100 of the Chi squared distribution ($x2$) with 1 degree of freedom

$\pi 1$ = proportion of the population of the i of K classes that represents the proportion closest to 50%

K = number of classes

σ = the standard deviation

bi = desired precision for class i

The results of the map accuracy assessment are described in more detail in the Evaluacion de la Precision 06jul2016 MV.docx

LULC Year	LULC Class	Total Class Accuracy
2001	Forest	90%
	Non-Forest	96%
2006	Forest	97%
	Non-Forest	97%

2010	Forest	86%
	Non-Forest	88%

Table 32. LULC class accuracy assessment results.

LULC Year	Verification Points	Total Map Accuracy
2001	1,191	91%
2006	692	97%
2010	857	88%

Table 33. Total map accuracy assessment results

5.3.3 ANALYSIS OF AGENTS AND DRIVERS OF DEFORESTATION (STEP 3 – VM0015)

5.3.3.1 Identification of agents of deforestation

The identification of agents of deforestation was undertaken in the Sarstun-Motagua region through workshops with local participants. The study of agents and drivers was conducted as part of the Guatemala National Emissions Reduction Program for the department of Izabal. The project used this data in order to align itself with the national program in the future. The CEAB-UVG team organized workshops in Morales, El Progreso, Puerto Barrios, and Rio Honda across the reference region to understand local perceptions of agents of deforestation. In short, the results of the workshops demonstrated that cattle ranchers and small to medium scale agriculture were the primary agents of deforestation in the Sarstun-Motagua region. Growth of agro-industrial crops such as palm oil were recognized as well, however, were not considered a direct agent of deforestation as large plantation and monocultures have taken the place of other permanent crops in fertile valleys. Additionally, tourism development and individuals who invade land for land speculation purposes were found to be relatively insignificant agents of deforestation, and thus were not focused on in this analysis. However, many of the project activities developed by this project, including forest patrols and the enforcement of local laws would help to curb any of these agents whose activities are possible due to weak law enforcement. It is worth noting that several other agents of deforestation were identified including illegal loggers and mines, however, these agents of deforestation were specifically excluded in the case of this REDD+ project. In the case of mines, deforestation is considered "planned" and is outside the scope of the baseline whereas illegal logging and fuelwood collection operations are small-scale, often leading to degradation that is outside the scope of this baseline. Again, despite not being included as agents of deforestation, in many cases the project activities would lead to reduced illegal logging and fuelwood collection through law enforcement and permitting processes implemented by FUNDAECO. Full descriptions and summaries of workshops held by UVG and other partners can be found in the following documents: CNCG SM drivers of deforestation_final_1.pdf, Brief on Agents and Drivers v2.docx, Mem T. C-A Defor_LB SM_El Progreso_19sept14.docx, Mem T. C-A Defor_LB SM_Morales_26ago14_vf.docx, Mem T. C-A Defor_LB SM_Puerto Barrios_25ago14_vf.docx, and Mem T. C-A Defor_LB SM_Rio Hondo_18sept14.docx.

In addition to mapping the perception of agents of deforestation with local stakeholders, FUNDAECO organized a workshop of three days with participation of 10 technicians with more than 10 years of experience in the project region to identify agents of deforestation. To develop the analysis the region was divided into protected areas and surrounding areas, and each protected area was divided into sectors. Type of agents and drivers were identified and mapped for each sector. The team worked using cadaster and land use dynamics maps for three periods; 1990-2001, 2001-2006, and 2006-2010. Table 34 summarizes the results of this workshop.

Agent	Driver	Areas Affected
Internal migrant invaders and subsistence farmers. Either Ladinos or Queqchis without land.	Need for housing areas, family subsistence, increased household numbers (in already existing communities), lack of local land planning, need of land for subsistence agriculture	Cerro San Gil, Rio Sarstun, Biotopo Chocon Machacas, Sierra Caral, Sierra Santa Cruz, Punta de Manabique
Farmers or cattle ranchers invaders: people who already has land and want to expand it for agriculture, cattle, or other purposes	Profitability of livestock, expansion of livestock areas to increase productivity, increased demand for meat and increased beef prices, income is short-medium term not long, expansions of farms to pastures (no cattle management)	Cerro San Gil, Rio Sarstun, Sierra Caral, Punta de Manabique
Invaders with no land needs	Land speculation, lack of clarity in land rights, deficient cadaster system	Montaña Chiclera, Sierra Caral
	Land speculation, absent land owners, abandoned land because of migration to United States	Cerro San Gil, Montaña Chiclera, Rio Sarstun
External migrant invaders	Displacement form other areas of the country, specifically Las Verapaces	Cerro San Gil, Sierra Santa Cruz
	External migration from El Progresso for livestock and small-scale farming.	Cerro San Gil
Farmers from Honduras	Market opportunities in cardamom, grazing, and coffee. Lack of control in boundaries.	Sierra Caral
Tourism developers (local or external)	Lack of regulations and weak institution OCRET, local market as an opportunity	Cerro San Gil, Parque Nacional Rio Dulce, Biotopo Chocon Machacas
Invaders; tenants	Demand for land for housing or subsistence agriculture	Around Montaña Chiclera in the Sector de Arrendamientos Valle Nuevo
Medium to large scale cattle ranchers (landowners)	Profitability of livestock, expansion of livestock areas to increase productivity, increased	Cerro San Gil, Rio Sarstun, Sierra Caral

	demand for meat and increased beef prices, income is short-medium term not long, expansions of farms to pastures	
Subsistence farmers	Agriculture expansion in their own lands (low productivity lands)	Cerro San Gil, Rio Sarstun, Sierra Caral, Sierra Santa cruz
Firewood extractors for commercial purposes	Firewood demand in rural and urban areas	Cerro San Gil
Illegal loggers	High demand for timber, lack of control and enforcement, no enforcement and weak institutions	Sierra Santa Cruz, Sierra Caral
Coal Extractors (small scale)	Local demand	Lote 6 in Cerro San Gil

Table 34. Identified agents of deforestation by FUNDAECO specialists and managers

From the above workshops held by both CEAB-UVG and FUNDAECO the agents of deforestation are summarized into the three following groups:

1.a. Name
Medium to large scale cattle ranchers

1.b. Brief Description
Medium to large scale cattle ranchers make-up a low proportion of the population in the Grouped Project Area that contribute deforestation activities and are among those that earn higher monthly incomes. Despite this, cattle ranchers are still a highly important deforestation agent given the relative amount of deforestation this group incurs due to the high land usage required by grazing (see Sections below). From the social assessment conducted by FUNDAECO (see Section 4.5.1), approximately 4 to 5% of respondents use their properties for cattle grazing. The rate of cattle grazing is highly determined by rural wages. Of the 222 respondents (< 1%) that reported a monthly income of less than GTQ-1,000 ($ 135) only 1 uses their land for cattle grazing with an area of approximately 3-5 hectares. For those that earn a monthly income of between GTQ- 1,000 to 3,000 ($135 to 400) there was a higher rate for cattle grazing with 6 out of 133 respondents (4.5%) using their land for this purpose. The grazing area used for cattle grazing in this income group is from 1 to 20 hectares, indicating higher land usage along with income. For those earning more than GTQ-3,000 ($400) monthly there is even a higher rate for cattle grazing with 7 out of 24 respondents (29%) using their property for cattle grazing. The majority of these identified families dedicated more than 30-hectares of land for grazing activities.

The results of the social assesment indicate that medium to large scale cattle ranchers are those that are more highly capitalized and with higher wages greater portions of land are deforested to make way for cattle grazing.

1.c. Development of population size
The National Statistical Institute foresees an annual population growth in the region of Izabal of 2.42% from 2011 to 2020, which is slightly higher than the national average (2.32%).

1.d. Deforestation Statistics

A land-use/land-cover (LULC) transition matrix is described below and quantified from a LULC analysis for 2001-2006 and 2006-2010 (Section 5.3.3.1) across the Sarstun-Motagua region. Several end land-use classes are defined including annual agriculture, permanent agriculture, pasture, shrubs (*guamil*), other non-forest, and urban. Among these end land-use classes, medium and large scale cattle ranchers are responsible for conversion of primary forest to pasture. Considering these transitions, 18,743-ha of primary forest were converted to pasture from 2001-2006 and 16,695-ha from 2006-2010 (see Tables 30 and 31).

The end land-use classes of shrubs (*guamil*) and other non-forest are not easily distinguished among the agents of deforestation. Shrubs or *guamil* is an area of vegetation that a user periodically stops sowing or grazing for several years in order to regenerate and increase its productivity. This practice is used in both agriculture (permanent and annual) as well as grazing and is a land-use that cannot be described further in terms of agents of deforestation. Similarly, other non-forest is a complex mixture of non-forest classes (annual agriculture, permanent agriculture, pasture, shrubs) and therefore cannot be specified in terms of an agent. The above statistics, however, serve to provide a relative importance of this agent among others.

Considering the entire reference period (2001-2010), medium to large scale cattle ranchers were responsible for 35,438-ha of deforestation found in the Grouped Project Area or 19.5% of the directly attributable deforestation.

2.a. Name
Small-scale farmers

2.b. Brief Description
The population of the grouped project area is mainly of indigenous Q´eqchi origin and mestizos (Ladino). The department of Izabal was first colonized in the 1960s and 1970s, originally by Ladinos looking to become owners of land through the INTA (National Institute of Agrarian Transformation). They began by settling in the east of the department, in areas near to the roads for easy access to markets. The Ladino population cultivates maize crops and also other more market-oriented crops (coffee, fruits, small scale farming of livestock).

At the same time, the Q´eqchi population, of indigenous Mayan origin, were fleeing the expansion of coffee in the neighboring department of Alta Verapaz and settled principally in the west of Izabal, close to the rivers and/or isolated areas within the forests. Within the Q´eqchi communities, land is collectively owned and the decision to carry out deforestation is also collective. However, agricultural work is independent and each family works the land that the community chief gives them (Maldidier, 2004). The Q´eqchi population maintains small agricultural plots, known as *milpas,* for family consumption.

The average size of the areas cultivated by these farms is 1.8 hectares. However, the communities also have access to the forested parts of the protected areas, from which they extract wood products (firewood and wood for domestic use) and non-wood products (decorative plants, particularly xate). The average monthly income of farmers in the area was GTQ 530 in 2004, or about $69 monthly, indicating a

high level of rural poverty. For these reasons, the REDD project has the potential to generate important social benefits, if it improves the living conditions of these populations.

2.c. Development of population size

The National Statistical Institute foresees an annual population growth in the region of Izabal of 2.42% from 2011 to 2020, which is slightly higher than the national average (2.32%). In 2004, only 27% of homes were using a method of family planning. This population growth is causing less land to be left in between two maize harvests and deforestation of the communities' lands is gradually continuing.

2.d. Deforestation Statistics

As described above, a land-use/land-cover (LULC) transition matrix is used to describe the deforestation attributable to small-scale farmers. Among these end land-use classes small-scale farmers are responsible for conversion of primary forest to annual agriculture (*milpas)* and to a smaller-scale permanent agriculture, including crops that include banana, plantain, coffee, palm oil, and rubber plantations. These permanent agriculture crops generally are established in areas that are distinguishable from the large-scale industrial agriculture operations in that they result in the deforestation of less-suitable mountainous forest areas and are grown in smaller areas. Considering these transitions from primary forest to annual and permanent agriculture, 15,264-ha from 2001-2006 and 17,976-ha from 2006-2010 can be attributed to small-scale farmers (see tables 30 and 31).

The end land-use classes of shrubs (*guamil*) and other non-forest are not easily distinguished among the agents of deforestation. Shrubs or *guamil* is an area of vegetation that a user periodically stops sowing or grazing for several years in order to regenerate and increase its productivity. This practice is used in both agriculture (permanent and annual) as well as grazing and is a land-use that cannot be described further in terms of agents of deforestation. Similarly, other non-forest is a complex mixture of non-forest classes (annual agriculture, permanent agriculture, pasture, shrubs) and therefore cannot be specified in terms of an agent. The above statistics, however, serve to provide a relative importance of this agent among others.

Considering the entire reference period (2001-2010), small-scale farmers are responsible for 33,239-ha of deforestation found in the Grouped Project Area or 18.3% of the directly attributable deforestation.

5.3.3.2 Identification of deforestation drivers

5.3.3.2.1 Driver Variables Explaining the Quantity of Deforestation

5.3.3.2.1 Cattle ranchers

Commodity Prices
Economic drivers are present in 80% of the causes that explain deforestation around the world (Geist and Lambin 2002). More specifically, the expansion of commodity agriculture was found to explain the majority of deforestation in the twenty-first century (DeFries et al. 2010). In Guatemala, heavy investment in palm oil, rubber plantations, and cattle has been observed at the start of the twenty-first century. The growth of palm oil plantations have displaced a number of land-uses including banana plantations and cattle as a 53% increase in the size of areas used for palm oil cultivation has been observed between 2006 and 2010. Within the Reference Region, prepared LULC maps for 2001, 2006, and 2010 (see Section 5.3.3.2) show 10,813 hectares of forest has been demolished and replaced with

areas of permanent agricultural cultivation such as coffee, rubber, or oil palm plantations. Commodity prices themselves have been connected to deforestation and re considered a driver of tropical deforestation (Macedo et al. 2012; Swenson et al. 2011). In the case of palm oil, the price has risen from $350/metric ton in 2000 to $500/metric ton in 2009 with a peak of $1200/metric ton in 2008 that coincides with the increased investment of palm oil in the *Departmento de Izabal* (Global Economic Monitor (GEM) Commodities| World DataBank).

The increase of commodity prices and thus commodity agriculture in Sasrtun-Motagua has been focused within the regions valleys that previously hosted cattle ranchers and small-farmers in the region. The process of land purchase by agro-industrial groups has created a problem of land scarcity in the valleys making forested regions within protected areas suitable for migrant rancher and farmers. In this light, commodity agriculture growth hasn't caused deforestation by its own activities by has caused significant portions of the population to be without land who seek new plots within nearby forested areas. By this process, the high opportunity cost of commodity agriculture afforded by increasing commodity prices has caused displacement of cattle ranchers who are willing to remove forest for new grazing areas.

1. **Small-scale farmers**

Commodity Prices
In addition to displacement of agricultural land uses such as cattle described above, palm oil has displaced rural communities through a process of land purchase in regions with fluvial plains that were already cleared several years ago. In search of new lands for cultivation for small-scale farming operations protected areas have served as plausible locations due to lack of oversight in these areas (see Section 5.3.3.4).

Population Growth and Land Quality
In addition to the expansion of small-scale agriculture due to commodity prices, small-scale farmers often will invade new lands in order to establish a new family or community. In addition, farmland that has been cultivated for years using unsustainable methods will often begin to decrease the quality and quantity of yields, which will drive the demand for agricultural expansion and deforestation.

5.3.3.2.1 Future Development of Deforestation Drivers Explaining Quantity
The future development of commodity prices is uncertain as but the prediction of these prices themselves has been difficult as they tend to shift with macro-economic shifts in production. Recent reports even indicate an economic slowdown in Latin America for commodity exports due to a slowdown in the Chinese economy (Calvo-González 2016). Alas, the coupled and complex nature of global markets makes the prediction of commodity prices and an increasing deforestation rate in the Reference Region difficult and inconclusive.

5.3.3.2.1 Project Measures for Deforestation Drivers Explaining Quantity
A full description of the AUD project technologies implemented in the REDD+ Project for Caribbean Guatemala can be found in Section 2.2.1. With regards to the driver of commodity prices and its effects on the deforestation rate FUNDAECO has implemented several important project activities. The first is Resource Protection which focuses on creating and maintaining protected areas. In regards to the driver of commodity prices this constrains the influence that large property purchases and subsequently population displacement can have on the region as less land is available for agro-industrial development. Secondly, the ongoing monitoring and surveillance of protected areas deters illegal settlement and provides institutional presence that previously was considered to be lacking (see Section 5.3.3.3).

For those portions of the population that already live within protected areas FUNDAECO is also pursuing a "Sustainable Enterprises" project activity. Within the activity a number of programs help small-scale farmers establish agro-forestry plots and provides alternative land-uses that don't entail deforestation and traditional options of *milpas* and cattle ranching do. This includes the development of nurseries for feedstock, workshops on crop management, and access to agricultural markets.

5.3.3.2.2 Driver Variables Explaining the Location of Deforestation

To assess driver variables that explain the location of deforestation a number of potential factors were initially investigated, including elevation, slope, settlement locations, density of agriculture, density of pasture lands, density of forest lands, density of population data, distance to hydrologic features (lakes, ocean, rivers, navigable waters), distance to roads (primary, secondary, and tertiary) and distance to the forest edge. Density and distance maps were created for each variable considered and a random sample of raster cells from each factor map were selected by the IDRISI LCM for statistical analysis. Statistical tests were made using the computing software R which is maintained by the Comprehensive R Archive Network (CRAN).

As many initial factors presented similar data – such as distance to primary, secondary and tertiary roads – covariance was analyzed among these initial factors to determine which factors exhibited significant correlation. To analyze the covariance of the initial factors, Chi-squared tests were applied to the off-diagonal elements of the sample covariance matrix. As expected, several factors were significantly correlated ($p > 0.9$). As inferred from these tests, the inclusion if these factors would violate the model assumption of independence. Certain correlated factors were dropped from the factor analysis; for each correlated factor, the factor with the greatest effect was retained. The factor effects were measured using a generalized linear model assuming an underlying binomial response (deforested vs. not deforested) and logit link function (logistic generalization). Significant correlation was observed in roads (primary, secondary and tertiary) and factors with latent proximity to water (town population, crop density, all hydrography and navigable hydrography). Resulting from the correlation analysis, final factors that explained the greatest variance in the location of deforestation were the following:

1. *Elevation*

In the case of the REDD+ Project for Caribbean Guatemala, elevations higher than 300-meters are more likely to experience deforestation as the majority of forest has been removed from low-lying valleys. Elevation, however, remains a proxy variable for accessibility of forest and a number of studies have shown that lower elevations, relatively, are an explanatory variable for higher rates of deforestation(Kinnaird et al. 2003; Trejo and Dirzo 2000).

2. *Slope*

Similar to elevation, slope is a proxy variable for accessibility of forest. Steeper slopes reduce the accessibility and suitability for agriculture often leaving remnant forest in these areas as found by other studies (Kinnaird et al. 2003; Trejo and Dirzo 2000).

3. *Distance to Forest Edge*

The accessibility of forest areas is influenced by their proximity to areas that have already been cleared for pasture or cropland (Rudel and Roper 1997).

4. *Distance to Secondary Roads*

Forests that are near roads are generally more accessible and are more susceptible to deforestation for agricultural and livestock systems. Several authors suggest that proximity to roads increases the likelihood of deforestation (Ferreira 2001, Nepstad et al 2001, Souza et al. 2004 and Ferreira et al. 2005). Roads facilitate the progression of deforestation in the Reference Region and, thus, are considered an enabling factor of deforestation.

5. *Distance to Navigable Hydrology*

There are a number of navigable hydrological features in Sarstun-Motagua, most notably the *Lago de Izabal*. Similar to secondary roads, navigable river and lakes facilitate the progression of deforestation due to the ease of access.

Project measures are not applicable in addressing the above predisposing factors. See Section 5.3.3.2.1 for a brief description of how project measure will address drivers and underlying causes of deforestation. For a full list of project activities, see Section 2.2.

5.3.3.3 Identification of underlying causes of deforestation

The agents of deforestation and factors that determine their decision (direct drivers) are themselves determined by broad forces that constitute the underlying causes of deforestation.   To understand this broader set of driving variables that cause deforestation, several workshops were held in Sarstun-Motagua to understand and explore the perceptions of local stakeholders surrounding the institutional causes of deforestation.   From these workshops, 501 responses from landowners and laborers to 39 attitude statements were collected in a specially designed questionnaire. An exploratory factor analysis (CNCG SM drivers of deforestation_final_1.pdf) of the results produced three key factors representing respondents' attitudes to drivers of deforestation common across the whole region which include:

1. Lack of Economic and Employment Opportunities
2. Lack of Laws, Enforcement and Capacity
3. Land Tenure

Further analysis comparing the combined results from across the region and sub-datasets from inside and outside two biosphere reserves as well as linear regression, analysis of variance and contextual qualitative analysis has shown that the first factor, 'Lack of Economic and Employment Opportunities' is consistently the strongest factor, explaining the most amount of variance and determining the most amount of deforestation in the region. Each factor is explained in further detail below:

1. Lack of Economic and Employment Opportunities

As indicated above, the average monthly income of the families of farmers in the area was GTQ -530 in 2004, in other words less than half of the minimum wage at the time (GTQ-1,348). Levels of access to basic services in the area are very low (for example, only 12% of the population have a septic tank to treat waste water and only 63% have access to running water at home) and levels of access to electricity are far below the national average (50% in the area versus 90% nationally). Most of the houses are built of wood with earth floors and roofs made of tin or palm leaves. This high level of poverty explains why the communities are very dependent on their environment, do not have the necessary capital to invest in their system of production, and do not hesitate to sell their land to large land owners in order to gain additional income. In addition, poor subsistence farmers will often continue to deforest the surrounding areas if the yields of their maize crops begin to decline due to decreasing soil quality.

Following section 2.2 that describes the project activities put forth by the project proponent, a number of project activities are aimed at addressing the Lack of Economic and Employment Opportunities. Namely, the Sustainable Enterprises, Access the Resource, and Education project activities are aimed at diversifying the income sources of families and individuals beyond traditional types of deforestation products such as maize, coffee, or fruits to include agroforestry products. Additional income can also be derived from forest protection through the PINFOR/ PINPEP programs incentivizing landowners to maintain forested areas. The Access to Resources activities allow for landowners to obtain the requisite materials and assistance to implement new forms of sustainable management as well as access to important markets to sell end products. Lastly, the Education project activities provide the knowhow for farmers to manage new types of crops. Together, these project activities, described in full in Section 2.2, address high levels of poverty and low access to capital to invest in sustainable and productive systems. Additionally, increased income from agroforestry products will reduce the incentives to sell properties to agro-industrial enterprises or tourism developers.

2. Lack of Laws, Enforcement and Capacity

No plans have yet been made for a national system of land-use planning and there is little inter-ministerial coordination, for example to avoid agro-industrial farming, mining and/or tourism activities developing in an uncontrolled manner and having a high impact on the protected areas (outside of the core areas, as in the core areas conservation takes precedence over all other uses) or on areas that are in the process of being declared.

Forestry activities (based on both wood and non-wood resources) for commercial use, and the transport of forest resources (even for domestic use) within the protected areas respectively require a forestry license and a transportation license from CONAP. However, this legislation is rarely met, due to CONAP's lack of resources to control this activity, the lack of involvement by local municipalities, and the complexity and cost of the system for obtaining licenses. The Readiness Preparation Proposal (RPP) submitted to the Forest Carbon Partnership Facility (FCPF) by Guatemala mentions the following shortcomings in the implementation of the environmental and forestry policy: a) the existence of significant regulatory loopholes; b) cross competencies among different institutions, which often means that none of the institutions take responsibility; c) regulations that lack sufficient coercion; d) few formal areas for public participation in the design and control of institutions and policies; and e) a lack of interinstitutional coordination.

FUNDAECO has designed a number of activities within the Resource Protection technology described in Section 2.2 that address the lack of law, enforcement, and capacity described above. In particular, FUNDAECO co-manages a network of 8 protected areas in the department of Izabal with CONAP. These activities include supporting forest patrols, writing management plans for each protected area, and the participation within the Consejo Ejecutivo Locals (CELs) of protected areas. With participation in the active management of protected areas FUNDAECO helps address issues identified in the RPP including lack of public participation and the lack of interinstitutional coordination. In addition, by co-managing the protected areas with CONAP, FUNDAECO provided additional resources to this ministry that in general lacks the resources to centrally manage the extensive network of protected areas across Guatemala.

3. Land Tenure

In the majority of cases, the communities have settled illegally on old private properties or national land, in particular in the protected areas. According to the Social assessment (see Base socioeconómica -

Altelia.pdf) only 24% of the families reported not owning a legal document of land ownership. When they have settled on private farms and the owner would like to claim back his land, there are three options: the expulsion of the community (which will often then invade national land), the transfer or sale of a portion of the farm to the community (which allows the owner to ensure a source of labor for their future activities), or the purchase of the land by Fontierra5 and its sale to the community (in theory at a low initial buying price, and a payment term of 10 years for the total value of the land). Sometimes, the private owners themselves look for a community to settle on their land so that Fontierra will buy it. When the communities occupy national farms in protected areas, the area's administrating body either offers them other land on another site, or recognizes the group's occupation of the land on the condition that they do not clear any more land in the core area. Large landowners, who are unable to obtain property titles for national land, sometimes work together with communities so that they occupy the land, are recognized as the occupiers and can then sell the land to the private owner. The lack of certainty regarding land tenure has given communities an impression of free access to the forest and its resources and discouraged investment in agricultural production, and is an obstacle to gaining access to government incentives (PINFOR in particular, and some other forms of credit).

The project activity focused on governance and land tenure, described in Section 2.2 was designed specifically by the project proponent to address the issues of difficulties in gain access to legal tenure. In areas where there are high rates of missing legal tenure documents, FUNDAECO helps communities and landowners with the technical process of registering properties. This includes generating geo-reference maps proposed properties, legal documentation of owners, and transportation costs to municipalities for landowners to be present. In addition, FUNDAECO provides services to CONAP to legally title undesignated land into new protect areas that further clarify the tenure and legal land management processes on given parcels. Lastly, FUNDAECO is active in the creation of new protected areas that define sustainable zoning and land management procedures. Most recently, Sierra Caral was designated as a protected area in 2014 with the legal and management advisory of FUNDAECO. Together, these project activities by FUNDAECO address the uncertainty of land tenure in the Grouped Project Area that allow property owners to access conservation benefits such as PINFOR/PINPEP and reduce land speculation due to poorly defined property rights. Additionally, the creation of protected areas and legalization of undesignated areas includes more lands with the protected area network that have clear procedures and laws regarding sustainable land-use.

5.3.3.4 Analysis of chain of events leading to deforestation

It was found that from 2000-2005 forest loss is positively correlated with urban population growth and exports of agricultural products for this time period (DeFries et al. 2010). At a national level, a wave of new agro-industrial product development has been observed in Guatemala itself including investment in palm oil, rubber plantations, and large private farms for cattle operations. The growth of palm oil plantations have displaced a number of land-uses including banana plantations and cattle as a 53% increase in the size of areas used for palm oil cultivation has been observed between 2007 and 2010. In addition to displacement of agricultural land uses, palm oil has displaced rural communities through a process of land purchase in regions with fluvial plains that were already cleared several years ago. In 2003, the department of Izabal had the second largest area of palm cultivation in the country (IV National Agricultural Census, 2004). In addition to increased investments from palm oil, a new wave of growth of extensive cattle farming, driven by highly capitalized enterprises, is leading to the purchase of private farms and in some cases the displacement of traditional communities. To date, the processes of agro-industrial development have taken place in areas that have already undergone deforestation, with

the exception of Punta de Manabique, and haven't been identified as agents of deforestation but rather have been identified as a driver of deforestation (see Section 5.3.3.2).

The process of population displacement by agro-industrial operations has led to the emergence of new villages of small-scale farmers and cattle ranchers (*Ladinos* and *Q´eqchis*), who are migrating to private farms and national land, often located within protected areas, in order to establish small-scale or subsistence farming and cattle grazing. In this context of territorial occupation, the remaining forests and protected areas that have been proposed for conservation are mainly located in the region's mountains, are generally over 300 meters high, and in steep regions that are not very suitable for agro-industrial cultivation and the extensive farming of livestock. For this reason the direct agents of deforestation are, and will remain, small-scale farmers and medium to large cattle grazing as identified in Section 5.3.3.1.

The agents of deforestation elect migration into either private or national property due to a number of underlying causes including: 1) Lack of Economic and Employment Opportunities; 2) Lack of Laws, Enforcement and Capacity; 3) Land Tenure (see Section 5.3.3.3). With the lack of alternative employment or economic opportunities in the *Departmento de Izabal* small scale farmers, in particular, are left to make a living off of the land.   Despite areas being designated as protected, national, or private lands the lack of laws and enforcement give little resistance to migratory families, communities, and small-scale farmers. Equally, large to medium to large scale cattle ranchers act in a sphere of influence similar to that of small-scale farmers where grazing lands can be sought in protected, national, and private lands. Some of these agents, however, are also more highly capitalized and are able to take advantage of weak tenure laws to seek out loopholes within land purchasing and titling arrangement. With this underlying condition the expansion of cattle farming and in protected areas has been observed.

At last, when it comes to choosing an area for small-scale farmers and large to medium scale cattle ranchers to make their lot, these decisions are driven by the factors discuss in Section 5.3.3.2.   In particular, elevation, slope, distance to forest edge, distance to secondary roads, and distance to navigable hydrology determines to suitability of different locations.

5.3.3.5 Conclusion of Agents and Drivers of Deforestation

The previous sections have shown that the evidence is conclusive that the small-scale farmers and medium to large scale cattle ranchers are the agents of deforestation in reference region, and the drivers involved and the underlying causes explain the a near constant rate of deforestation. Evidence from statistical tests and exploratory factor analysis were used to observe the spatial determinants of deforestation as well as identify the underlying causes of deforestation, respectively. Agents of deforestation were observed from stakeholder workshops in the reference region as well as expert opinion from technicians in the *Departmento de Izabal*. Lastly, evidence from literature, national studies, and the Social assesment confirmed the drivers of deforestation in the reference region.

5.3.4 PROJECTION OF FUTURE DEFORESTATION (STEP 4 – VM0015)

This step towards estimating baseline emissions includes projecting the annual rate of deforestation over the Reference Region for the project crediting period as well as the location of deforestation. The

reference region has one single stratum as the assessment of agents and drivers of deforestation (Section 5.3.1.1) demonstrates similar baseline deforestation activities across the Reference Region.

5.3.4.1 Selection of Baseline Approach (VM0015 Section 4.1.1)

A historical average approach according to VM0015 v1.1 was selected as a baseline approach for determining future rates of deforestation. Under this approach, the rate of baseline deforestation is assumed to be a continuation of the average annual rate measured during the historical reference period within the Reference Region.

The analysis of deforestation rates in the Reference region during the historical reference period revealed a rate of 2.86% for the 2001-2006 sub-period and 3.96% for the 2006-2010 sub-period demonstrating an increasing trend. Whether this increasing trend continues into the future was not conclusively answered in the agents and drivers of deforestation analysis. Principal drivers of deforestation were identified as global commodity prices. Commodity prices have been linked with deforestation in several previous studies[7,8] but the prediction of these prices themselves has been difficult as they tend to shift with macro-economic shifts in production. Recent reports even indicate an economic slowdown in Latin America for commodity exports due to a slowdown in the Chinese economy(Calvo-González 2016). Alas, the coupled and complex nature of global markets makes the prediction of commodity prices and an increasing deforestation rate in the Reference Region inconclusive.

Therefore, no conclusive evidence emerged from the analysis of agents and drivers of deforestation explaining the increasing deforestation rate across the historical reference period. Thus, as indicated by VM0015, approach "a" (historical average) was selected.

5.3.4.2 Quantitative Projection of Future Deforestation (VM0015 Section 4.1.2)

Using the historical average approach a projection of the baseline deforestation during the project crediting period was applied to the reference region. The annual baseline deforestation area at year t within the reference region area was calculated as indicated in the equation 3 of VM0015 version 1.1:

$$ABSLRR_{i,t} = ARR_{i,t-1} * RBSLRR_{i,t}$$

Where:

      $ABSLRR_{i,t}$: Annual area of baseline deforestation in stratum i within the reference region (ha yr^{-1})
      $ARR_{i,t-1}$: Area with forest cover in stratum i within the reference regin at year $t-1$ (ha)
      $RBSLRR_{i,t}$: Deforestation rate applicable to stratum i within the reference region at year t (%)
      t: 1, 2, 3…T, a year of the proposed project crediting period;
      i: 1, 2, 3…I$_{RR}$, a stratum within the reference region

From the historical LULC analysis the deforestation rate across the Reference Region was found to be 3.41%, accounting for 20,503 ha yr^{-1} of forest loss. This rate was applied per equation 3 of VM0015 version 1.1 for the Reference Region over the project crediting period and the results are summarized in Table 35.

Project year t	Stratum in the Reference Region	Total

	1	annual	cumulative
	ABSLRR$_{i,t}$ (ha)	ABSLRR$_t$ (ha)	ABSLRR (ha)
1	15,392	15,392	15,392
2	20,503	20,503	35,895
3	20,503	20,503	56,399
4	20,503	20,503	76,902
5	20,503	20,503	97,405
6	20,503	20,503	117,909
7	20,503	20,503	138,412
8	20,503	20,503	158,916
9	20,503	20,503	179,419
10	20,503	20,503	199,923
11	20,503	20,503	220,426
12	20,503	20,503	240,929
13	20,503	20,503	261,433
14	20,503	20,503	281,936
15	20,503	20,503	302,440
16	20,503	20,503	322,943
17	20,503	20,503	343,447
18	20,503	20,503	363,950
19	20,503	20,503	384,454
20	20,503	20,503	404,957
21	20,503	20,503	425,460
22	20,503	20,503	445,964
23	20,503	20,503	466,467
24	20,503	20,503	486,971
25	20,503	20,503	507,474
26	18,506	18,506	525,980
27	0	0	525,980
28	0	0	525,980
29	0	0	525,980
30	0	0	525,980

Table 35: Annual areas of baseline deforestation in the Reference Region

5.3.4.2.1 Partial Year Interpolation

The project start (April 2012) and the date of the 2010 benchmark map do not match. Hence the projection of the location of future deforestation starts as of 2010 prior to the project start date and the project start date does not exactly coincide with prediction dates. Therefore to determine the LULC change for partial years between spatial model predictions, a linear interpolation function was used:

$$y = y_0 + (x - x_0)\frac{y_1 - y_0}{x_1 - x_0}$$

where x and y are the interpolation date (expressed as days) and LULC change, respectively, and where subscript 0 and 1 are the prior and posterior prediction values, respectively. Artifacts of interpolation can been seen at the starting and ending dates pf the crediting period in Table 34.

5.3.4.3 Projection of the Location of Future Deforestation (VM0015 Section 4.2)

This step analyzes where future deforestation is most likely to happen in the baseline case in order to match the location of the projected deforestation with carbon stock and determine the annual areas of baseline deforestation in the project area and leakage belt. The requirements of VM0015 v1.1 were followed to construct a spatial model of future deforestation using steps outline in Figure 31 below. The spatial deforestation analysis included the following steps: preparation of factor maps, assessing the importance of each factor in explain the location of deforestation, applying the factor maps in an IDRISI model to create a final deforestation risk map.
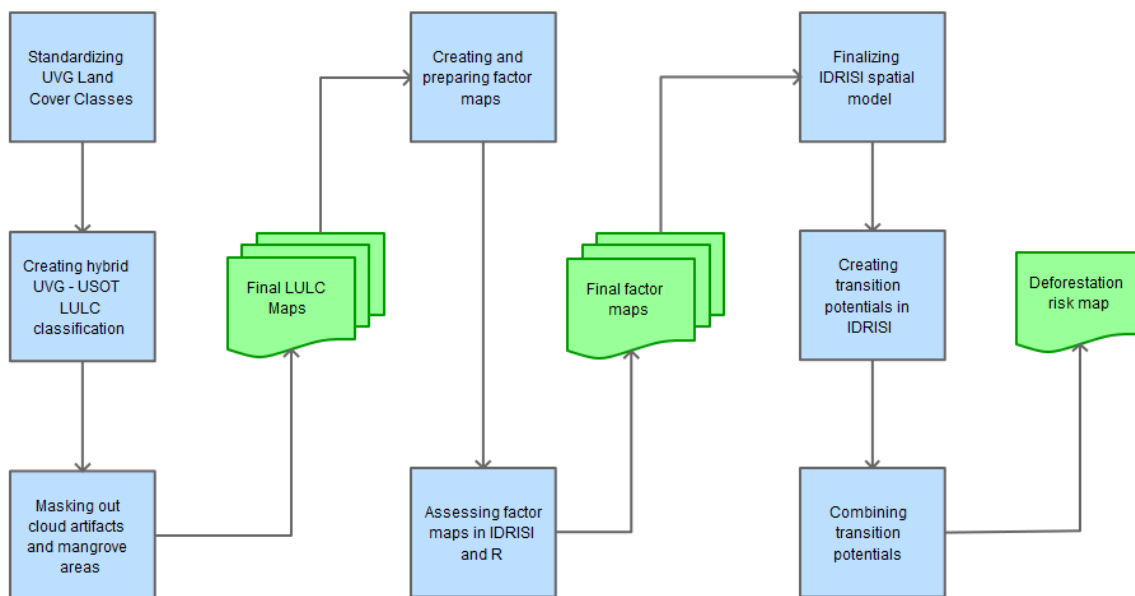
Figure 31. Flow diagram of the determination of a deforestation risk map used for the prediction of future deforestation locations

5.3.4.3.1 Preparation of Factor Maps

A number of potential factors were initially investigated, including elevation, slope, settlement locations, density of agriculture, density of pasture lands, density of forest lands, density of population data, distance to hydrologic features (lakes, ocean, rivers, navigable waters), distance to roads (primary, secondary, and tertiary) and distance to the forest edge. Factor maps were created for each factor and a random sample of raster cells (n=618,851 cells) from each factor map were selected by the IDRISI LCM

for statistical analysis. Statistical tests were made using the computing software R which is maintained by the Comprehensive R Archive Network (CRAN).

As many initial factors presented similar data – such as distance to primary, secondary and tertiary roads – covariance was analyzed among these initial factors to determine which factors exhibited significant correlation. To analyze the covariance of the initial factors, Chi-squared tests were applied to the off-diagonal elements of the sample covariance matrix. As expected, several factors were significantly correlated (p>0.9). As inferred from these tests, the inclusion if these factors would violate the model assumption of independence. Certain correlated factors were dropped from the factor analysis; for each correlated factor, the factor with the greatest effect was retained. The factor effects were measured using a generalized linear model assuming an underlying binomial response (deforested vs. not deforested) and logit link function (logistic generalization). Significant correlation was observed in roads (primary, secondary and tertiary) and factors with latent proximity to water (town population, crop density, all hydrography and navigable hydrography).

Resulting from the correlation analysis, the final factors used to produce risk maps were as follows:
- Elevation
- Slope
- Distance to Forest Edge [dynamic]
- Distance to Navigable Hydrology
- Distance to Secondary Roads

These five factors constitute the full model by which nested models were compared during model selection (see Table 36). Maps of each factor map are provided in the Project Description annexes (FactorMap_Figure_DistanceToForestEdge.png, FactorMap_Figure_DistanceToNavigableHydrologicalFeatures.png, FactorMap_Figure_Elevation.png, FactorMap_Figure_SecondaryRoads.png, and FactorMap_Figure_Slope.png).

Some aspects were not considered when choosing the factor maps and creating the risk map. These include areas of planned infrastructure development and unplanned infrastructure development. Both of these were excluded from the modeling process due to lack of evidence and are not required by VM0015.

The first steps in preparing factor maps were to obtain and pre-process the necessary data: land cover and land use maps, data for masking/pre-processing, and data for factor maps. Data required for the production of factor maps included the land cover and land use maps, DEMs of the region, road and stream networks, and settlement locations and population. A mangrove extent dataset was used to remove these from the reference region to meet the eligibility requirements of VM0015. Similarly, a mining concession dataset was used to remove areas of planned deforestation. Any cloud pixels identified in any of the 2001, 2006, 2010, and 2014 land cover maps were also removed from all land cover maps. Finally, all data was matched to the extent, coordinate system, and raster cell size of the land cover and land use maps provided by UVG.

Once the initial pre-processing was complete, the factor maps for IDRISI were created. There were three types of factor maps produced: distance factor maps, land cover density factor maps, and a population density factor map. The distance maps were produced using the Euclidean Distance tool in ArcGIS, the land cover density factor maps were produced using the focal statistics tool, and the population density

factor map was produced using the inverse-distance-weighted Interpolation tool in ArcGIS. Each of these factor map types were heuristically produced. The distance from forest edge factor map originally did not cover deep core forest areas, so Euclidean Allocation was used to extend the maximum distance value throughout the forest core.

Once the factor maps were produced, IDRISI Land Change Modeler for ArcGIS was used to convert all LULC and factor map .tif files into .rst files. A final standardization process in ArcGIS was run, which ensured that every factor map and LULC map had the same coordinate system, projection, extent, cell size, and cell snapping. Additionally, this process set the pixel type for factor maps to 16-bit signed, and the cell type for LULC maps to 8-bit unsigned.

The factor maps listed above were inputted directly into IDRISI, which treats the factor maps using a heuristic approach, using each input factor map to estimate the likelihood of deforestation as a function of distance.

Factor Map		Source	Variable Represented		Meaning of the categories or pixel value		Other Maps and Variables used to create the Factor Map		Algorithm or Equation Used
ID	File Name		Unit	Description	Range	Meaning	ID	File Name	
1	Factor_DEM.img	Client DEM	m	Elevation	1 – 2,981	Meters elevation	N/A	N/A	
2	Factor_Forest Edge_2001.img	LULC data	m	Distance	30 – 3,742	Meters from feature	N/A	LULC 2001 UVG/USOT data	Euclidean Distance
3	Factor_hydro _navigable.img	Client hydrological data	m	Distance	15 – 19,224	Meters from feature	N/A	Hydro_nagivable.shp	Euclidean Distance
4	Factor_roads _secondary.img	Client road data	m	Distance	1 – 22,447	Meters from feature	N/A	Roads_secondary.shp	Euclidean Distance
5	Factor_slope.img	Client DEM	%	Slope	1 – 4,276	% Change in Slope	1	Factor_DEM.img	N/A

Table 36. Lists of variables, maps and factor maps

5.3.4.3.2 Preparation of Deforestation Risk Maps

The IDRISI Land Change Modeler for ArcGIS allows for the creation of transition potentials, a raster image where the value in each cell represents the probability of a transition from a given land cover class (e.g. forest) to another given land cover class (e.g. pasture). The software uses the inputted factor maps in combination with the land use change model to create transition potentials. The transition potential layers were combined by using the maximum transition potential value from all layers, creating a single composite transition potential raster, where the value of each cell was the probability of a transition from forest land cover type to a non-forest land cover type. This composite transition potential raster was used as the final deforestation risk map.

5.3.4.4 Selection of the Most Accurate Deforestation Risk Map (VM0015 Section 4.2.3)

The most accurate deforestation risk map was selected by measuring the Akaike Information Criteria (AIC) for all combinations of nested models in the full five-factor model described earlier in this document. This is a deviation from the measurement requirements identified in section 4.2.3 of

VM0015 which are to use cross-validation methods. Justification for this deviation is provided in the Section 4.3. The primary reason for the deviation is that risk maps quantify the probability of deforestation while comparative data prescribed by VM0015 quantify the presence of deforestation, not probability; we cannot observe the probability of deforestation so it is impossible to cross validate risk maps.

Using the well-recognized and well-accepted approach of AIC to measure model fit, model selection is possible in the absence of observable deforestation probabilities. AIC was measured for all combinations of factors in the full model using the sample data randomly selected by the IDRISI LCM (n= 618,851). As measured by AIC, no nested model performed better than the full model so the full model was selected for further analysis. As prescribed by VM0015, the Figure of Merit (FOM) metric was used to determine that the final model met the minimum threshold, as described below.

Once the final model was selected, transition potentials were created as described in section 2.2 and end land use predictions were created for each raster cell. This 2100 prediction of end land use was then altered to include more detailed forest types by replacing any cells of forest left with cells of subtyped forest including Very Humid Forest and Humid Forest. Additionally, an alternate end land use raster was created for sole use in the spatial model by removing any remaining forest land cover. This was performed with the Euclidean Allocation tool to replace forest cells with the nearest non-forest class. Additionally, the 2100 end land use prediction map, the starting LULC maps, a deforestation transition potential map, and the factor maps were used to create prediction maps for each year using IDL over the 30-year crediting period (2011-2041).

The "Figure of Merit" (FOM) assessment technique was used to confirm the model prediction. As stated in VM0015,

"*The FOM is a ratio of the intersection of the observed change (change between the reference maps in time 1 and time 2) and the predicted change (change between the reference map in time 1 and simulated map in time 2) to the union of the observed change and the predicted change. The FOM ranges from 0.0, where there is no overlap between observed and predicted change, to 1.0 where there is a perfect overlap between observed and predicted change. The highest percent FOM must be used as the criterion for selecting the most accurate Deforestation Risk Map to be used for predicting future deforestation.*"

The calculated FOM was 0.1472, which was above the minimum threshold for best fit of 0.04061. As stated in VM0015,

"*The minimum threshold for the best fit as measured by the Figure of Merit (FOM) shall be defined by the net observed change in the reference region for the calibration period of the model. Net observed change shall be calculated as the total area of change being modeled in reference region during the calibration period as percentage of the total area of the reference region. The FOM value shall be at least equivalent to this value. If the FOM value is below this threshold, the project proponent must demonstrate that at least three models have been tested, and that the one with the best FOM is used.*"

The net observed change in the reference region for the calibration period of the model was calculated using the deforestation data from 2010 – 2014, resulting in a minimum threshold for the best fit of 0.04061, or 4.06% of change, in the reference region. As the calculated FOM for the Prediction Map is

0.1472, or 14.72% of change, the Prediction Map has been demonstrated to reproduce actual deforestation accurately enough for use.

5.3.4.4.1 Mapping of the Locations of Future Deforestation (VM0015 4.2.4)

The annual deforestation rate was calculated by considering the two time periods within the reference period separately (2001 – 2006, 2006 – 2010). The annual deforestation rate for each of the two periods was calculated and then averaged to produce a deforestation rate for the reference period from 2001-2010. For each period, the number of cells deforested was divided by the number of years in the period to get the amount of annual deforestation in cells. The annual deforestation was then converted into a rate by dividing the annual deforestation amount by the total number of forest pixels at the start of the period to generate the annual deforestation rate. The annual deforestation rates for the two periods were then averaged to produce the final average annual deforestation rate of 3.41% (Section 5.3.2).

The spatial model uses the 2010 LULC class data, the factor maps described in the "Preparation of Factor Maps & Risk Maps" section above, the alternate predicted end land use raster, and the combined deforestation risk map raster as inputs. The deforestation rate calculated above is read into the Spatial Model using IDL, and converted from units of hectares per year to cells per year. The model then calculates the number of forest cells within the 2010 LULC class data to deforest, and sorts the deforestation risk map from highest to lowest value, with the highest values representing the highest likelihood of deforestation. The model is designed to loop over year-long intervals. Within each loop, the model applies the deforestation rates to an array of cells from the deforestation risk map in order to determine the number of pixels depleted over the course of a year. For example, if the deforestation rate is equal to 200 cells per year, the first 200 cells in the deforestation risk map array will be effectively depleted to their end land use value as determined from the alternate end land use prediction map. The deforestation risk map values for the depleted pixels are then converted to a value of -1, effectively changing their position to the bottom of the transition potential array. After the pixel depletion has occurred within a loop, an end land use map is created for that year, which is then used to compute a transition matrix between the end land use map and the land use map from the previous year. The transition matrix is calculated with the function 100*Scene 1 – Scene 2, which produces a unique LULC transition code for each transition type.

Each loop results in an output of a map showing end land use after pixel depletion, a transition matrix between the end land use map and the previous year's land use map, as well as a summary of the total number of pixels in each LULC class. When the model runs the loop for the following year, the total forest remaining is calculated from the previous year's estimated end land. The spatial model is run over a period of 30 years to predict the end land uses from the deforestation rate and transition potentials.

Following the mapping of locations of future deforestation, Table 37, and Table 38 below report the annual areas of baseline deforestation in the Project Area, and the Grouped Project Area.

Project year t	Stratum in the Project Area	Total

	1	annual	cumulative
	$ABSLPA_{i,t}$ (ha)	$ABSLPA_t$ (ha)	$ABSLPA$ (ha)
1	1,233	1,233	1,233
2	2,255	2,255	3,487
3	2,339	2,339	5,826
4	2,652	2,652	8,479
5	2,931	2,931	11,409
6	3,054	3,054	14,464
7	3,189	3,189	17,653
8	3,377	3,377	21,031
9	3,627	3,627	24,658
10	3,946	3,946	28,604
11	4,148	4,148	32,752
12	4,018	4,018	36,770
13	3,807	3,807	40,577
14	3,733	3,733	44,311
15	3,682	3,682	47,992
16	3,326	3,326	51,318
17	2,845	2,845	54,163
18	2,742	2,742	56,905
19	3,094	3,094	59,999
20	3,216	3,216	63,215
21	3,089	3,089	66,304
22	3,560	3,560	69,864
23	2,567	2,567	72,431
24	1,414	1,414	73,844
25	256	256	74,101
26	33	33	74,133
27	0	0	74,133
28	0	0	74,133
29	0	0	74,133
30	0	0	74,133

Table 37: Annual areas of baseline deforestation in the Project Area

Project year t	Stratum in the Grouped Project Area	Total	
	1	annual	cumulative
	ABSLGPAi,t (ha)	ABSLGPAt (ha)	ABSLGPA (ha)
1	4,931	4,931	4,931
2	6,442	6,442	11,373
3	5,568	5,568	16,941
4	5,526	5,526	22,467
5	5,636	5,636	28,103
6	5,454	5,454	33,558
7	5,315	5,315	38,873
8	5,277	5,277	44,150
9	5,334	5,334	49,484
10	5,481	5,481	54,965
11	5,458	5,458	60,423
12	5,023	5,023	65,446
13	4,643	4,643	70,089
14	4,498	4,498	74,587
15	4,383	4,383	78,970
16	3,913	3,913	82,883
17	3,347	3,347	86,230
18	3,188	3,188	89,418
19	3,557	3,557	92,974
20	3,654	3,654	96,629
21	3,470	3,470	100,099
22	3,955	3,955	104,054
23	2,853	2,853	106,907
24	1,571	1,571	108,478
25	285	285	108,762
26	36	36	108,799
27	0	0	108,799
28	0	0	108,799
29	0	0	108,799
30	0	0	108,799

Table 38: Annual areas of baseline deforestation in the Grouped Project Area

5.3.5 DEFINITION OF THE LAND-USE AND LAND-COVER CHANGE COMPONENT OF THE BASELINE (STEP 5 – VM0015)

5.3.5.1 Calculation of Baseline Activity Data per Forest Class (VM0015 5.1)

Using the output of projecting the quantity and location annual deforestation in the reference region over the project crediting period as well as the LULC Map (Section 5.3.2.4.3), annual maps showing areas that would be deforested in the absence of the project for each forest class were produced see Project Description annexes for all maps. Forest degradation is not part of the baseline and the initial forest classes are considered to be static in terms of carbon stocks until deforested. These maps are summarized below in Table 39, Table 40, Table 41 and Table 42 for the Project Area, Grouped Project Area, Leakage Area, and Reference Region, respectively.

Area deforested per forest class *icl* within the project area			Total baseline deforestation in the project area	
ID_{icl}	1	2	$ABSLPA_t$	ABSLPA
Name	*Very Humid Forest*	*Humid Forest*	annual	cumulative
Protect year t	ha	ha	ha	ha
1	279	954	1,233	1,233
2	712	1,542	2,255	3,487
3	879	1,459	2,339	5,826
4	1,204	1,448	2,652	8,479
5	1,404	1,527	2,931	11,409
6	1,521	1,533	3,054	14,464
7	1,587	1,602	3,189	17,653
8	1,669	1,708	3,377	21,031
9	1,694	1,933	3,627	24,658
10	1,740	2,206	3,946	28,604
11	1,817	2,331	4,148	32,752
12	1,931	2,087	4,018	36,770
13	1,915	1,893	3,807	40,577
14	1,866	1,867	3,733	44,311
15	1,943	1,738	3,682	47,992
16	1,990	1,336	3,326	51,318
17	1,803	1,042	2,845	54,163

18	1,817	925	2,742	56,905
19	2,075	1,020	3,094	59,999
20	1,950	1,266	3,216	63,215
21	1,579	1,510	3,089	66,304
22	1,023	2,537	3,560	69,864
23	468	2,100	2,567	72,431
24	621	793	1,414	73,844
25	78	178	256	74,101
26	0	33	33	74,133
27	0	0	0	74,133
28	0	0	0	74,133
29	0	0	0	74,133
30	0	0	0	74,133

Table 39: Annual areas deforested per forest class icl within the Project Area in the baseline case (baseline activity per forest class)

	Area deforested per forest class *icl* within the grouped project area		Total baseline deforestation in the grouped project area	
ID$_{icl}$	1	2	ABSLGPA$_t$	ABSLGPA
Name	*Very Humid Forest*	*Humid Forest*	annual	cumulative
Protect year t	ha	ha	ha	ha
1	1,117	3,814	4,931	4,931
2	2,036	4,406	6,442	11,373
3	2,094	3,475	5,568	16,941
4	2,509	3,017	5,526	22,467
5	2,700	2,936	5,636	28,103
6	2,717	2,738	5,454	33,558
7	2,645	2,670	5,315	38,873
8	2,608	2,669	5,277	44,150
9	2,491	2,843	5,334	49,484
10	2,416	3,064	5,481	54,965
11	2,391	3,067	5,458	60,423

12	2,414	2,609	5,023	65,446
13	2,335	2,308	4,643	70,089
14	2,248	2,249	4,498	74,587
15	2,314	2,070	4,383	78,970
16	2,341	1,572	3,913	82,883
17	2,121	1,226	3,347	86,230
18	2,113	1,075	3,188	89,418
19	2,385	1,172	3,557	92,974
20	2,216	1,438	3,654	96,629
21	1,774	1,697	3,470	100,099
22	1,137	2,818	3,955	104,054
23	520	2,333	2,853	106,907
24	690	881	1,571	108,478
25	86	198	285	108,762
26	0	36	36	108,799
27	0	0	0	108,799
28	0	0	0	108,799
29	0	0	0	108,799
30	0	0	0	108,799

Table 40. Annual areas deforested per forest class icl within the Grouped Project Area in the baseline case (baseline activity per forest class)

Area deforested per forest class icl within the leakage area			Total baseline deforestation in the leakage area	
ID_{icl}	1	2	$ABSLRR_t$	ABSLRR
Name	*Very Humid Forest*	*Humid Forest*	annual	cumulative
Protect year t	ha	ha	ha	ha
1	151	517	668	668
2	386	836	1,222	1,890
3	477	791	1,267	3,157
4	653	785	1,437	4,595

5	761	827	1,588	6,183
6	825	831	1,655	7,839
7	860	868	1,728	9,567
8	905	926	1,830	11,397
9	918	1,048	1,966	13,363
10	943	1,196	2,139	15,502
11	985	1,263	2,248	17,750
12	1,047	1,131	2,178	19,927
13	1,038	1,026	2,063	21,991
14	1,011	1,012	2,023	24,014
15	1,053	942	1,995	26,009
16	1,079	724	1,803	27,812
17	977	565	1,542	29,354
18	985	501	1,486	30,839
19	1,124	553	1,677	32,516
20	1,057	686	1,743	34,259
21	855	818	1,674	35,933
22	555	1,375	1,929	37,862
23	253	1,138	1,391	39,254
24	336	430	766	40,020
25	42	97	139	40,158
26	0	18	18	40,176
27	0	0	0	40,176
28	0	0	0	40,176
29	0	0	0	40,176
30	0	0	0	40,176

Table 41. Annual areas deforested per forest class icl within the Leakage Area in the baseline case (baseline activity per forest class)

Area deforested per forest class *icl* within the reference region			Total baseline deforestation in the reference region	
ID_{icl}	1	2	$ABSLRR_t$	ABSLRR
Name	*Very Humid Forest*	*Humid Forest*	annual	cumulative
Protect year t	ha	ha	ha	ha
1	4,663	10,728	15,392	15,392
2	7,987	12,517	20,503	35,895
3	9,927	10,576	20,503	56,399
4	11,113	9,391	20,503	76,902
5	11,481	9,023	20,503	97,405
6	11,622	8,881	20,503	117,909
7	11,653	8,850	20,503	138,412
8	11,755	8,749	20,503	158,916
9	11,555	8,949	20,503	179,419
10	11,322	9,182	20,503	199,923
11	11,226	9,278	20,503	220,426
12	11,578	8,925	20,503	240,929
13	12,166	8,337	20,503	261,433
14	12,218	8,286	20,503	281,936
15	12,200	8,304	20,503	302,440
16	12,578	7,925	20,503	322,943
17	13,070	7,433	20,503	343,447
18	13,760	6,743	20,503	363,950
19	14,726	5,778	20,503	384,454
20	15,513	4,991	20,503	404,957
21	16,343	4,161	20,503	425,460
22	15,088	5,416	20,503	445,964
23	14,551	5,953	20,503	466,467
24	18,274	2,229	20,503	486,971
25	19,780	724	20,503	507,474

26	18,171	335	18,506	525,980
27	0	0	0	525,980
28	0	0	0	525,980
29	0	0	0	525,980
30	0	0	0	525,980

Table 42: Annual areas deforested per forest class icl within the Reference Region in the baseline case (baseline activity per forest class)

5.3.5.2 Calculation of Baseline Activity Data per Post-Deforestation Forest Class

Using the suitability model from IDRISI LCM an end-land use map was prepared by running the model well beyond the project crediting period (90 years). As part of the pixel depletion model (Section 5.3.4.4), at each time step the forest area removed was replaced with the LULC class represented by the end-land use map. The result obtained was a LULC Map for each time step during the project crediting period. The final LULC map (t = 32) is shown in Figure 32. The results of each map during the whole project crediting period are summarized in Table 42.
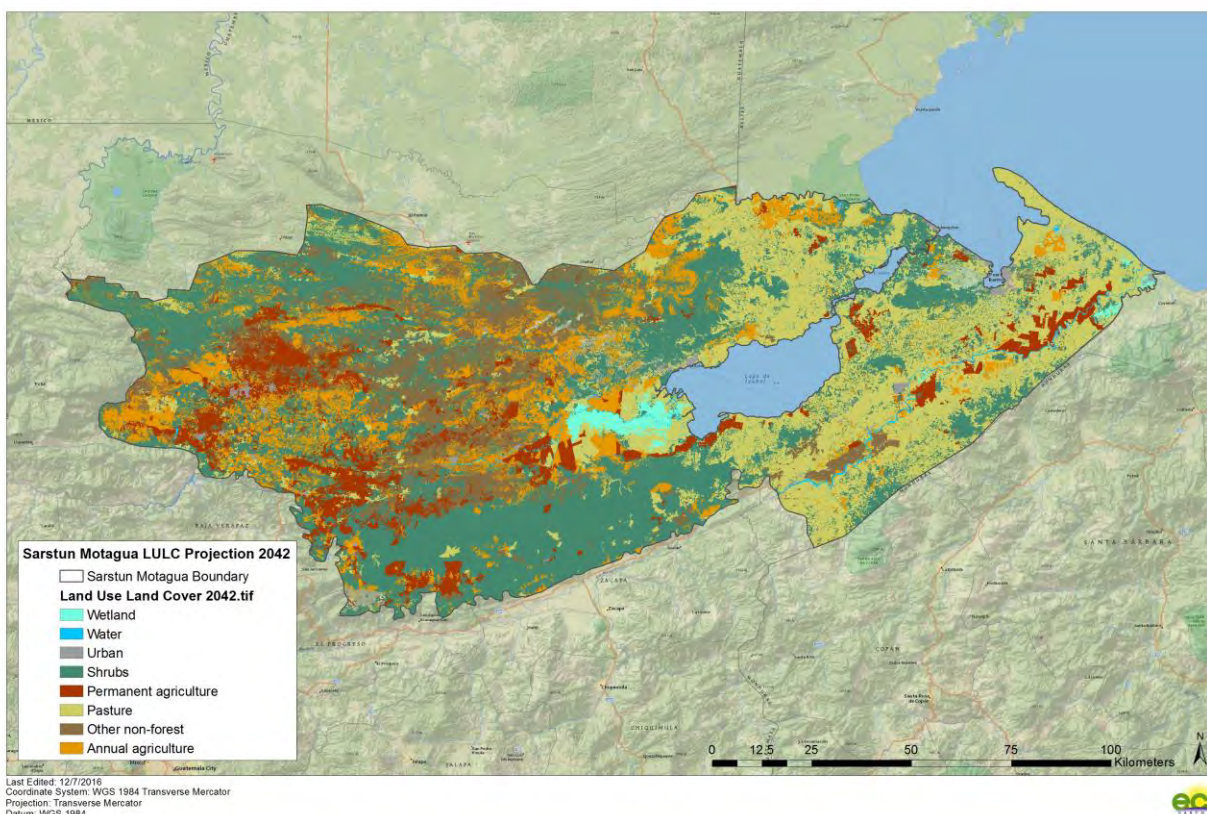
Figure 32: LULC map of projected baseline deforestation in 2042

5.3.5.3 Calculation of Baseline Activity Data per LULC Change Category

The LULC change categories (*ct*) were determined over the crediting period by observing the "from" class in the previous time step (*t-1*) with the "to" class in the current time step (*t*). The results are summarized in Table 43, Table 44, Table 45 and Table 46.

Activity data per LU/LC category *ct* within the project area									Total baseline deforestation in the project area	
ID$_{ct}$	4	5	6	7	8	9	10	11	ABSLPA$_t$	ABSLPA
Name	*Water*	*Urban*	*Wetland*	*Permanent agriculture*	*Annual agriculture*	*Pasture*	*Shrubs*	*Other non-forest*	annual	cumulative
Projtect year t	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha
1	0	2	0	3	16	1,090	121	1	1,233	1,233
2	0	3	0	6	23	2,063	160	1	2,255	3,487
3	0	2	0	6	20	2,185	125	1	2,339	5,826
4	0	0	0	7	18	2,509	117	1	2,652	8,479
5	0	0	0	6	18	2,789	116	1	2,931	11,409
6	0	0	0	7	18	2,900	128	1	3,054	14,464
7	0	0	0	11	39	2,861	277	2	3,189	17,653
8	0	0	0	32	116	2,329	895	5	3,377	21,031
9	0	0	0	31	196	1,857	1,540	4	3,627	24,658
10	0	0	0	32	236	1,576	2,095	8	3,946	28,604
11	0	0	0	26	213	1,386	2,515	9	4,148	32,752
12	0	0	0	13	186	1,209	2,603	7	4,018	36,770
13	0	0	0	10	170	1,094	2,524	9	3,807	40,577
14	0	0	0	8	202	993	2,523	6	3,733	44,311

ID$_{ct}$	4	5	6	7	8	9	10	11	ABSLGPA$_t$	ABSLGPA
15	0	0	0	6	246	911	2,513	5	3,682	47,992
16	0	0	0	2	252	724	2,344	4	3,326	51,318
17	0	0	0	1	258	551	2,033	3	2,845	54,163
18	0	0	0	0	281	445	2,010	5	2,742	56,905
19	0	0	0	0	389	388	2,311	5	3,094	59,999
20	0	0	0	0	714	368	2,125	9	3,216	63,215
21	0	0	0	1	1,091	322	1,660	15	3,089	66,304
22	0	0	0	2	1,808	190	1,537	22	3,560	69,864
23	0	0	0	11	903	263	1,369	22	2,567	72,431
24	0	0	0	1	33	199	1,175	5	1,414	73,844
25	0	0	0	0	0	54	202	0	256	74,101
26	0	0	0	0	0	0	33	0	33	74,133
27	0	0	0	0	0	0	0	0	0	74,133
28	0	0	0	0	0	0	0	0	0	74,133
29	0	0	0	0	0	0	0	0	0	74,133
30	0	0	0	0	0	0	0	0	0	74,133

Table 43. Baseline activity data for LU/LC change categories (ct) in the Project Area

Activity data per LU/LC category *ct* within the grouped project area									Total baseline deforestation in the grouped project area	
ID$_{ct}$	4	5	6	7	8	9	10	11	ABSLGPA$_t$	ABSLGPA

Name	Water	Urban	Wetland	Permanent agriculture	Annual agriculture	Pasture	Shrubs	Other non-forest	annual	cumulative
Projtect year t	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha
1	0	6	0	13	64	4,360	484	4	4,931	4,931
2	0	8	0	16	65	5,894	456	4	6,442	11,373
3	0	5	0	15	46	5,201	299	3	5,568	16,941
4	0	1	0	14	38	5,227	244	2	5,526	22,467
5	0	0	0	12	35	5,364	222	2	5,636	28,103
6	0	0	0	12	32	5,179	229	2	5,454	33,558
7	0	0	0	18	65	4,768	462	3	5,315	38,873
8	0	0	0	50	182	3,639	1,399	7	5,277	44,150
9	0	0	0	45	289	2,730	2,264	5	5,334	49,484
10	0	0	0	44	327	2,189	2,910	11	5,481	54,965
11	0	0	0	34	280	1,824	3,309	12	5,458	60,423
12	0	0	0	17	233	1,512	3,253	9	5,023	65,446
13	0	0	0	12	207	1,334	3,079	11	4,643	70,089
14	0	0	0	9	244	1,197	3,040	7	4,498	74,587
15	0	0	0	7	293	1,084	2,992	6	4,383	78,970
16	0	0	0	3	296	851	2,758	5	3,913	82,883
17	0	0	0	1	303	648	2,391	4	3,347	86,230
18	0	0	0	0	327	517	2,338	6	3,188	89,418
19	0	0	0	0	447	446	2,656	6	3,557	92,974
20	0	0	0	1	812	418	2,415	10	3,654	96,629
21	0	0	0	1	1,225	361	1,865	17	3,470	100,099

22	0	0	0	2	2,009	211	1,708	25	3,955	104,054
23	0	0	0	12	1,003	293	1,521	25	2,853	106,907
24	0	0	0	1	37	221	1,306	6	1,571	108,478
25	0	0	0	0	1	60	224	0	285	108,762
26	0	0	0	0	0	0	36	0	36	108,799
27	0	0	0	0	0	0	0	0	0	108,799
28	0	0	0	0	0	0	0	0	0	108,799
29	0	0	0	0	0	0	0	0	0	108,799
30	0	0	0	0	0	0	0	0	0	108,799

Table 44. Baseline activity data for LU/LC change categories (ct) in the Grouped Project Area

Activity data per LU/LC category *ct* within the leakage area									Total baseline deforestation in the leakage area	
ID_{ct}	4	5	6	7	8	9	10	11	$ABSLRR_t$	ABSLRR
Name	*Water*	*Urban*	*Wetland*	*Permanent agriculture*	*Annual agriculture*	*Pasture*	*Shrubs*	*Other non-forest*	annual	cumulative
Protect year t	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha
1	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	4	0	0	4	4
6	0	0	0	0	0	8	0	0	8	12

7	0	0	0	0	0	12	1	0	13	25
8	0	0	0	0	1	13	5	0	19	44
9	0	0	0	0	1	13	11	0	25	69
10	0	0	0	0	2	13	18	0	33	103
11	0	0	0	0	2	14	25	0	41	144
12	0	0	0	0	2	14	30	0	46	190
13	0	0	0	0	2	14	33	0	50	240
14	0	0	0	0	3	15	37	0	55	295
15	0	0	0	0	4	15	41	0	60	355
16	0	0	0	0	5	13	42	0	60	415
17	0	0	0	0	5	11	40	0	56	470
18	0	0	0	0	6	10	43	0	59	529
19	0	0	0	0	9	9	53	0	72	601
20	0	0	0	0	18	9	53	0	80	681
21	0	0	0	0	29	9	44	0	83	763
22	0	0	0	0	52	5	44	1	102	865
23	0	0	0	0	28	8	42	1	78	943
24	0	0	0	0	1	6	38	0	46	989
25	0	0	0	0	0	2	7	0	9	998
26	0	0	0	0	0	0	1	0	1	999
27	0	0	0	0	0	0	0	0	0	999
28	0	0	0	0	0	0	0	0	0	999
29	0	0	0	0	0	0	0	0	0	999
30	0	0	0	0	0	0	0	0	0	999

Table 45. Baseline activity data for LU/LC change categories (ct) in the Leakage Area

	Activity data per LU/LC category *ct* within the reference region								Total baseline deforestation in the reference region	
ID_{ct}	4	5	6	7	8	9	10	11	$ABSLRR_t$	ABSLRR
Name	Water	Urban	Wetland	Permanent agriculture	Annual agriculture	Pasture	Shrubs	Other non-forest	annual	cumulative
Protect year t	ha	ha	ha	ha	ha	ha	ha	ha	ha	ha
1	0	6	0	4,073	182	9,528	1,450	152	15,392	15,392
2	0	8	0	6,003	186	11,247	1,392	1,667	20,503	35,895
3	0	5	0	3,209	1,119	9,173	1,453	5,545	20,503	56,399
4	0	1	0	2,341	1,219	8,843	1,537	6,563	20,503	76,902
5	0	0	0	1,582	1,610	8,870	1,643	6,799	20,503	97,405
6	0	0	0	1,344	2,597	8,825	2,111	5,627	20,503	117,909
7	0	0	0	1,080	3,078	8,488	2,986	4,871	20,503	138,412
8	0	0	0	1,002	3,580	6,177	5,513	4,232	20,503	158,916
9	0	0	0	908	4,042	4,025	8,084	3,445	20,503	179,419
10	0	0	0	806	4,039	3,228	9,508	2,922	20,503	199,923
11	0	0	0	692	3,820	2,758	10,876	2,357	20,503	220,426
12	0	0	0	610	3,745	2,278	11,780	2,090	20,503	240,929
13	0	0	0	577	3,646	1,911	12,491	1,879	20,503	261,433
14	0	0	0	562	3,579	1,682	13,094	1,586	20,503	281,936

15	0	0	0	513	3,400	1,469	13,765	1,357	20,503	302,440
16	0	0	0	425	2,870	1,139	15,046	1,023	20,503	322,943
17	0	0	0	377	2,528	875	15,850	873	20,503	343,447
18	0	0	0	336	2,411	720	16,182	854	20,503	363,950
19	0	0	0	373	3,407	680	15,104	940	20,503	384,454
20	0	0	0	580	5,458	751	12,661	1,053	20,503	404,957
21	0	0	0	592	8,028	695	9,660	1,529	20,503	425,460
22	0	0	0	664	7,884	629	10,069	1,258	20,503	445,964
23	0	0	0	1,122	3,699	1,125	13,101	1,456	20,503	466,467
24	0	0	0	1,071	934	923	16,799	777	20,503	486,971
25	0	0	0	1,670	864	808	16,966	195	20,503	507,474
26	0	0	0	896	459	118	16,911	111	18,495	525,969
27	0	0	0	0	0	0	0	0	0	525,969
28	0	0	0	0	0	0	0	0	0	525,969
29	0	0	0	0	0	0	0	0	0	525,969
30	0	0	0	0	0	0	0	0	0	525,969

Table 46: Baseline activity data for LU/LC change categories (ct) in reference region

Zone	Water		Urban		Wetland		Permanent agriculture		Annual agriculture		Pasture		Shrubs		Other non-forest		Total of all other LU/LC classes present in the Zone	Total area of each Zone
	ID_{fcl}	4	ID_{fcl}	5	ID_{fcl}	6	ID_{fcl}	7	ID_{fcl}	8	ID_{fcl}	9	ID_{fcl}	10	ID_{fcl}	11		

ID z	Name	Area ha	% of Zone %	Area ha	% of Zone %	Area ha	% of Zone %	Area ha	% of Zone %	Area ha	% of Zone %	Area ha	% of Zone %	Area ha	% of Zone %	Area ha	% of Zone %	Area ha	% of Zone %	Area ha	% of Zone %
1	Zone 1	11,216	1.1%	12,269	1.2%	16,860	1.6%	99,167	9.4%	146,963	14.0%	280,131	26.7%	337,160	32.1%	146,005	13.9%	1,049,771	100.0%	1,049,771	100.0%

Table 47. Zones of the reference region encompassing different combinations of potential post-deforestation LU/LC classes as of the end of the historical reference period

5.3.6 ESTIMATION OF BASELINE CARBON STOCK CHANGES AND NON-CO$_2$ EMISSIONS (STEP 6 – VM0015)

Following the VM00015 Methodology, this section outlines the steps taken to estimate the carbon stocks existing within each LULC class and the baseline carbon stock changes that occur due to deforestation.

In support of the National REDD+ Program, the CNCG working group led by UVG recently updated a forest inventory in the Sastrun-Motagua reference region. The field campaign was conducted in 2014 where 150 forest inventory plots were collected. Additionally, a subsequent inventory to collect inventory from non-forest type land classes was led by UVG in 2015-2016 where 78 plots were sampled. Together, a network of 274 plots were installed over Sarstun-Motagua and a subset of 121 plots that were found within the Project Zone have been utilized herein to estimate the carbon stocks over the REDD+ Project for Caribbean Guatemala.

5.3.6.1 Estimation of the Average Carbon Stocks of each Forest LULC Class (VM0015 6.1.1)
To estimate the carbon stocks for each Forest LULC class the guidance and requirements presented in Appendix 3 of VM0015 were followed. A full, detailed methodology for the forest carbon stock measurement (*Metodologia para la estimacion del contenido de carbon en bosques y sistemas agroforestales en Guatemal*), a summary report for the data collection and results determined for the Sarstun-Motagua region, and the collected inventory results from plots found in the Project Zone can be found in Forest Carbon Stock Model_Quilo_v1.1.xlsm.

5.3.6.1.1 Plot Size and Design
The plot design implemented across the forest carbon stock inventory was first implement in the "Metodología para la estimación del contenido de carbono en bosques y sistemas agroforestales en Guatemala" in November 2010 (Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf). The circular plot design was installed across the plot network that includes three nested sub-plots (Figure 33).
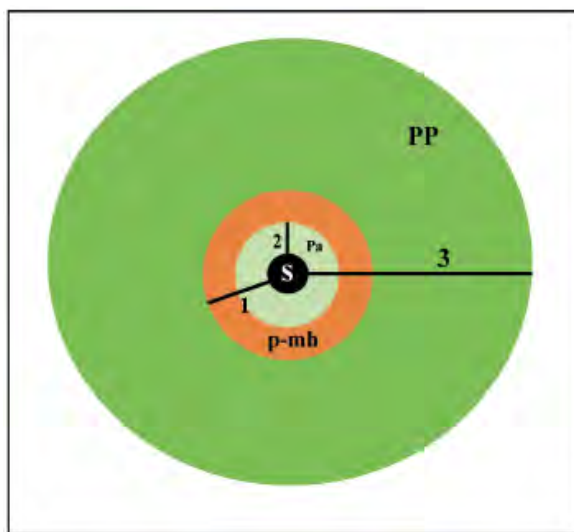
Figure 33. Plot size and design for measuring carbon pool in the forest classes

Each sub-plot is used to evaluate different carbon pools within each land class. The 1st subplot that was 0.6-meters in radius (1 square meter in area) was used to collect samples for litter that are later

analyzed in a laboratory setting. The 2nd sub-plot that was 3-meters in radius (28 square meters in area) measured saplings with diameters at breast height between 2.5-9.9-cm. Lastly, the 3rd sub-plot that was 18-meters in radius (1,018 square meters in area) and the largest was used to inventory the diameter of all tree species at or above 10-cm in diameter. Details of the sampling protocol for each plot is provided in Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf.

5.3.6.1.2 Plot Locations

A network of plots was determined by the Clima, Naturaleza y Comunidades en Guatemala (CNCG) working group heading by UVG-CEAB. To avoid subjective choice of plot locations a stratified random sample of forest plots was done over the Sarstun-Motagua reference region. Additionally, plots were located in accessible protected areas that were non-contiguous. To assure that plots were evenly distributed across these protected areas within the stratified random sample, the area (ha) of each protected area was divided by the average area per plot (VM0015 Annex 3). The result of the 150 forest inventory plot locations across the Reference Region is shown in Figure 34. In addition to the CNCG plots, additional forest inventory plots that had been installed and measured by different institution including UVG and INAB were included. These plots supplemented the CNCG plots in determination of carbon stocks to be used across the Sarstun-Motagua region in the forthcoming national REDD+ program.
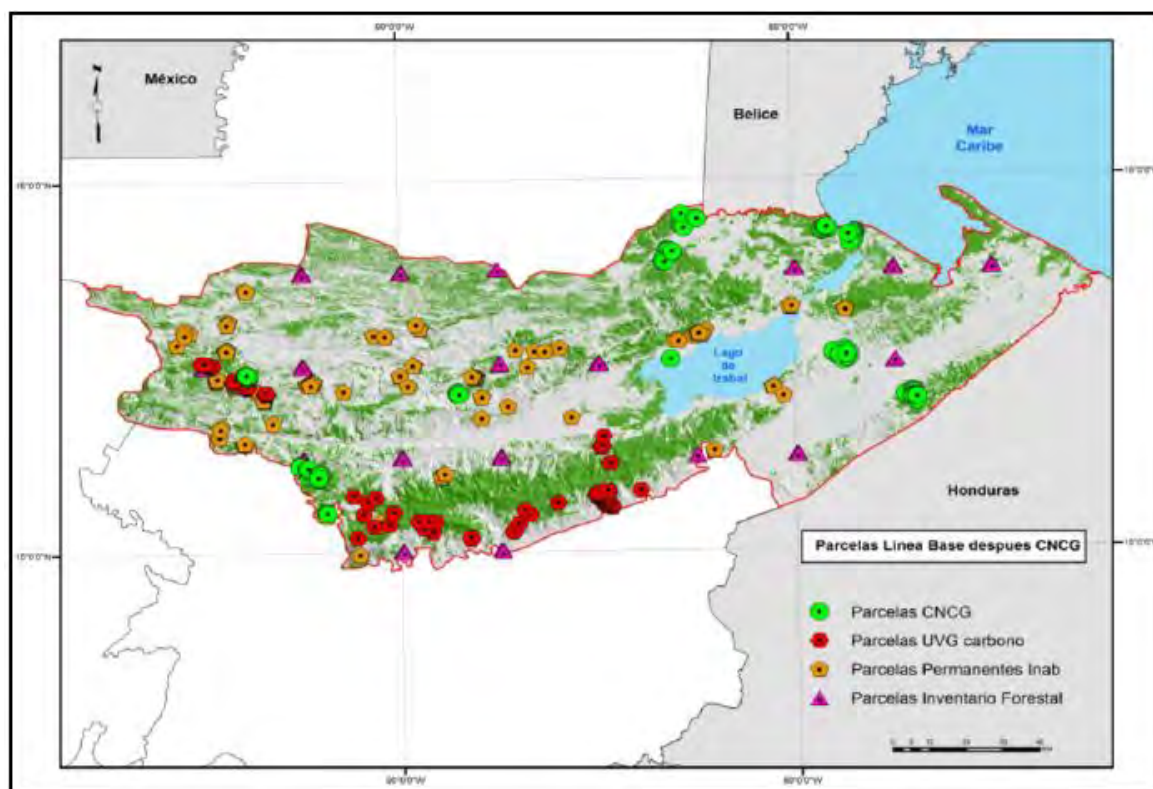
Figure 34. Forest inventory plot network across the Reference Region

For the purposes of the REDD+ Project for Caribbean Guatemala, however, a subset of plots within the Project Zone were selected to determine the relevant carbon stocks for baseline emissions within the Grouped Project Area. The selected plots within the Project Zone that were used to determine the carbon stocks across the selected carbon pools are listed in the forest carbon stock analysis (Forest

Carbon Stock Model_Quilo_v1.1.xlsm).

5.3.5.1.3 Estimation of Carbon Stocks
Following the sampling of forest inventory plots and filed collection the total average carbon stock per hectare in each forest LULC class was estimated using equation A3-6 below from VM0015:

$$Ctot_{cl} = Cab_{cl} + Cbb_{cl} + Cl_{cl} + Csoc_{cl} - Cwp_{cl}$$

Where:
$Ctot_{cl}$: average carbon stock per hectare in all accounted carbon pools of the LULC class *cl* (tCO$_2$eha^{-1})
Cab_{cl}: average carbon stock per hectare in the above-ground biomass carbon pool of the LULC class *cl* (tCO$_2$eha^{-1})
Cbb_{cl}: average carbon stock perhectare in the below-ground biomass carbon pool of the LULC class *cl* (tCO$_2$eha^{-1})
Cl_{cl}: average carbon stock per hectare in the litter carbon pool of the LULC class *cl* (tCO$_2$eha^{-1})
$Csoc_{cl}$: average carbon stock per hectare in the soil organic carbon pool of the LULC class *cl* (tCO$_2$eha^{-1})
Cwp_{cl}: average carbon stock per hectare in the wood products carbon pool of the LULC class *cl* (tCO$_2$eha^{-1})

Each carbon pool was estimated for its carbon stock following the guidelines and requirements provided in Appendix 3 of VM0015 as discussed below.

Above-Ground Biomass (Tree)
The above-ground biomass tree component was estimated the using direct field measurements – method (b) in Appendix 3 of VM0015 – where the biomass of each individual tree present in the forest and non-forest inventory discussed above was estimated. Estimates of biomass per tree were based on the allometric method – (b.1) in Appendix 3 of VM0015 – where regional equations for coniferous and broadleaf trees have been defined for Guatemala. Following equations presented in Appendix 3, biomass estimates are scaled up to carbon stock estimated per plot and eventually per LULC class (Forest Carbon Stock Model_Quilo_v1.1.xlsm).

The allometric equations used were based on study of three species in Guatemala: *Vochysia guatemalensis*, *Clophyllum brasiliense*, and *Cybistax donnellsmithii* that were then generalized into equations for coniferous and broadleaf species. This study included 40 sampled trees within the Sarstun-Motagua region.

Below-Ground Biomass (Tree)
Below-ground carbon stocks for each tree was estimated using root-to-shoot ratios and above-ground carbon stocks estimated as described above. A root-to-shoot ratio of 0.20 for tree species with an above-ground biomass less than 125-t ha^{-1} and 0.24 for trees with an above-ground biomass greater than 125- t ha^{-1} was applied to each individual tree from the forest and non-forest inventory (Table 2, Appendix 3, VM0015). Per tree below-ground biomass values were scaled to per plot averages and LULC class averages according to Appendix 3 found in VM0015 (Forest Carbon Stock Model_Quilo_v1.1.xlsm).

Litter Carbon Pool
In the field, litter was sampled in the first subplot. Plant material is first collected by hand followed by the collection of all dead material (litter) within the small plot. Both materials are weighed to obtain the

wet field weight. A small sample is collected and weighed to determine its humidity content in the laboratory, as dry biomass is the quantity needed to determine carbon.

Following Annex 3 of VM0015 v1.1, the carbon stock per hectare in the litter carbon pool is calculated by multiplying the dry mass by an expansion factor to extrapolate the plot size to hectares and then multiplied by the carbon fraction for dry biomass of 0.5.

Wood Products
Wood products are only calculated for the Very Humid Forest and Humid Forest LULC classes, as these were the classes where wood products were derived from. As described in Section 4.3, the determination of the wood products pool used a methodology deviation that is more accurate and conservative than that presented in Annex 3 of VM0015 v1.1 (see section 4.3). Rather than using equation A3-34 found in Annex 3 of VM0015 v1.1 that is used to calculate the biomass of carbon of the commercial volume extracted prior to or in the process of deforestation, equations 31, 32, 33, and 34 from VM0003 Methodology for Improved Forest Management Through Extension Rotation Age (IFM ERA), v1.2 were used in its place.
The following equation is from VM0015:

$$CXB_{cl} = Cab_{cl} * (1/BCEF) * Pcom_{cl}$$

Where:
CXB_{cl}: mean stock of extracted biomass carbon from the initial forest class *icl* at time t (tCO$_2$eha^{-1})
Cab_{cl}: average carbon stock per hectare in the above-ground biomass carbon pool of the LULC class *cl* (tCO$_2$eha^{-1})
BCEF: biomass conversion and expansion factor for conversion of merchantable volume to toal aboveground tree biomass
$Pcom_{cl}$: commercial volume as a percent of total aboveground volume in initial forest class *icl.*

Instead of using equation A3-34 from VM0015, the following equations (eq 31, 32, 33, and 34) from VM0003 were used. Equation 35, used to estimate carbon in medium-lived wood products was omitted from the calculations in order to be conservative, as is described in the methodology deviation, section 4.3.

Equation 31 is as follows:

$$EXC_{WP,ty} = \sum_{h=1}^{Hps} \sum_{j=1}^{Sps} (V_{ex,h,ty,j} * D_j * CF_j)$$

where:

$EXC_{WP,ty}$	The summed stock of extracted biomass carbon from within the project area class of wood product *ty*; t C
$V_{ex,h,ty,j,}$	The volume of timber extracted from within the project area during harvest *h* by species *j* and wood product class *ty*; m3
D_j	Basic wood density of species *j*; t d.m.m-3
CF_j	Carbon fraction of biomass for tree species *j*; t C t-1 d.m. (IPCC default value = 0.5 t C t-1 d.m.)
h	1, 2, 3 …number of harvests since the start of the IFM project activity

j	*1, 2, 3 … S$_{PS}$* tree species in the baseline scenario
ty	Wood product class – defined here as sawnwood, wood-based panels, other industrial roundwood, paper and paper board, and other

Equation 32 is as follows:

$$C_{mill,ty} = \sum_{s,w,oir,p}^{ty} EXC_{WP,ty} * (1 - WW)$$

where:

C$_{mill,ty}$	Carbon in wood products after milling for category *ty* C ,
EXC$_{WP,ty}$	Total extracted wood volumes over all types *ty*
WW	Wood waste fraction based on mill efficiency
s,w,oir,p	Wood product categories: sawnwood, woodbase panels, other industrial roundwood, paper and paperboard

Equation 33 is as follows:

$$C_{WP,ty} = \sum_{s,w,oir,p}^{ty} (C_{mill,ty} - SLF)$$

where:

C$_{WP,ty}$	Total carbon for all wood product categories C ,
C$_{mill,ty}$	The summed stock of carbon remaining in wood products after milling from within the project area by class of wood product *ty*; t C ty Mill C ,
SLF	Fraction of wood products that will be emitted to the atmosphere within 3years of timber harvest; t C
ty	Wood product class – defined here as sawnwood, wood-based panels, other industrial roundwood, paper and paper board
t	*1, 2, 3 … t* years elapsed since the start of the IFM project activity

Equation 34 is as follows:

$$SLF = C_{mill,ty} * slp$$

where:

SLF	Fraction of wood products that will be emitted to the atmosphere within 3 years of timber harvest; t C
C$_{mill,ty}$	The summed stock of carbon remaining in wood products after milling from within the project area by class of wood product ty; t C
slp	Short-lived proportion -
ty	Wood product class – defined here as sawnwood, wood-based panels, other industrial roundwood, paper and paper board, and other

The equations from VM0003 result in a direct estimate, whereas equation A3-34 from VM0015 relies on two estimators, one for determined the average carbon stock per hectare from allometric equations (Cab_{cl}) as well as estimator for determing commercial volume ($Pcom_{cl}$) from volume equations. The use of multiple estimators in equation A3-34 leads to greater uncertainty and equations 31-34 were elected in place of this. In addition, the medium term wood products pool was not calculated making this approach more conservative.

Final estimates of wood products for each plot were multiplied by an expansion factor to result in a per hectare figure. The results were then averaged and confidence intervals determined for each forest stratum. Wood products were only calculated for the Humid Forest and Very Humid Forest strata, as those are the only strata with the potential to generate wood products.

5.3.5.1.4 Results of Carbon Stock Estimations
The results of the carbon stock estimations are summarized below in Table 48 and Table 49.

Initial Forest Class (icl)	ID_{icl}		1	2
	Name		Very Humid Forest	Humid Forest
Cab_{icl}	C stock	$tCO_2e\ ha^{-1}$	116.2	141.8
	C stock change	$tCO_2e\ ha^{-1}$	0	0
Cbb_{icl}	C stock	$tCO_2e\ ha^{-1}$	27.9	34.0
	C stock change	$tCO_2e\ ha^{-1}$	0	0
Cdw_{icl}	C stock	$tCO_2e\ ha^{-1}$	N/A	N/A
	C stock change	$tCO_2e\ ha^{-1}$	N/A	N/A
Cl_{icl}	C stock	$tCO_2e\ ha^{-1}$	3.9	8.5
	C stock change	$tCO_2e\ ha^{-1}$	0	0
$Csoc_{icl}$	C stock	$tCO_2e\ ha^{-1}$	0	0
	C stock change	$tCO_2e\ ha^{-1}$	0	0
Cwp_{icl} short, medium, and long lived	C stock	$tCO_2e\ ha^{-1}$	7.5	3.6
	C stock change	$tCO_2e\ ha^{-1}$	0	0

Table 48. Carbon stock estimate values to be used for the Leakage Area after discounts for uncertainties

Initial Forest Class (icl)	ID_{icl}		1	2
	Name		Very Humid Forest	Humid Forest
Cab_{icl}	C stock	$tCO_2e\ ha^{-1}$	116.2	115.6
	C stock change	$tCO_2e\ ha^{-1}$	0	0
Cbb_{icl}	C stock	$tCO_2e\ ha^{-1}$	27.9	27.7
	C stock change	$tCO_2e\ ha^{-1}$	0	0
Cdw_{icl}	C stock	$tCO_2e\ ha^{-1}$	N/A	N/A

	C stock change	tCO$_2$e ha^{-1}	0	0
CI$_{icl}$	C stock	tCO$_2$e ha^{-1}	3.9	7.0
	C stock change	tCO$_2$e ha^{-1}	0	0
Csoc$_{icl}$	C stock	tCO$_2$e ha^{-1}	0	0
	C stock change	tCO$_2$e ha^{-1}	0	0
Cwp$_{icl}$ short, medium, and long lived	C stock	tCO$_2$e ha^{-1}	7.5	2.9
	C stock change	tCO$_2$e ha^{-1}	0	0

Table 49. Carbon stock estimate values to be used for the Project Area after discounts for uncertainties

5.3.6.2 Estimation of the Average Carbon Stocks of each Post-Deforestation LULC Class (VM0015 6.1.1)

To estimate the carbon stocks for each Post-Deforestation LULC class the guidance and requirements presented in Appendix 3 of VM0015 were followed. A full, detailed methodology for the end-land use carbon stock measurement can be found in Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf. The results of the post-deforestation carbon stock analysis can be found in nonforest Carbon - All LULC Categories v1.6.xlsx.

5.3.6.2.1 Plot size and design
Given the variety of end-land uses and the unique challenges with determining the inventory of each different plot designs were used for each LULC class.

Permanent Agriculture
Within the permanent agriculture a nested square plot design was used.   Within the smaller subplot of 1-meter x 1-meter, as in the forest carbon inventory plots, litter biomass was measured using the same techniques as described above and available in Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf. In the larger plot of 50-meters x 20-meters, diameters of plantation species such as *palma africana* and *xule* were taken. All plots were corrected for slope as indicated in *Metodologia C Linea Base Sarstun Motagua borrador_may 2016.pdf*.
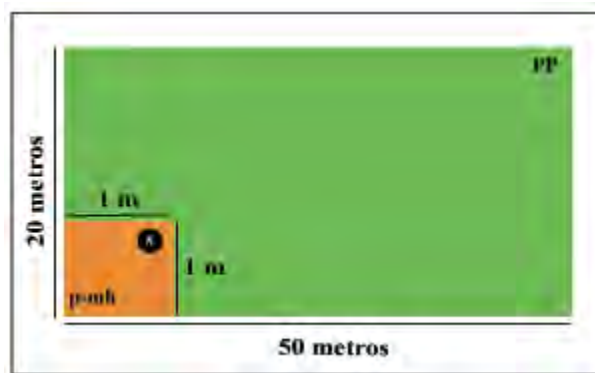
Figure 35: Plot design used to inventory carbon stocks within permanent agriculture

Annual Agriculture

Adequate carbon stock measurements for annual agriculture was not taken at the project commencement, thus literature estimates for the carbon stock values were used in place of actual measurements. Full carbon stock measurements will be taken for the first monitoring period.

The aboveground carbon stocks for annual agriculture were estimated using literature values from the IPCC GPG 2006, Chapter 5, Table 5.9.

Similar to permanent agriculture, a nested plot design will be used to measure carbon stocks within annual agricultural areas, although with a smaller surface area. Within the smaller subplot of 1-meter x 1-meter, as in the forest carbon inventory plots, litter biomass will be measured using the same techniques as described above and available in Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf. With the larger plot of 3-meters x 3-meters, agricultural plants including maize, frijol, and caña will be removed within the sampling frame and separated into roots, stalks, and the fruit and weighed in the field. In the laboratory, plants will be selected and the dry weight will be determined according to *Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf* and Metodologia C Linea Base Sarstun Motagua borrador_may 2016.pdf.
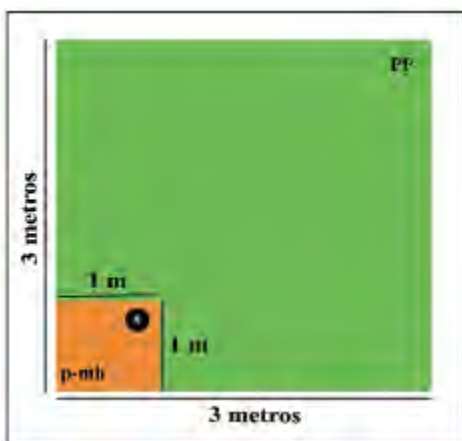
Figure 36: Plot design used to inventory carbon stocks within annual agriculture

Pasture

In pasture areas only one square plot was used of 2-meters x 2-meters which was adjusted for slope. Within the sampling frame grass and any herbaceous matter was pulled from the soil and weighed in the field. The herbaceous material was sent to a nearby laboratory following the guildelines described in Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf.
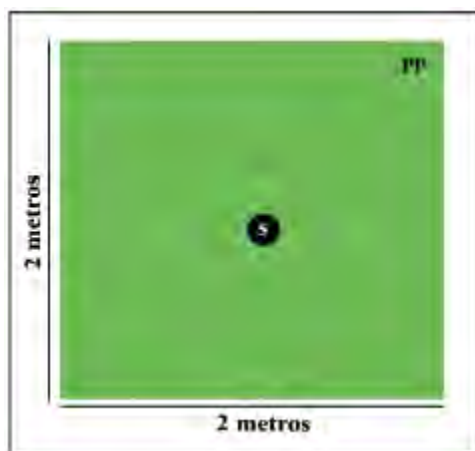
Figure 37: Plot design used to inventory carbon stocks within pastures

Shrubs

Similar to annual agriculture, a nested plot design was used to measure carbon stocks within other non-forest areas. Within the smaller subplot of 1-meter x 1-meter, as in the forest carbon inventory plots, litter was measured using the same techniques as described above and available in *Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf*. With the larger plot of 3-meters x 3-meters, shrubs, grass and any other herbaceous matter was pulled from the soil and separated into roots, stalks, and the fruit and weighed in the field. In the laboratory, plants were selected and the dry weight was determined according to *Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf* and Metodologia C Linea Base Sarstun Motagua borrador_may 2016.pdf. The herbaceous material was sent to a nearby laboratory following the guildelines described in *Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf*.
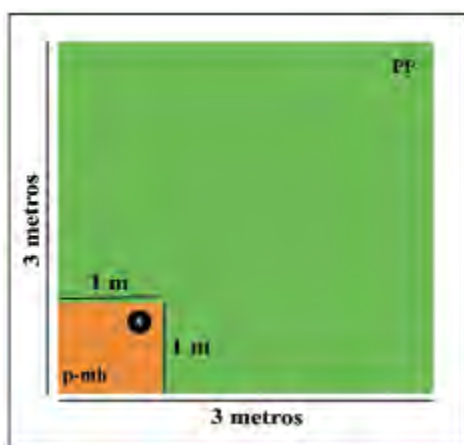
Figure 38: Plot design used to inventory carbon stocks within shrub areas

Other Non-Forest

As described above, this class is a complex mix of the post-deforestation classes and can't be distinguished as a pure area of annual agriculture, permanent agriculture, pasture or shrubs. Similar to annual agriculture, a nested plot design was used to measure carbon stocks within other non-forest areas. Within the smaller subplot of 1-meter x 1-meter, as in the forest carbon inventory plots, litter

was measured using the same techniques as described above and available in *Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf*. With the larger plot of 3-meters x 3-meters, all plants agricultural plants including shrubs, grasses, and agricultural crops were removed within the sampling frame and separated into roots, stalks, and the fruit and weighed in the field. In the laboratory, plants were selected and the dry weight was determined according to *"Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf* and Metodologia C Linea Base Sarstun Motagua borrador_may 2016.pdf.
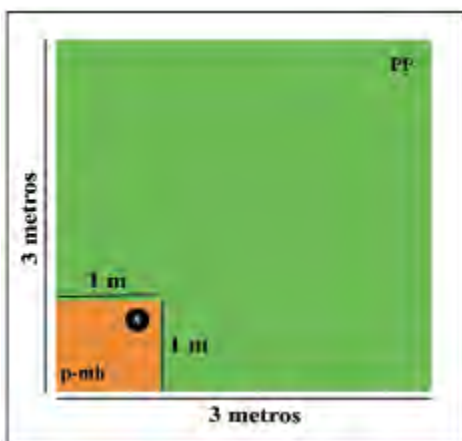
Figure 39: Plot design used to inventory carbon stocks within other non-forest areas

Urban

In urban areas only one square plot was used of 2-meters x 2-meters which was adjusted for slope. Within the sampling frame, grass and any herbaceous matter was pulled from the soil and weighed in the field. The herbaceous material was sent to a nearby laboratory following the guildelines described in *Metodología en estimación de Carbono-español_CEAB-UVG 2010.pdf*.
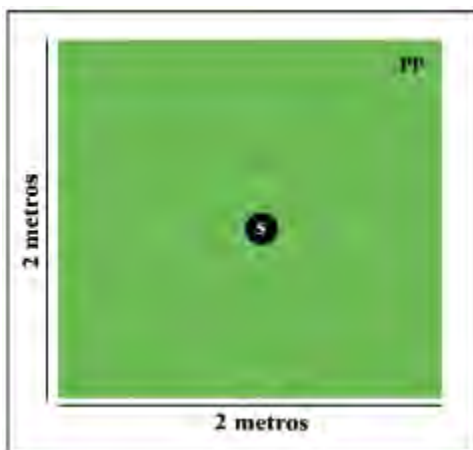
Figure 40: Plot design used to inventory carbon stocks in urban areas

Wetland

The Wetland post-deforestation LULC class wasn't measured in the field-work described above. No transitions to or from wetland was observed in the baseline scenario across the reference, project, and

leakage areas. If any transitions to wetland are observed in the project area as a result of project activities, the carbon stocks for those wetland areas will be conservatively estimated as 0tC.

Water
Water was not sampled in the field and was considered to have no carbon stocks.

5.3.6.2.2 Estimation of Carbon Stocks
Following the sampling of post-deforestation inventory plots and field collection the total average carbon stock per hectare in each post-deforestation LULC class was estimated using equation A3-6 below from VM0015:

$$Ctot_{cl} = Cab_{cl} + Cbb_{cl} + Cl_{cl} + Csoc_{cl}$$

Where:
$Ctot_{cl}$: average carbon stock per hectare in all accounted carbon pools of the LULC class *cl* (tCO_2eha^{-1})
Cab_{cl}: average carbon stock per hectare in the above-ground biomass carbon pool of the LULC class *cl* (tCO_2eha^{-1})
Cbb_{cl}: average carbon stock per hectare in the below-ground biomass carbon pool of the LULC class *cl* (tCO_2eha^{-1})
Cl_{cl}: average carbon stock per hectare in the litter carbon pool of the LULC class *cl* (tCO_2eha^{-1})
$Csoc_{cl}$: average carbon stock per hectare in the soil organic carbon pool of the LULC class *cl* (tCO_2eha^{-1})

Each carbon pool was estimated for its carbon stock following the guidelines and requirements provided in Appendix 3 of VM0015 as discussed below.

Above-Ground Biomass
In the case of post-deforestation LULC classes, this carbon pool is only relevant for Permanent Agriculture.

The above-ground biomass component of plantation species (*palma africana, xule, cacoa, banano*) was estimated using direct field measurements – method (b) in Appendix 3 of VM0015 – where the biomass of each individual species above was estimated. Estimates of biomass per species were based on the allometric method – (b.1) in Appendix 3 of VM0015 – where regional equations for measured species were used. These equations are presented in Metodologia C Linea Base Sarstun Motagua borrador_may 2016.pdf. Following equations presented in Appendix 3, biomass estimates are scaled up to carbon stock estimated per plot and eventually per LULC class (nonforest Carbon - All LULC Categories v1.6.xlsx).

Below-Ground Biomass
In the case of post-deforestation LULC classes, this carbon pool was measured for all LULC plots based on the following criteria:

For permanent agriculture plots, below-ground carbon stocks were estimated using root-to-shoot ratios and above-ground carbon stocks estimated as described above. A root-to-shoot ratio of 0.20 for species with an above-ground biomass less than 125-t ha^{-1} and 0.24 for species with an above-ground biomass greater than 125- t ha^{-1} was applied to each individual tree from post-deforestation inventory (Table 2, Appendix 3, VM0015). Per species below-ground biomass values were scaled to per plot averages and

LULC class averages according to Appendix 3 found in VM0015 (nonforest Carbon - All LULC Categories v1.6.xlsx).

In all other plots, below-ground carbon stocks were measured directly by separating roots portions of larger vegetation including agricultural crops and shrubs. The field weight of the roots were taken and a sample sent to a laboratory to determine the dry weight. Following Annex 3 of VM0015 v1.1, the carbon stock per hectare from direct measurement of below-ground biomass is calculated by multiplying the dry mass by an expansion factor to extrapolate the plot size to hectares and then multiplied by the carbon fraction for dry biomass of 0.5.

Litter Carbon Pool
In the case of post-deforestation LULC classes, this carbon pool is only relevant for Annual Agriculture, Pasture, and Shrubs.

To measure the litter carbon pool, plant material is first collected by hand followed by the collection of all dead material (litter) within the plot as determined by the land use. Both materials are weighed to obtain the wet field weight. A small sample is collected and weighed to determine its humidity content in the laboratory, as dry biomass is the quantity needed to determine carbon.

Following Annex 3 of VM0015 v1.1, the carbon stock per hectare in the litter carbon pool is calculated by multiplying the dry mass by an expansion factor to extrapolate the plot size to hectares and then multiplied by the carbon fraction for dry biomass of 0.5.

5.3.6.2.3 Results of Carbon Stock Estimations
The results of carbon stock estimations of each relevant post-deforestation LULC classes is represented as *t** in Tables 50-56. As required by VM0015, the results are also reported as 20-year long term average which can also be seen in Table 50-56.

Post Deforestation class *fcl*		Name		Urban		ID_{fcl}		5	
Project year	Cab_{icl}		Cbb_{icl}		Cl_{icl}		Csoc_{icl}		Cwp_{icl} short, medium, and long lived	
	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI
t	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
t*	0	0	0	0	0	0	0	0	0	0
t*+1	0	0	0	0	0	0	0	0	0	0
t*+2	0	0	0	0	0	0	0	0	0	0
t*+3	0	0	0	0	0	0	0	0	0	0
t*+4	0	0	0	0	0	0	0	0	0	0
t*+5	0	0	0	0	0	0	0	0	0	0
t*+6	0	0	0	0	0	0	0	0	0	0
t*+7	0	0	0	0	0	0	0	0	0	0
t*+8	0	0	0	0	0	0	0	0	0	0
t*+9	0	0	0	0	0	0	0	0	0	0
t*+10	0	0	0	0	0	0	0	0	0	0
t*+11	0	0	0	0	0	0	0	0	0	0
t*+12	0	0	0	0	0	0	0	0	0	0
t*+13	0	0	0	0	0	0	0	0	0	0
t*+14	0	0	0	0	0	0	0	0	0	0
t*+15	0	0	0	0	0	0	0	0	0	0
t*+16	0	0	0	0	0	0	0	0	0	0
t*+17	0	0	0	0	0	0	0	0	0	0
t*+18	0	0	0	0	0	0	0	0	0	0
t*+19	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	0	0

Table 50. Long-term (20-years) average carbon stocks per hectare for Urban post-deforestation LU/LC class present in the Reference Region

Post Deforestation class *fcl*		Name	Wetland		ID*fcl*		6		
Project year	Cab*icl*		Cbb*icl*		Cl*icl*		Csoc*icl*		Cwp*icl* short, medium, and long lived	
	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI
t	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}
t*	0	0	0	0	0	0	0	0	0	0
t*+1	0	0	0	0	0	0	0	0	0	0
t*+2	0	0	0	0	0	0	0	0	0	0
t*+3	0	0	0	0	0	0	0	0	0	0
t*+4	0	0	0	0	0	0	0	0	0	0
t*+5	0	0	0	0	0	0	0	0	0	0
t*+6	0	0	0	0	0	0	0	0	0	0
t*+7	0	0	0	0	0	0	0	0	0	0
t*+8	0	0	0	0	0	0	0	0	0	0
t*+9	0	0	0	0	0	0	0	0	0	0
t*+10	0	0	0	0	0	0	0	0	0	0
t*+11	0	0	0	0	0	0	0	0	0	0
t*+12	0	0	0	0	0	0	0	0	0	0
t*+13	0	0	0	0	0	0	0	0	0	0
t*+14	0	0	0	0	0	0	0	0	0	0
t*+15	0	0	0	0	0	0	0	0	0	0
t*+16	0	0	0	0	0	0	0	0	0	0
t*+17	0	0	0	0	0	0	0	0	0	0
t*+18	0	0	0	0	0	0	0	0	0	0
t*+19	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	0	0

Table 51. Long-term (20-years) average carbon stocks per hectare Wetland post-deforestation LU/LC class present in the Reference Region

Post Deforestation class *fcl*	Name		**Permanent agriculture**				ID_{fcl}		**7**	
Project year	Cab_{icl}		Cbb_{icl}		CI_{icl}		$Csoc_{icl}$		Cwp_{icl} short, medium, and long lived	
	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI
t	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
t*	-4.41	-0.30	-0.07	0.00	0	0	0	0	0	0
t*+1	0	0	-0.07	0.00	0	0	0	0	0	0
t*+2	0	0	-0.07	0.00	0	0	0	0	0	0
t*+3	0	0	-0.07	0.00	0	0	0	0	0	0
t*+4	0	0	-0.07	0.00	0	0	0	0	0	0
t*+5	0	0	-0.07	0.00	0	0	0	0	0	0
t*+6	0	0	-0.07	0.00	0	0	0	0	0	0
t*+7	0	0	-0.07	0.00	0	0	0	0	0	0
t*+8	0	0	-0.07	0.00	0	0	0	0	0	0
t*+9	0	0	-0.07	0.00	0	0	0	0	0	0
t*+10	0	0	0	0	0	0	0	0	0	0
t*+11	0	0	0	0	0	0	0	0	0	0
t*+12	0	0	0	0	0	0	0	0	0	0
t*+13	0	0	0	0	0	0	0	0	0	0
t*+14	0	0	0	0	0	0	0	0	0	0
t*+15	0	0	0	0	0	0	0	0	0	0
t*+16	0	0	0	0	0	0	0	0	0	0
t*+17	0	0	0	0	0	0	0	0	0	0
t*+18	0	0	0	0	0	0	0	0	0	0
t*+19	0	0	0	0	0	0	0	0	0	0
Average	-0.2	0	0	0	0	0	0	0	0	0

Table 52. Long-term (20-years) average carbon stocks per hectare of Permanent Agriculture post-deforestation LULC class present in the reference region

Post Deforestation class *fcl*		Name		Annual agriculture		ID_{fcl}		8	
Project year	Cab_{icl}		Cbb_{icl}		Cl_{icl}		$Csoc_{icl}$		Cwp_{icl} short, medium, and long lived	
	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI
t	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
t*	-5	-4	-0.13	-0.10	0	0	0	0	0	0
t*+1	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+2	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+3	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+4	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+5	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+6	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+7	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+8	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+9	0	0	-0.13	-0.10	0	0	0	0	0	0
t*+10	0	0	0	0	0	0	0	0	0	0
t*+11	0	0	0	0	0	0	0	0	0	0
t*+12	0	0	0	0	0	0	0	0	0	0
t*+13	0	0	0	0	0	0	0	0	0	0
t*+14	0	0	0	0	0	0	0	0	0	0
t*+15	0	0	0	0	0	0	0	0	0	0
t*+16	0	0	0	0	0	0	0	0	0	0
t*+17	0	0	0	0	0	0	0	0	0	0
t*+18	0	0	0	0	0	0	0	0	0	0
t*+19	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	0	0

Table 53. Long-term (20-years) average carbon stocks per hectare Annual Agriculture post-deforestation LU/LC class present in the Reference Region

Post Deforestation class *fcl*		Name		**Pasture**		ID$_{fcl}$		**9**	
Project year	Cab$_{lcl}$		Cbb$_{lcl}$		Cl$_{lcl}$		Csoc$_{lcl}$		Cwp$_{lcl}$ short, medium, and long lived	
	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI
t	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}
t*	-7.64	-3.58	-0.14	-0.07	-0.71	-0.33	0	0	0	0
t*+1	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+2	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+3	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+4	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+5	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+6	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+7	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+8	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+9	0	0	-0.14	-0.07	0	0	0	0	0	0
t*+10	0	0	0	0	0	0	0	0	0	0
t*+11	0	0	0	0	0	0	0	0	0	0
t*+12	0	0	0	0	0	0	0	0	0	0
t*+13	0	0	0	0	0	0	0	0	0	0
t*+14	0	0	0	0	0	0	0	0	0	0
t*+15	0	0	0	0	0	0	0	0	0	0
t*+16	0	0	0	0	0	0	0	0	0	0
t*+17	0	0	0	0	0	0	0	0	0	0
t*+18	0	0	0	0	0	0	0	0	0	0
t*+19	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	0	0

Table 54. Long-term (20-years) average carbon stocks per hectare Pasture post-deforestation LU/LC class present in the Reference Region

Post Deforestation class *fcl*		Name		**Shrubs**		ID$_{fcl}$		**10**	
Project year	Cab$_{icl}$		Cbb$_{icl}$		Cl$_{icl}$		Csoc$_{icl}$		Cwp$_{icl}$ short, medium, and long lived	
	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI
t	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}	tCO$_2$e ha^{-1}
t*	-4.74	-2.39	-0.04	-0.02	-1.70	-0.86	0	0	0	0
t*+1	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+2	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+3	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+4	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+5	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+6	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+7	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+8	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+9	0	0	-0.04	-0.02	-2	0	0	0	0	0
t*+10	0	0	0	0	-2	0	0	0	0	0
t*+11	0	0	0	0	-2	0	0	0	0	0
t*+12	0	0	0	0	-2	0	0	0	0	0
t*+13	0	0	0	0	-2	0	0	0	0	0
t*+14	0	0	0	0	-2	0	0	0	0	0
t*+15	0	0	0	0	-2	0	0	0	0	0
t*+16	0	0	0	0	-2	0	0	0	0	0
t*+17	0	0	0	0	-2	0	0	0	0	0
t*+18	0	0	0	0	-2	0	0	0	0	0
t*+19	0	0	0	0	-2	0	0	0	0	0
Average	0	0	0	0	-2	0	0	0	0	0

Table 55. Long-term (20-years) average carbon stocks per hectare Shrubs post-deforestation LU/LC class present in the Reference Region

Post Deforestation class *fcl*		Name	Other non-forest		ID$_{fcl}$	11	

Project year	Cab$_{icl}$		Cbb$_{icl}$		Cl$_{icl}$		Csoc$_{icl}$		Cwp$_{icl}$ short, medium, and long lived	
	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI	average stock	±90% CI
t	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$	$tCO_2e\ ha^{-1}$
t*	-6.64	0.00	0.00	0.00	0.00	0.00	0	0	0	0
t*+1	0	0	0.00	0.00	0	0	0	0	0	0
t*+2	0	0	0.00	0.00	0	0	0	0	0	0
t*+3	0	0	0.00	0.00	0	0	0	0	0	0
t*+4	0	0	0.00	0.00	0	0	0	0	0	0
t*+5	0	0	0.00	0.00	0	0	0	0	0	0
t*+6	0	0	0.00	0.00	0	0	0	0	0	0
t*+7	0	0	0.00	0.00	0	0	0	0	0	0
t*+8	0	0	0.00	0.00	0	0	0	0	0	0
t*+9	0	0	0.00	0.00	0	0	0	0	0	0
t*+10	0	0	0	0	0	0	0	0	0	0
t*+11	0	0	0	0	0	0	0	0	0	0
t*+12	0	0	0	0	0	0	0	0	0	0
t*+13	0	0	0	0	0	0	0	0	0	0
t*+14	0	0	0	0	0	0	0	0	0	0
t*+15	0	0	0	0	0	0	0	0	0	0
t*+16	0	0	0	0	0	0	0	0	0	0
t*+17	0	0	0	0	0	0	0	0	0	0
t*+18	0	0	0	0	0	0	0	0	0	0
t*+19	0	0	0	0	0	0	0	0	0	0
Average	0	0	0	0	0	0	0	0	0	0

Table 56. Long-term (20-years) average carbon stocks per hectare Other Non-Forest post-deforestation LU/LC class present in the Reference Region

5.3.6.3 Calculation of baseline carbon stock change (VM0015 6.1.3)

The AFOLU Requirements require the use of decay models for carbon stocks in the soil organic carbon pool models, below-ground biomass, dead wood, and harvest wood products. In VM0015 v1.1, linear decay functions are applied to account for the day of carbon stock in the initial forest classes and increases in the carbon stock of post-deforestation classes. Decay models as defined in VM0015 v1.1, Section 6.1.2 and Table 20c for Method 2 were applied to both the initial forest classes and post-deforestation classes and can be seen in the Carbon Accounting Model provided in Fundaeco VM0015 Accounting Model v1.57.xlsm. Carbon stock changes or emission factors were then calculated for each land-use transition

Following Method 2 described in VM0015, carbon stock changes or emission factors were then calculated for each land-use transition category and multiplied by the baseline activity data for each

land-use transition category (see Section 5.3.5.3 and Tables 43-44). These calculations were done for each carbon pool found within the Project Area and Leakage Area. The results for the Project Area and the Leakage Area can be found in Tables AI-AT in the PD Template section of the accounting model (Fundaeco VM0015 Accounting Model v1.57.xlsm).

5.3.6.4 Baseline non-CO2 Emissions from Forest Fires (VM0015 6.2)
Emissions from fires used to clear forests were not included in the baseline.

5.4 PROJECT EMISSIONS (CL2)

This step provides an *ex-ante* estimate of future carbon stock changes for unplanned deforestation. Carbon stock changes due to possible future catastrophic events cannot be predicted and are therefore excluded from the *ex-ante* estimate and, rather, are handled through the Non-Permanence Risk Tool (see Section 2.3.4 and Table 11).

5.4.1 EX-ANTE ESTIMATION OF ACTUAL CARBON STOCK CHANGES (VM0015 SECTION 7.1)

5.4.1.1 Ex-ante estimation of actual carbon stock changes due to planned Activities (VM0015 Section 7.1.1).

Planned activities were not included in the baseline and are not estimated for the purpose of project emissions.

5.4.1.2 Ex-ante estimation of actual carbon stock changes due to unavoidable unplanned deforestation with the Grouped Project Area (VM0015 Section 7.1.2).

The selected baseline for the project is continued unplanned deforestation for timber, agriculture and grazing activities resulting in removal of old growth/ primary forest. In this section the level at which deforestation is reduced from this measured baseline activity, known as the Project Scenario, is estimated.

Following VM0015 v1.1, to allow *ex-ante* projections of emissions reduction that will occur due to project activities in the Grouped Project Area, an estimate of the effectiveness of project activities is required known as the Effectiveness Index (EI). In the case of the REDD+ Project for Caribbean Guatemala, an EI was defined in part relying on ex-post information available at validation of the project from 2012 to 2014. Beyond 2014, the EI was defined for the full project crediting period based on the Implementation Plan (Section 1.7.2) and the scaling of project activities.

Using this method the EI from 2012 to 2014 was found to be 71%. This value was determined by comparing the baseline deforestation that was defined within the Project Area and comparing it to observed deforestation from 2012 to 2014. This comparison was possible due to the availability of a 2014 LULC map described in the Monitoring and Implementation Report that uses that same LULC classes described in Section 5.3.2. Detailed calculations can be found in the Carbon Accounting Model (Fundaeco VM0015 Accounting Model v1.57.xlsm).

For the period after 2014 until 2042 that defines the project crediting period the EI was incremented by roughly 1% per year until reaching 93% in 2042. This is a conservative estimate of project effectiveness based on the scaling of project activities across the Grouped Project Area as described by the

Implementation Plan. The defined EI is summarized in Table 57 and was applied to the total baseline carbon stock change per year based on equation 16 found in VM0015 v1.1, Section 7.1.2.

$$\Delta CUDdPA_t = CBSL_t * (1 - EI_t)$$

Where:

$\Delta CUDdPA_t$: total *ex ante* actual carbon stock change due to unavoided unplanned deforestation at year *t* in the project area (tCO_2e)

$CBSL_t$: total baseline carbon stock change at year *t* in the project area (tCO_2e)

EI_t: *ex ante* estimated Effectivness Index (%)

As the REDD+ Project for Caribbean Guatemala is defined as a grouped project an *ex ante* estimate of changes in the project area are also required to make an *ex ante* estimate of emission reductions. To include this unique aspect of a grouped project an Activity Adoption Rate (AAR) was defined based on the ratio of the Project Area defined by the area where the project ownership is clearly defined to that of the Grouped Project Area. Similar to the EI, the AAR was defined based on *ex-post* information available at project validation based on the defined Project Area (see Section 1.2.6) and the start date of each project activity instance. The Project Area was collated for each year in the monitoring period (i.e. 2012-2014) and compared to the Grouped Project Area in order to determine an AAR. From 2015 to 2042 through the project crediting period the AAR was incremented based on an analysis provided by FUNDAECO of the likelihood of landowners partake in the REDD+ Project for Caribbean Guatemala through signing carbon contracts. The results of this analysis can be seen in Table 57.

The AAR was included in the estimate of *ex ante* carbon stock changes due to unavoided unplanned deforestation by adding an additional quotient to equation 16 above to create the equation shown below:

$$\Delta CUDdPA_t = CBSL_t * (1 - EI_t) * ARR_t$$

Where:

$\Delta CUDdPA_t$: total *ex ante* actual carbon stock change due to unavoided unplanned deforestation at year *t* in the project area (tCO_2e)

$CBSL_t$: total baseline carbon stock change at year *t* in the project area (tCO_2e)

EI_t: *ex ante* estimated Effectivness Index (%)

ARR_t: *ex ante* estimated Activity Adoption Rate (%)

Year (t)	Effectiveness Index (%)	Activity Adoption Rate (%)
2013	71%	25%
2014	71%	35%
2015	71%	42%
2016	72%	48%
2017	72%	52%
2018	73%	56%

Year	EI	ARR
2019	74%	60%
2020	75%	64%
2021	75%	68%
2022	76%	72%
2023	77%	76%
2024	78%	80%
2025	78%	82%
2026	79%	83%
2027	80%	84%
2028	81%	85%
2029	82%	85%
2030	82%	86%
2031	83%	87%
2032	84%	88%
2033	85%	89%
2034	86%	90%
2035	87%	90%
2036	87%	90%
2037	88%	90%
2038	89%	90%
2039	90%	90%
2040	91%	90%
2041	92%	90%
2042	93%	90%

Table 57. Defined Effectiveness Index (EI) and Activity Adoption Rate (ARR) for the project crediting period

The result of applying the above equation over the Grouped Project Area for each year in the project crediting period is summarized in Table 58 below.

Project year t	Total carbon stock decrease due to planned activities		Total carbon stock increase due to planned activities		Total carbon stock decrease due to unavoided unplanned deforestation		Total carbon stock change in the project scenario	
	annual $\Delta CPAdPA_t$ tCO$_2$e	cumulative $\Delta CPAdPA$ tCO$_2$e	annual $\Delta CPAiPA_t$ tCO$_2$e	cumulative $\Delta CPAiPA$ tCO$_2$e	annual $\Delta CUDdPA_t$ tCO$_2$e	cumulative $\Delta CUDdPA$ tCO$_2$e	annual $\Delta CPSPA_t$ tCO$_2$e	cumulative $\Delta CPSPA$ tCO$_2$e
1	0	0	0	0	141,654	141,654	141,654	141,654
2	0	0	0	0	262,264	403,918	262,264	403,918

3	0	0	0	0	276,878	680,796	276,878	680,796
4	0	0	0	0	310,082	990,878	310,082	990,878
5	0	0	0	0	339,288	1,330,166	339,288	1,330,166
6	0	0	0	0	351,123	1,681,289	351,123	1,681,289
7	0	0	0	0	364,356	2,045,645	364,356	2,045,645
8	0	0	0	0	383,710	2,429,354	383,710	2,429,354
9	0	0	0	0	408,593	2,837,947	408,593	2,837,947
10	0	0	0	0	438,083	3,276,029	438,083	3,276,029
11	0	0	0	0	451,887	3,727,916	451,887	3,727,916
12	0	0	0	0	429,196	4,157,112	429,196	4,157,112
13	0	0	0	0	400,862	4,557,974	400,862	4,557,974
14	0	0	0	0	383,794	4,941,768	383,794	4,941,768
15	0	0	0	0	367,549	5,309,317	367,549	5,309,317
16	0	0	0	0	327,198	5,636,516	327,198	5,636,516
17	0	0	0	0	279,788	5,916,304	279,788	5,916,304
18	0	0	0	0	259,965	6,176,268	259,965	6,176,268
19	0	0	0	0	270,616	6,446,885	270,616	6,446,885
20	0	0	0	0	265,083	6,711,968	265,083	6,711,968
21	0	0	0	0	243,947	6,955,914	243,947	6,955,914
22	0	0	0	0	259,274	7,215,189	259,274	7,215,189
23	0	0	0	0	190,429	7,405,618	190,429	7,405,618
24	0	0	0	0	116,726	7,522,344	116,726	7,522,344
25	0	0	0	0	52,624	7,574,969	52,624	7,574,969
26	0	0	0	0	36,019	7,610,988	36,019	7,610,988
27	0	0	0	0	29,501	7,640,489	29,501	7,640,489
28	0	0	0	0	24,784	7,665,273	24,784	7,665,273
29	0	0	0	0	19,748	7,685,020	19,748	7,685,020
30	0	0	0	0	14,710	7,699,731	14,710	7,699,731

Table 58. Ex ante estimated net carbon stock change in the project area under the project scenario

5.4.2 EX-ANTE ESTIMATION OF ACTUAL NON-CO2 EMISSION FROM FOREST FIRES (VM0015 SECTION 7.2)

Emissions from fires used to clear forests were not included in the baseline and subsequently are not accounted for in the Project Scenario.

5.5 LEAKAGE (CL3)

This step provides an *ex-ante* estimate of the possible decrease in carbon stock and increase in GHG emissions due to leakage. *Ex-ante* estimates are made prior to monitoring and are thus included in this Project Description. Two sources of leakage are considered in the VM0015 v1.1 methodology including: 1) decrease in carbon stocks and increase in GHG emissions associated with leakage prevention measure; 2) decrease in carbon stocks and increase in GHG emission associated with activity displacement leakage.

This is a grouped project. As noted in Section 3.4.1 of the VCS Standard v3.6, grouped projects allow for the expansion of a project activity subsequent to project validation. The expansions of project activities are still underway. As such, the project area has not been finalized for purposes of this Project Description Document and consequently neither has the leakage belt nor the leakage management area. Please see the section below for more details.

5.5.1 LEAKAGE BELT

As specified by section 1.1.3 of the applicable methodology, VM0015 version 1.1 Methodology for Avoided Unplanned Deforestation, the creation of a leakage belt is required and subject to monitoring, reporting and verification, especially if there is not a jurisdictional system already in place. The leakage area is defined within VM0015 version 1.1 as consisting of the forested land areas surrounding the project area in which baseline activities could be displaced due to project activities implemented in the project area.

It should be noted that the delineation of the leakage belt is contingent on the creation of a finalized Project Area. The Project Area has not yet been finalized because it is expected to increase in size over time as new Project Activity Instances are established; the project is a grouped project, thus the project area is subject to change (Section 3.4.1 of the VCS Standard v3.6) as more land is enrolled in the project over time. Because the boundaries of the Project Area have not been finalized, the leakage belt boundaries have not been definitively defined but will be finalized by the end of the first monitoring period and will be available in the first monitoring period report.

The Project Description focuses on the project's *ex-ante* estimates; because *ex-ante* estimates are carried out prior to project initiation, the exact boundaries of the project area (and thus the leakage belt and leakage management area) are subject to change. For the purposes of validation, the leakage belt, nor the leakage management area, has been entirely defined within this Project Description Document. However, the analysis for defining the leakage belt boundaries has been planned and will be carried out using the following processes.

To define the boundaries of the leakage belt, the mobility analysis (Option II) will be selected from the possibilities outlined in the methodology. A participatory rural appraisal has been carried out by FUNDAECO in the form of a socioeconomic baseline study (Base socioeconómica - Altelia.pdf). Within this study, a variety of questions were asked in interviews with local community members throughout the Project Zone.

Two questions which concerned direct deforestation by community agents will be used to carry out the mobility analysis. These questions asked the interviewees how far they would be willing to walk in order

to obtain wood (i.e. for building etc.) and how far they would be willing to walk in order to obtain firewood.

Reponses for these two questions will be collected and then averaged separately. According to the results, community agents would be willing to walk an average of approximately 2.6 kilometers for wood and 1.6 kilometers for firewood. To exercise conservativeness, the greater of the two averages (2.6 kilometers) will be used as the maximum distance one would be willing to walk for wood resources and thus, the maximum distance for the leakage belt boundaries. Roads, trails and pathways will be considered as the routes on which agents would travel in order to reach wood resources.

A 2.6 kilometer buffer will be created around all roads, trails and pathways that existed within the Project Area. In this buffering process, an area will be created where any part of a road, trail or pathway existing inside the project area acts as a central point from which 2.6 kilometers extended outward. In many instances, these buffered areas will overlap the Project Area and thus will be subject to the project activities which inhibited deforestation by agents for purposes of wood collection. These buffered areas which overlapped the project area will not be considered part of the leakage area.

The buffered area will include both the forest and non-forest areas within the buffer extending outward from the Project Area boundaries. The forested areas within the buffer will not be subject to project activity implementation and thus will be susceptible to leakage. Therefore, the forest areas falling within the 2.6 kilometer buffer outside of the project area boundaries will be uniquely exported and designated as the Leakage Area.

The leakage management area is part of the leakage belt and is managed in the same manner as the leakage belt. The notable difference between the leakage management area and the leakage belt is that the leakage management area only consists of the non-forest areas within the leakage belt. The leakage management area will be clearly defined as part of the first monitoring period as it is also dependent upon the finalization of the Project Area.

This analysis and the results of the analysis, including a finalized leakage belt and leakage management area are described in the monitoring report for the initial verification.

5.5.2 EX-ANTE ESTIMATION OF THE DECREASE IN CARBON STOCK AND INCREASE IN GHG EMISSIONS DUE TO LEAKAGE PREVENTION MEASURES (VM0015 SECTION 8.1).

As discussed in the Section 5.2 – Leakage Management – the leakage prevention measures include the installment of agroforestry plots and reforestation programs. No activities are planned with livestock intensification that would result in increased methane (CH_4) or nitrous oxide (N_2O) emissions. Based on the nature of the activities that will increase carbon stocks and decrease GHG emissions in the leakage belt and subsequently these activities are not a significant source of leakage.

5.5.3 EX-ANTE ESTIMATION OF MARKET EFFECTS LEAKAGE

Market effects leakage is estimated for all projects that significantly reduce the production of a commodity, causing changes in the supply and an ultimate increase in production of that commodity elsewhere to meet any loss in supply. By implementing project activities aimed at reducing timber extraction due to illegal logging, it is expected that the project will affect the supply of timber in the

local market. While it is expected that these impacts will be small, it is very difficult to estimate the significance of the potential for market impacts as a result of restrictions on this market commodity due to a lack of literature on the supply chains and markets for timber in Izabal. Thus, the project is conservatively estimating a 20% default market leakage factor following the requirements in sections 4.6.13, 4.6.14, and 4.6.14 of the VCS AFOLU Requirements.

The 20% default factor is applied in situations "where the ratio of merchantable biomass to total biomass is higher within the area to which harvesting is displaced compared to the project area." Due to the fact that the primary timber producing region within Guatemala is located in the department of Petén, which neighbors the department of Izabal, it is assumed that any changes in timber supply in Izabal will most likely affect the production of the commodity in Petén. Generally, timber production is a marginal/small-scale economic activity in the department of Izabal due to a difference in merchantable species diversity and abundance, thus it is expected that the merchantable biomass in Petén is higher than in Izabal and the 20% default value is applicable for the project.

5.5.4 EX ANTE ESTIMATION OF THE DECREASE IN CARBON STOCKS AND INCREASE IN GHG EMISSIONS DUE TO ACTIVITY DISPLACEMENT LEAKAGE

Activities that will cause deforestation within the project area in the baseline case could be displaced outside the project boundary due to the implementation of the AUD project activities. If carbon stocks in the leakage belt area will decrease more during project implementation than projected in the baseline case, this will be an indication that leakage due to displacement of the bassline activities has occurred. With this framework in mind, leakage due to activity displacement can be estimated by *ex post* monitoring of deforestation in the Leakage Area and comparing *ex post* deforestation with *ex ante* projected baseline deforestation. Typically, at the time of validation no *ex post* data is available and the *ex ante* displacement leakage is not known requiring the definition of a Displacement Leakage Factor (DLF). The DLF represents the percent of deforestation expected to be displaced outside the project boundary. However, at the time of validation *ex post* information was available from 2012-2014 due to the creation of a 2014 LULC map using the same LULC classes as defined in Section 5.3.2. The development of the 2014 LULC map product is described in full in the Monitoring and Implementation Report.

Using this method the DLF from 2012 to 2014 was found to be negative, as fewer emissions occurred in the project scenario than were estimated in the baseline scenario. As with the Effectiveness Index (see Section 5.4.1), this value was determined by comparing the baseline deforestation that was defined within the Leakage Area (see Section 5.5.1) and comparing it to observed deforestation from 2012 to 2014 in the Leakage Area. Detailed calculations can be found in the Carbon Accounting Model – Displacement Leakage Factor tab (Fundaeco VM0015 Accounting Model v1.57.xlsm). However, in order to produce a conservative assumption of emissions due to activity displacement leakage, it was estimated that the project would result in a DLF of 5%, as the project expands to cover more area within the region.

For the period following 2014 until the end of the project crediting period, the displacement leakage factor was increased to roughly 5% over the project lifetime. This is justified by the scaling of project activities across the Grouped Project Area including in the Leakage Area. The defined DLF is summarized in Table 59.

Year (*t*)	Displacement Leakage Factor (%)
2013	0.0%
2014	0.0%
2015	0.0%
2016	0.0%
2017	0.2%
2018	0.4%
2019	0.6%
2020	0.7%
2021	0.9%
2022	1.1%
2023	1.3%
2024	1.5%
2025	1.7%
2026	1.9%
2027	2.0%
2028	2.2%
2029	2.4%
2030	2.6%
2031	2.8%
2032	3.0%
2033	3.1%
2034	3.3%
2035	3.5%
2036	3.7%
2037	3.9%
2038	4.1%
2039	4.3%
2040	4.4%
2041	4.6%
2042	4.8%

Table 59. Displacement Leakage Factor (DLF) for the project crediting period

The emissions of forest fires were not included in the baseline and subsequently were not included in the estimate of decreased carbon stock due to displaced forest fires. As required by the VM0015 methodology, activity data for the Leakage Area had to be calculated for each carbon pool. To estimate the activity data for the Leakage Area, a leakage size factor was used. The leakage size factor was the expected size of the Leakage Area relative to the size of the Project Area as of the end of the first monitoring period and was calculated to be about 54% (see Fundaeco VM0015 Accounting Model v1.57.xlsm, Ex-Ante Reporting Parameters Tab).

The leakage size factor was applied to the projected size of the Project Area to estimate the projected size of the Leakage Area over time. The ex ante quantity of land use change on a per-hectare basis for each LULC transition for the Leakage Area was likewise estimated from LULC transition data for the projected Project Area in the baseline case. The appropriate emissions factor was applied to LULC transitions in the projected Leakage Area to estimate baseline emissions in the Leakage Area, the activity data shown in table Y, and table AQ-AT of the PD template tab in the accounting model, and tables 41 and 45 in section 5.3.5 of the PD. The calculated total *ex ante* estimated decrease in carbon stocks due to displaced deforestation, based off of the DLF described above is summarized in Table 60.

Project year t	Total *ex ante* estimated decrease in carbon stocks due to displace deforestation		Total *ex ante* estimated increase in GHG emissions due to discplaced forest fires	
	annual $\Delta CADLK_t$ tCO$_2$e	cumulative $\Delta CADLK$ tCO$_2$e	annual $\Delta EADLK_t$ tCO$_2$e	cumulative $\Delta EADLK$ tCO$_2$e
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	1,859	1,859	0	0
6	3,942	5,801	0	0
7	6,303	12,104	0	0
8	9,103	21,207	0	0
9	12,564	33,771	0	0
10	16,828	50,599	0	0
11	21,059	71,658	0	0
12	23,634	95,292	0	0
13	25,706	120,999	0	0
14	28,655	149,654	0	0
15	31,505	181,159	0	0
16	31,423	212,581	0	0
17	29,937	242,519	0	0
18	31,358	273,876	0	0
19	37,552	311,429	0	0
20	42,543	353,972	0	0

21	45,190	399,162	0	0
22	57,752	456,915	0	0
23	47,439	504,354	0	0
24	29,354	533,709	0	0
25	11,529	545,237	0	0
26	7,204	552,442	0	0
27	5,971	558,412	0	0
28	5,335	563,748	0	0
29	4,570	568,318	0	0
30	3,678	571,996	0	0

Table 60. Ex ante estimated leakage due to activity displacement

5.5.5 EX-ANTE ESTIMATION OF TOTAL LEAKAGE

All of the sources of leakage calculated above are summarized in Table AW in the PD Template section of the Accounting model (Fundaeco VM0015 Accounting Model v1.57.xlsm).

5.6 SUMMARY OF GHG EMISSION REDUCTIONS AND REMOVALS (CL2 & CL3)

In this section the net anthropogenic GHG emission reductions of the REDD+ Project for Caribbean Guatemala is calculated following the requirements and equations provided in the VM0015 Methodology, v1.1. The NERs from the analysis presented in this section are summarized in Table 61 below.

5.6.1 SIGNIFICANCE ASSESSMENT (VM0015 SECTION 9.1)

Each carbon pool included in the Carbon Accounting Model was tested for significance following the "Tool for testing significance of GGH emissions in A/R CDM project activities". The results are detailed in the Carbon Accounting Model (Fundaeco VM0015 Accounting Model v1.57.xlsm) and each carbon pool was found to be significant and each carbon pool was included in the calculation of net anthropogenic GHG emission reductions.

5.6.2 CALCULATION OF EX-ANTE ESTIMATION OF TOTAL NET GHG EMISSIONS REDUCTIONS (VM0015 SECTION 9.2)

The Net Emission Reductions (NERs) were calculated according to equation 19 below provided in VM0015, v1.1.

$$\Delta REDD_t = (\Delta CBSLPA_t + EBBBSLPA_t) - (\Delta CPSPA_t + EBBBPSPA_t) - (\Delta CLK_t + ELK_t)$$

Where:
$\Delta REDD_t$ - *ex-ante* estimated net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t (tCO$_2$e)
$\Delta CBSLPA_t$ - sum of baseline carbon stock change in the project area at year t (tCO$_2$e)

$EBBBSLPA_t$ - sum of baseline emissions from biomass burning in the project area at year t (tCO$_2$e)

$\Delta CPSPA_t$ - sum of *ex ante* estimated actual carbon stock change in the project area at year t (tCO$_2$e)

$EBBBPSPA_t$ - sum of (*ex-ante* estimated) actual emissions from biomass burning in the project area at year t (tCO$_2$e)

ΔCLK_t - sum of *ex ante* estimated leakage net carbon stock change at year t (tCO$_2$e)

ELK_t - sum of *ex ante* estimated leakage emissions at year t (tCO$_2$e)

t - 1, 2, 3...T, a year of the proposed project crediting period

The NERs ($\Delta REDD$) from the analysis presented in this section are summarized in Table 61 below.

Year	Estimated baseline emissions or removals (tCO$_2$e)	Estimated project emissions or removals (tCO$_2$e)	Estimated leakage emissions (tCO$_2$e)	Estimated net GHG emission reductions or removals (tCO$_2$e)
1	488,461	141,654	69,362	277,446
2	904,359	262,264	128,419	513,676
3	954,751	276,878	135,575	542,299
4	1,094,705	310,082	156,925	627,698
5	1,227,008	339,288	179,403	708,317
6	1,301,295	351,123	193,976	756,196
7	1,384,590	364,356	210,350	809,884
8	1,496,312	383,710	231,624	880,979
9	1,636,578	408,593	258,161	969,825
10	1,804,422	438,083	290,096	1,076,243
11	1,916,861	451,887	314,054	1,150,920
12	1,878,006	429,196	313,396	1,135,414
13	1,810,285	400,862	307,591	1,101,832
14	1,793,061	383,794	310,509	1,098,758
15	1,779,629	367,549	313,921	1,098,159
16	1,640,351	327,198	294,053	1,019,100
17	1,451,424	279,788	264,265	907,372
18	1,404,086	259,965	260,182	883,939
19	1,536,011	270,616	290,631	974,763
20	1,582,688	265,083	306,064	1,011,540
21	1,533,244	243,947	303,050	986,247
22	1,735,600	259,274	353,018	1,123,309
23	1,333,975	190,429	276,148	867,397
24	839,477	116,726	173,904	548,846

25	355,279	52,624	72,059	230,595
26	234,874	36,019	46,975	151,879
27	193,938	29,501	38,858	125,579
28	167,087	24,784	33,796	108,507
29	137,060	19,748	28,032	89,280
30	105,361	14,710	21,808	68,842
Total	35,720,779	7,699,731	6,176,206	21,844,843

Table 61. Estimated net GHG emission reductions or removals

5.6.3 CALCULATION OF EX-ANTE VERIFIED CARBON UNITS (VM0015 SECTION 9.3)

The number of Verified Carbon Units (VCUs) are calculated using the results present in Table 61 above and subtracting buffer credits as calculated as a percentage of NERs ($\Delta REDD$) determined by the Non-Permanence Risk Tool (see Section 2.3.4). Equations 20 and 21 are presented in VM0015 for the determination of VCUs.

$$\Delta VCU_t = \Delta REDD_t - VBC_t$$

$$VBC_t = (\Delta CBSLPA_t - \Delta CPSPA_t) * RF_t$$

Where:
ΔVCU_t – number of Verified Carbon Units that can be traded at time t (tCO$_2$e)
VBC_t - number of Buffer Credits deposited in the VCS Buffer at time t (tCO$_2$e)
RF_t - risk factor determined by the Non-Permanence Risk Tool to calculate VCS buffer credits at time t (%)

The results of applying the above equation are summarized in Table AZ of the PD template tab in the accounting model (Fundaeco VM0015 Accounting Model v1.57.xlsm). The buffer allocation was calculated separately for risk area A and risk area B, using the relative area of each with respect to the total project area.

5.7 CLIMATE CHANGE ADAPTATION BENEFITS (GL1)

Climate Gold for climate change adaptation is not being sought.

6 COMMUNITY

6.1 NET POSITIVE COMMUNITY IMPACTS (CM2)

A study on the drivers of deforestation in the Sarstun Motagua Region carried out in 2015, identifies the lack of economic and employment opportunities as the strongest factor for deforestation in the region where the REDD+ Project is located. This underlying driver can be tackled improving two basic conditions that will then trigger positive long term impacts: a) Access to Resources and Economic Opportunities, and b) Education.

Other factor such as lack of laws and law enforcement were recognized as well and need to be addressed not only through forest protection in the field, but also through the litigation and the guarantee of a legal protection status for the most vulnerable forests.

Also, the study indicates the importance of the demand of the communities to participate in avoiding deforestation; because if local communities are not involved the development of the project, then the project will hardly be successful. Since most of the communities participating in the proposed project have organized groups and other links, it is important to always considerate them in order to create catalytic impacts.

Access to resources and economic opportunities
When people depend on the expansion of agricultural lands needed for maize cultivation, the study and the experience of FUNDAECO in the region shows that people deforest because they need land to expand their crops and where yields barely produce incomes to local farmers.

Implementing a model where the people don't depend on extracting timber for their household, or expanding agricultural lands for the culture of crops with low productivity yields -that can barely feed them and give them a little extra money-, requires the provision of conditions and resources that will guarantee sustainable livelihoods. During the consultation people asked for support to implement new and more productive crops. Some of them are individuals and some others are already organized in producers associations, that although they have achieved some success, they still need training and funding or to start working.

With 25 years of work in the region FUNDAECO with some communities, have experienced with alternative economic activities, and found several that well accepted by people and that profit from the natural potential of the region; ecotourism, forestry and agroforestry.

A. Livelihoods

Under this program, the project will ensure supplies and conditions to help local farmers in the initial but fundamental phases for sustainable livelihoods. The idea is to support the whole production cycle so at the end communities or individuals are not only producing quality products that can be sell and

generate incomes; the impact is not only that people will generate sufficient household income but that pressure over the forest will be reduced.

The project will also support individuals and communities to access to the forest incentives program – PINFOR and PINPEP/PROBOSQUE-, through the preparation of forest inventories, management plans and legal files requires by the programs and which costs cannot be paid by poor people.

B. Natural resources

The need for timber and firewood is recognized and integrated in the project. Therefore the project will support legal access to firewood and family wood needs, and will also support plantation for sustainable timber production

C. Access to reproductive health

Satisfying women basic needs will strengthen their participation in the economy and the decision making process of the community, that is why the project includes this program as an integral intervention to the fill the gap in access to women health services. Access to sexual and reproductive health services and family planning will also provide families a tool to plan their economy and the education of their children, though expanding the impacts of the program in the medium and long term. The program will support of a network of women health clinics, already established inside the project zone.

Through the Theory of Change analysis, it was determined that these project activities will result in the following positive impacts:

Access to resources and economic opportunities positive impacts
- ✓ All marginalized and vulnerable communities with customary right have legalized land
- ✓ Ability and capacity of communities to implement sustainable resource management techniques
- ✓ Inclusion of all marginalized and vulnerable communities with customary rights in resource management decisions that may impact them.
- ✓ Sufficient household income from provision of ecotourism services, sale of agroforestry products, and resource protection
- ✓ Protection of ecosystem services important to livelihoods and health
- ✓ Resource management with consideration of traditional, cultural, spiritual, and religious rights

Education
The fact that education can influence multiples situations; access to better job opportunities, decision making in family economy, and decision making in natural resources management, implies that it can generate multiple positive impacts. Therefore in the project, education will have several approaches.

A. Education for opportunities

The project will provide direct training and education opportunities to youth, especially to women. This will allow youngster to develop new capacities for the implementation of sustainable productive activities that a have a good potential in the project area, such as; ecotourism, agroforestry and sale of agroforestry products and forest protection.

B. Education for Life

Education triggers to a life change not only because technical capacities are increased, but because people can envision different paths to their future. As explained in the section community conditions without the project, girls living in the project region are turned in to moms at a very young age, condemning them and their families to poverty. The project will tackle this situation supporting girl to finish elementary school and continue to high school and accompanying benefited girls with integral education on girl and women rights, especially family planning rights.

C. Education for Resource Management

Communities are willing to take the best decisions that guarantee natural resources in the long term as well as reduce emissions from deforestation; therefore the project will provide training that creates the Ability and capacity of communities to implement sustainable resource management techniques

Through the Theory of Change Analysis, it was determined that the project activities described above would have the following impacts:

Education positive impacts
- ✓ Widespread awareness among women and families of reproductive rights and health
- ✓ Increased access to health information and care within the project zone
- ✓ Widespread access to community capacity building and educational opportunities
- ✓ Recognition and assistance in protection of significant traditional, cultural, spiritual, and religious sites.

6.1.1. Measures to Negative Community Impacts

Through a deep analysis exercise with the project team and a compilation of the main concerns expressed by the communities during the Free, Prior and Informed Consent process, the team of the project has identified several potential negative impacts. Due to the fact that the project has numerous positive impacts and is actively working to mitigate any potential negative impacts, the project is determined to have a net positive impact on communities. The following negative impacts and their mitigation measures were identified:

- One of the concerns of several the communities was that the REDD+ Project will affect their ownership of the land. As a mitigation measure, these doubts were clarified during the FPIC meetings and it is constantly reminded that carbon contracts will not cause the loss of land titles.

- The risk of unemployment was another possible negative impact related to the livelihoods of some community member working in small local sawmills. FUNDAECO have been actively informing that the project main target is to fight deforestation, and that sawmills that complies with national laws will not be affected by the project activities.

- The communities identified as a potential negative impact the reduction of their access to timber and firewood extraction. To address this, the project will strengthen the processes of education and awareness promoting tree planting of fast-growing and high energy trees, and

the use of *Family Consumption Permits* authorized by the National Forest and Protected Areas Laws.

6.1.2 Measures to Maintain HCVs

Following the precautionary principle, the project considers a series of measures to maintain HVCs important to community's wellbeing. Measures include the following:

- Creation and protection of nature reserves to preserve critical ecosystems services, especially watersheds, as well as to protect sacred sites.
- Support to cultural expressions related to the management and preservation of sacred sites
- Foster the inclusion of forest plots into the Project Area in order to avoid the deforestation of watersheds
- Environmental education to raise awareness on HCVs and promote their maintenance.

6.2 OTHER STAKEHOLDER IMPACTS (CM3)

It is expected that the implementation of the REDD+ Project will positively impact other stakeholders. Through a deep analysis exercise with the project team and a compilation of meetings during the Free, Prior and Informed Consent process, the project has identified several potential positive impacts, and a potential negative impact during the process. Overall, given the number of positive impacts for other stakeholders and the measures taken by FUNDAECO to mitigate any negative impacts, it was determined that the project will provide a net positive impact for other stakeholders.

Other stakeholders include government institutions, municipalities, and other organized groups that are not community groups. The next table shows potential impact for identified stake holders:

Stakeholder	Identified Impact
MICAI	The project will provide with technical assistance to legalize communities that inhabit the project zone and do not have a land title. Supporting MICAI mission in the region
CODEDE DE IZABAL	The project will be positively impacted by the participation of FUNDAECO in CODEDE, especially for activity coordination with other stakeholders, and with information exchange. *FUNDAECO participates at the CODODE as NGO
CONAP	The project will provide with technical assistance and resources to activities related to law enforcement. The project will be benefitted by CONAP with the payment of parkguards and the participation of other technicians that will coordinate with FUNDAECO for law enforcement activities.
Municipalidad de Morales	FUNDAECO and Municipalidad de Morales are coordinating control and surveillance activities, providing both personal for patrols, as well as environmental education.
INAB	FUNDAECO promote and support access to PINFOR, PROBOSQUE and PINPEP inside the project zone.
Asociación o Comité Pimenteros	This group will be benefitted with technical assistance and the promotion and market access for their products, using The Conservation coast trademark.

Asociación o Comité de Xateros	This group will be benefitted with technical assistance and the promotion and market access for their products, using The Conservation coast trademark.
Asociación o Comité de Cardamomeros	This group will be benefitted with technical assistance and the promotion and market access for their products, using The Conservation coast trademark.
Asociación de Rambutaneros	This group will be benefitted with technical assistance and the promotion and market access for their products, using The Conservation Coast trademark.
ASOPROGAL	FUNDAECO and ASOPROGAL will coordinate activities to develop specific productive projects in order to foster communities' development inside the project zone. In this coordinate both ASOPROGAL and the Project can provide technical assistance or funds.
Asociación Ak´Tenamit	Asociación Ak'Tenamit is an association dedicated to support rural development for indigenous communities inside the project zone; providing Education and Health to Q'eqchi' communities. Both the project and Ak'tenamit are benefitted with the participation of AkTenamit scholars as interns at the Ecotourism sites and in the agroforestry activities in the REDD+ project
Cattle Ranchers	This group may experience potential negative impacts as a result of the reduced availability of forest for the expansion of pasture. Without the ability to expand pasture areas by clearing forest, there is a potential negative impact on the incomes of cattle ranchers. However, FUNDAECO is mitigating these negative impacts by providing alternative livelihood options for landowners throughout the region.

6.3 EXCEPTIONAL COMMUNITY BENEFITS (GL2)

Community Gold is not being sought.

7 BIODIVERSITY

7.1 NET POSITIVE BIODIVERSITY IMPACTS (B2)

Methods for Determining Project Biodiversity Impacts

The Theory of Change approach, proposed in Richards and Panfil (2011), was used to design project activities that address threats to biodiversity and achieve the desired project objectives discussed in Section 1.1.2. This method of analysis requires that all outputs, medium and long term impacts, and outcomes be assessed for each activity that is implemented. This process helps to identify both positive and potential negative impacts (see Section 2.2.4) of a project activity, enabling the project proponent

to implement preventative measures to minimize risks, and to evaluate the effectiveness of each activity in achieving predicted biodiversity benefits over time.

One of the primary reasons the project is implementing the Theory of Change model, is because the model provides a structure for project activity implementation, management, and monitoring that is flexible and traceable. In order to measure and quantify the positive impacts on biodiversity as a result of the project, all project activities are monitored using a set of indicators that are intended to measure the effectiveness of the project activity at different stages of implementation. This monitoring framework allows for the project to implement a continuously iterative process called "adaptive management," which is crucial to maintaining strong relationships with project stakeholders as well as increasing project activity effectiveness and mitigating any potential risks to the project's biodiversity benefits if they arise. Adaptive management is the process by which a project activity's outputs and impacts can be monitored, its effectiveness evaluated, and ultimately the activity itself can be revised if the desired impacts are not achieved. Throughout this process, input from various stakeholders and communities will be sought and considered when making any programmatic or project-activity specific changes. In addition, these methods help to focus resources into project activities that are effectively generating biodiversity benefits.

Project activities have primarily been designed to reduce deforestation and forest degradation in the project area, thus the majority of positive biodiversity impacts will be assessed on the basis of forest cover within the project area. As discussed previously in Section 4.5.2, this method is based on the Richards and Panfil (2011) Impact Assessment guidelines, which discuss the correlation between biodiversity and forest cover. The demonstration of a net-positive biodiversity impact over the project lifetime will be done by comparing the biodiversity baseline scenario, with the project's current biodiversity conditions. Quantifying a net-positive impact will not be done by comparing biodiversity conditions at the start of the project with biodiversity conditions of a later monitoring period, because this does not accurately capture the full biodiversity benefits of the project.

As mentioned previously, reducing deforestation and forest degradation in the project area allows for the maintenance of biodiversity attributes within existing ecosystems, while facilitating the regeneration of forest cover in degraded areas. Regeneration within degraded areas has the potential to increase the complexity and abundance of flora, which in turn contributes to greater ecosystem connectivity, erosion control, water purification, nutrient cycling, and habitat for faunal species. In addition, the protection of breeding grounds for different marine species will result in population increases due to greater lifecycle integrity. All of these project impacts result in a net positive impact to biodiversity in the project area when compared to the biodiversity baseline scenario. A summary of the theory of change model for the project biodiversity benefits can be seen in Table 62 below.

The project activities that will produce biodiversity impacts have been categorized into four different program areas, through the theory of change approach, that focus on resource protection, empowerment and inclusiveness, education, and access to resources. Many of these project activities that are effectively maintaining and supporting biodiversity in the project area are bringing about climate and community benefits as well. The expected biodiversity impacts of each program area and its corresponding project activities are described below.

Program Areas	Activities	Medium-term Impacts	Long-term Impacts
	Implementation of fish	Greater clarity and	Increased awareness of

Resource Protection and Governance	restoration zones	commitment re land-use and sustainable strategies.	the role of Guatemala's Caribbean coast in the support of diverse and globally important species populations.

Maintenance or enhancement of the integrity of important ecosystem services.

Widespread protection of forest in project zone |
| | Enforced protection and management of protected area forests and community water sources | Prevention of habitat loss and maintenance of natural ecosystems. Greater awareness and respect for land title and land-use designations. | |
| | Increased land tenure and land legalization efforts | Increased area of newly legally registered land that can be brought into forest protection, agroforestry, or reforestation. | |
| | Environmental litigation, and participation in local government and protected area councils | Continuation of important forestry, land use planning, and climate change laws

Increased governance capacity and a positive influence on land management decisions within protected areas | |
| Empowerment and Inclusiveness | Engagement of community in biological monitoring process including the engagement of local fisherman in reef monitoring initiatives | Increased awareness and knowledge of biodiversity, ecosystems, and threatened or endangered species within the project area and Caribbean coast | Increased awareness of the role of Guatemala's Caribbean coast in the support of diverse and globally important species populations

Awareness of rare, threatened, and endangered species and their importance |
| Education | Ecotourism site establishment | Increased awareness and knowledge of biodiversity, ecosystems, and threatened or endangered species within the project area, Caribbean coast, and world | Increased awareness of the role of Guatemala's Caribbean coast in the support of diverse and globally important species populations

Maintenance or enhancement of critical habitat and |
| | Workshops and education initiatives for schools and communities on biodiversity and ecosystem conservation | | |
| | Support for biodiversity research throughout the | | |

	project zone		populations of rare, threatened, and endangered species within the project zone
	Training and education for park guards on amphibian fungus and preventing its spread to vulnerable populations	Maintenance and protection of habitat integrity and populations of endangered species	
Access to Resources	Land use planning and legal services in project zone	Increased implementation of forest protection through land use management and land legalization	Widespread protection of forest in project zone

Reduced reliance on unsustainable timber extraction |
| | Establishment of agroforestry plantations and related services to diversify incomes and supply timber needs | Decreased illegal timber extraction

Local production and employment alternatives

Dividends to the community | |
| | Technical assistance for crops, agroforestry plantations, and sustainable fishing. | | |
| | Improved access to ecosystem services payment programs such as PINFOR and PINPEP | | |

Table 62. Theory of change overview for biodiversity related project activities

Resource Protection and Governance

In the without project scenario, the exploitation of forests, water sources, and fisheries would continue un-checked, which would create severe negative impacts on biodiversity within the project zone. In order to address these threats, the project is implementing activities such as the patrolling and enforcement of protected area laws, the management of water sources, and implementation of fish restoration zones. As shown in Table 62 above, and in TOC Activity Matrix v1.14.xlsm, these project activities are designed to protect these valuable resources through legal enforcement, and by increasing community awareness and respect for resource integrity and land titles. In particular, the patrolling of protected area core zones serves to enhance biodiversity throughout the project area in addition to maintaining critical project biodiversity HCVs.

Activities regarding governance have been designed to fill an existing void in the local and national governments capacity to enact meaningful land use management and land tenure systems throughout the region. In the without-project scenario, this lack of governance capacity would create further stress on biodiversity through the expansion of illegal settlements, an increase in land disputes, and a lack of political willpower to promote conservation measures. FUNDAECO has designed activities that enable historically established and vulnerable populations to receive land tenure rights while discouraging the establishment of new illegal settlements within forested areas. This allows well-established communities

and individuals who previously had no legal rights to their land to invest in their land and forests without the fear of being displaced. Additionally, FUNDAECO is an active participant in environmental litigation on a national level and serves on the boards of numerous protected areas in order to advocate for further environmental protection at the local and national level. All of these actions serve to strengthen local capacity and reduce deforestation and degradation pressures within the project area, which result in positive benefits for biodiversity within the project area and project zone.

Empowerment and Inclusiveness

The engagement of local communities in project activities is an important factor in creating biodiversity benefits. By encouraging local participation in biodiversity monitoring activities, community members can gain a greater appreciation and awareness of the importance of biodiversity within the project zone. Additionally, participants in monitoring activities may be able to come away from this work feeling invested in the survival and health of different ecosystems and species. Through increased participation and investment in project activities, community members will be able support and understand the project's biodiversity initiatives and goals in addition to gaining a broader understanding of the importance of biodiversity in a local, regional, and global context.

Education

Project activities that are of an educational nature are essential to maintaining and protecting biodiversity within the project zone. FUNDAECO is implementing activities that are aimed at biodiversity and environmental education on local, national, and global scales. FUNDAECO has developed ecotourism sites in several locations along the coast and plans to further enhance the facilities at these sites in order to draw in local and foreign visitors who are interested in learning about the unique ecosystems and species in this region of Guatemala. Educational initiatives are also being implemented in coordination with public schools so that schoolchildren will be taught the importance of conservation, endangered species, and environmental stewardship. By teaching these fundamental concepts to young children, the project will be cultivating a better understanding of and relationship with the natural world in the next generation. Project activities will also support the research and study of biodiversity within the project area. By deepening the knowledge of species and ecosystem dynamics within the Caribbean coast of Guatemala, FUNDAECO will be contributing to the global scientific community and bringing awareness to the importance of this region's biodiversity on a global level.

Additionally, FUNDAECO is taking steps to protect and enhance the populations of endangered amphibian populations within the project area through educational initiatives. Forest patrols are trained in techniques to prevent the possible introduction or spread of a fungus that can wreak havoc on amphibian species. By taking conservative measures to protect endangered species, FUNDAECO is ensuring that no project activities have unintended negative impacts on HCVs.

Access to Resources

Through the analysis of agents and drivers of deforestation (see CNCG SM drivers of deforestation_final_1.pdf, Brief on Agents and Drivers v2.docx, and Section 4.5.3), FUNDAECO has been able to identify that a large contributing factor to land use change and forest loss is due to a lack of economic opportunities and resources for people within the project zone. As is discussed in Section 1.3.6, most communities within the project zone live in extreme poverty with limited access to water,

electricity, education, and healthcare. Many of these families survive through subsistence agriculture and will turn to agriculture expansion, and cattle ranching in order to take advantage of any economic opportunities available. Many subsistence farmers do not have the technical knowledge or financial means to improve the systems of agricultural production on their existing property, and may resort to clearing more land to increase their agricultural outputs. FUNDAECO works to provide these farmers with the resources needed to create improved and diversified agroforestry systems with their existing cropland. Farmers that participate in these programs receive free or subsidized nursery stock to establish their agroforestry plots, in addition to land use planning guidance from FUNDAECO staff. Land use planning is aimed at creating diversified income for farmers (i.e. growing rubber and pepper), while also providing basic needs such as food, timber and fuelwood. These agroforestry plans are also designed to create a structurally and biologically diverse farming system, so as to provide a more habitable environment for native flora and fauna. Farmers are also able to gain access to technical expertise from agroforestry specialists on methods for improving agricultural yields from cash crops such as pepper, rambutan, rubber, and cardamom. Through the implementation of these diversified agroforestry production models, FUNDAECO is able to improve livelihoods, while reducing deforestation pressure throughout the project area. For example, by encouraging farmers to plant fast-growing native trees for timber on their land, these farmers will be able to harvest trees whenever necessary without needing to resort to illegal logging. Additionally, farmers who grow cash crops with improved nutrient cycling techniques can increase their income from the same area of land without needing to resort to deforestation to increase crop yields.

FUNDAECO is also working to provide access to legal counsel for landowners without official land title, and to reduce barriers to participation in payment for ecosystem services programs such as PINFOR and PINPEP. Many farmers and landowners within the project zone have little formal education and no financial means to engage in the process of land legalization without assistance. FUNDAECO is helping families and communities to become recognized title-holders to their land on the local and national levels by providing documentation and legal counsel services to those needing support. Additionally, FUNDAECO has been registering and providing land management planning and documentation services to any farmers wanting to participate in government sponsored PINFOR and PINPEP programs. These programs provide incentives for farmers to preserve any forest on their property, however there are numerous forms including a land management plan that must be prepared for a property to be enrolled. Many farmers do not have the technical skills to be able to prepare this documentation on their own, and as such can work with FUNDAECO to be able to gain access to these alternative income sources. By providing consultation services and legal resources to farmers and communities throughout the project zone, FUNDAECO is effectively reducing deforestation pressures tied to land tenure problems and a lack of economic opportunities. Overall, these activities have a net positive effect on biodiversity within the project area and project zone.

Potential Negative Biodiversity Impacts from Project Activities

All project activities have been analyzed for any potential negative effects on biodiversity within the project area and project zone. Negative biodiversity impacts for REDD+ projects are most often associated with deforestation-related activities shifting to areas outside the project area, but can come about from the misuse of pesticides and fertilizers as well as ineffective waste management techniques. As discussed in section 2.3.3 of the PD, other potential risks to project biodiversity benefits include lack of governance capacity resulting in unclear land tenure, changes in local economic conditions that may increase deforestation pressure, and the possibility for displaced forest loss outside of the project area.

FUNDAECO has taken steps to mitigate all potential harmful impacts on biodiversity benefits as a direct and indirect result of project activities. Agroforestry project activities adhere to standard USAID protocols on the safe and judicious use and disposal of pesticides and fertilizers in addition to banning the use of GMO's and invasive species as part of project activities (see Plan General de BPA 2016.docx, and EG-PERSUAP-Final_Oct2012.docx). Due to existing agricultural markets and increased economic incentives for small-scale farmers, FUNDAECO does use several non-native species in its agroforestry programs, including rubber, cardamom, rambutan, and pepper. However, these species are non-invasive and were introduced into Guatemala as agricultural species over 50 years ago. The Guatemalan government considers these species to be "naturalized" and to pose no threats to biodiversity within the country. A detailed justification and analysis of non-native species use in FUNDAECO agroforestry programs can be found in Consultoria Selvin Perez doc Final 10062014.docx. In order to further reduce any risks to biodiversity benefits through the use of non-native species in agroforestry programs, FUNDAECO engages landowners in land-management and planning activities to diversify agricultural commodities across an ownership and to avoid monoculture plantations. Farmers are encouraged to promote a more structurally diverse and natural agroforestry system that is able to support native flora and fauna as opposed to structurally and biologically homogenous plantations (see Consultoria Selvin Perez doc Final 10062014.docx).

Any potential indirect negative impacts on biodiversity caused by project activities are also being minimized and mitigated through FUNDAECO programs. In order to avoid possible activity-shifting deforestation from the project area into the project zone as a result of project activities, FUNDAECO is engaging with landowners throughout the project zone to support land legalization efforts, enroll landowners into PINFOR and PINPEP programs, and eventually incorporate additional landowners with forest area into the grouped project over time. This will serve to minimize deforestation pressures that could result in further biodiversity loss.

FUNDAECO is also taking steps to ensure that biodiversity HCV's are not negatively impacted by project activities. By preventing deforestation within the project area, FUNDAECO is effectively protecting the majority of biodiversity HCVs identified in Section 1.3.8. However, potential negative effects on HCVs as a result of project activities include the spread of fungal diseases to IUCN endangered amphibian species during forest patrol activities. To prevent the spread of any harmful amphibian diseases throughout the project area, forest patrols are instructed in appropriate decontamination methods for shoes or clothing. While the spread of these diseases through forest patrol activities is unlikely, extra measures are being taken to protect vulnerable wildlife populations.

Net Positive Biodiversity Impacts

In evaluating the net benefits to biodiversity as a result of project activities, the theory of change framework consisting of the problem flow analysis and impact assessment was considered in addition to the historical LULC analysis and the results of LULC modeling. All these factors combine to provide us with quantitative and qualitative assessments of biodiversity benefits across the project's lifetime.

Through a historical analysis of land cover change within the reference region, over the past decade, roughly 20,503 hectares of forest have been lost annually, and the modeled baseline scenario predicts that same number of hectares of forest will be lost annually over the next 30 years without project intervention. Conversely, project activities are expected to substantially reduce deforestation within the project area over this same time frame. As discussed earlier, the reduction in deforestation and forest

degradation is the most effective method to reduce threats to biodiversity and improve ecosystem function across the project area. The project is expected to increase forest connectivity, protect existing forest ecosystems, and promote the sustainable use of forest and marine species within local communities. Figure 41 shows the increase in cropland area over time for the baseline scenario, and Figure 42 shows the area of cropland over time for the project scenario. These figures show a dramatic reduction in cropland in the project scenario, and an increased amount of forested area, which results in net positive benefits to biodiversity through sustained wildlife populations and greater ecosystem integrity.
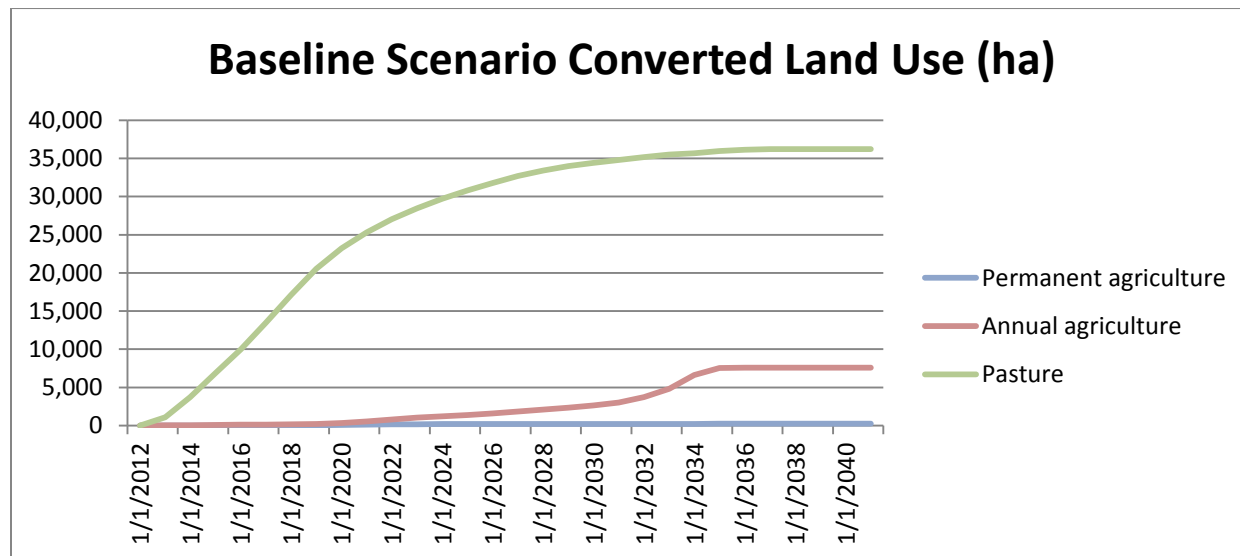
Figure 41. Land use converted in the baseline scenario
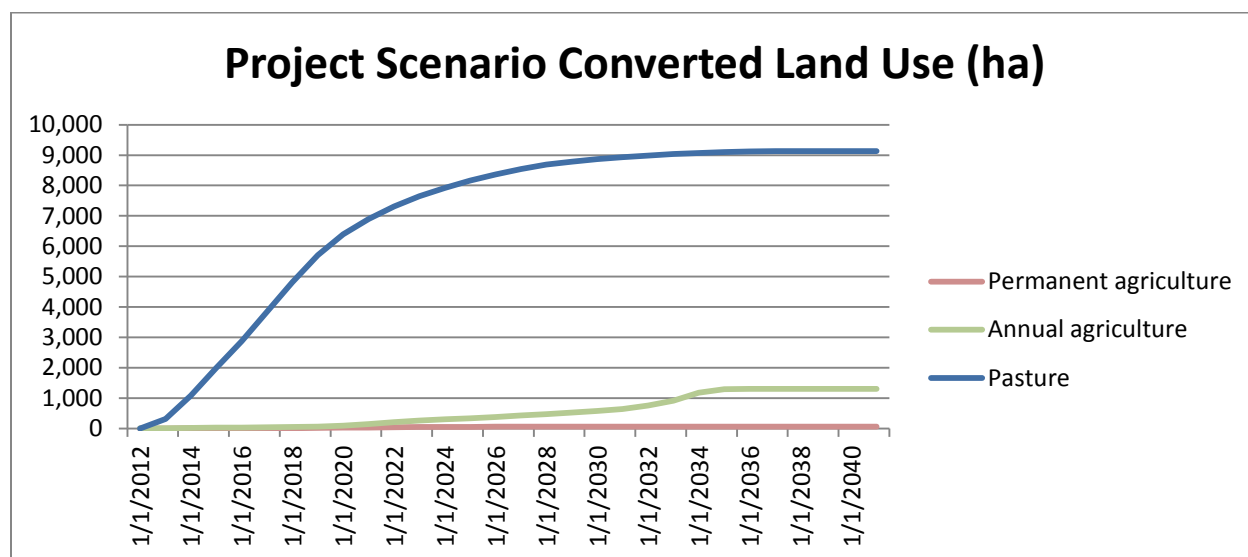
Figure 42. Land use converted in the project scenario

7.2 OFFSITE BIODIVERSITY IMPACTS (B3)

Many of the net positive biodiversity impacts from the project activities within the project area will also have positive biodiversity impacts outside the project area. The protection of existing forest areas and regeneration within degraded areas will contribute to greater ecosystem connectivity, erosion control, water purification, nutrient cycling, and habitat for faunal species. The protection of breeding grounds for different marine species will also result in population increases due to greater lifecycle integrity. These ecosystem services can affect the landscape level and thus provide positive offsite biodiversity benefits.

Additionally, the engagement of local communities in project activities will spread a greater understanding of the importance of biodiversity. Most deforestation and forest degradation occurs as a response to extreme poverty and lack of economic opportunity. As communities participate in and become invested in project activities and benefit from them, knowledge of these new practices and the advantages of preserving biodiversity may spread outside of the communities within the project area and positively affect offsite biodiversity.

The primary risk to offsite biodiversity as a result of project activities is the potential for activity-shifting leakage. Activity-shifting leakage occurs when hunting, mining, or deforestation and degradation activities are discouraged or prevented in the project area, and are subsequently moved to areas outside the project zone.

The only activities that pose some concerns for potential offsite negative biodiversity impacts are deforestation and forest degradation activities. There is no mining present in the project area, and there is an insignificant presence of hunters within the project area, thus it is unlikely that either of these kinds of activities would have negative offsite impacts as a result of project activities. While it is theoretically possible for offsite negative biodiversity impacts to occur as a result of shifted deforestation and degradation activities, it is unlikely to happen due to restricted resource and land availability outside of the project area. Much of the remaining forested areas in the region are included within the project area, and those forests that do exist outside of the project area are privately held land ownerships. Both of these factors would pose a challenge to current actors of deforestation and degradation within protected areas. However, the possibility of this type of leakage does exist, and FUNDAECO is taking steps to mitigate this type of biodiversity leakage from occurring.

Through project activities geared at the incorporation of landowners throughout the region into PINFOR and PINPEP programs as well as the grouped project area, FUNDAECO is increasing the area of protected forest within the region. Additionally, FUNDAECO is implementing educational programs throughout the region aimed at encouraging resource conservation and environmental stewardship, which can improve people's understanding of the importance of forests and biodiversity within the region. Overall, any potential shift of deforestation activities would cause minimal negative impacts to biodiversity in comparison with the net positive impacts of the project activities discussed in Section 7.1 and above.

7.3 EXCEPTIONAL BIODIVERSITY BENEFITS (GL3)

Biodiversity Gold is not being sought.

8 MONITORING

8.1 DESCRIPTION OF THE MONITORING PLAN (CL4, CM4 & B4)

In the context of FUNDAECO's VCS/CCBA REDD+ project in Guatemala, the purpose of the monitoring plan is to measure and record data and indicators used to measure the climate, community, and biodiversity effect of the project compared to the baseline, without project, scenario. In accordance with project verification standards, FUNDAECO has set up the necessary follow-up mechanisms in order to ensure monitoring of all relevant variables and indicators, including: forest cover; forest degradation; socio-economic data; average family income evolution; reproductive health indicators; employment creation; average agricultural yields; biodiversity monitoring (indicator species); etc. The data and information collected and origin of the data are enumerated in sections 8.2 and 8.3. Methodologies used to estimate and model values correspond to those proscribed by VM0015 v1.1, and are detailed in sections 4, 5, 6, and 7 of the Joint VCS-CCB Project Description. Periodicity of monitoring is enumerated for each parameter sections 8.2 and 8.3. Roles and responsibilities for monitoring are in section 8.1.1. GHG information management systems are described in section 8.1.2.
The climate impact on the project and other areas will be monitored using remote sensing, permanent plots measuring the carbon content of the forest, and a suite of monitoring strategies to climate-related activities within the leakage belt and the project area itself. While models of carbon savings will be created to predict the impacts, empirical evidence from the project area and similar control areas outside of the project will be used at verification to confirm the carbon savings generated.

FUNDAECO will monitor activities related to community impacts by keeping records of community indicators outlined in the Theory of Change document (see TOC Activity Matrix v1.14.xlsm). By keeping detailed records of the people participating in and affected by community related project activities, FUNDAECO will been able to measure improvements in the quality of life within communities throughout the project zone. See Section 8.1.2.2 and Procedimiento para el Monitoreo Socioeconomico y Comunitario.docx for a more detailed description of community monitoring procedures and results.

Biodiversity impacts of the project will be measured primarily through analyzing the change in intact forest, which is used as a proxy for both floral and faunal diversity. Additionally, FUNDAECO will implement an extensive bird monitoring program in order to catalog avian diversity throughout the project region for use both in the project's biodiversity monitoring goals as well as for use within the scientific community. See the Implementation Plan (Plan de Implementación REDD V6.docx) for more details.

8.1.1 ORGANIZATION AND MANAGEMENT

FUNDAECO's organizational structure for project management and implementation consists of four levels: first level is National Directive Level where Board of director, and Project Directive Committee are involved, this level also includes legal assessment and communications assessment; second level includes Thematic coordination with units that respond to each of project components; the third level is the Regional coordination Level where the Regional Project Director coordinate directly with field level or the fourth level; the Geographic Coordination or Protected Area Coordination.   Each Geographic Coordination has a Coordinator as well as staff who manage teams that implement project activities under the climate, community, or biodiversity categories. See Figure 43 for a detailed organizational structure.
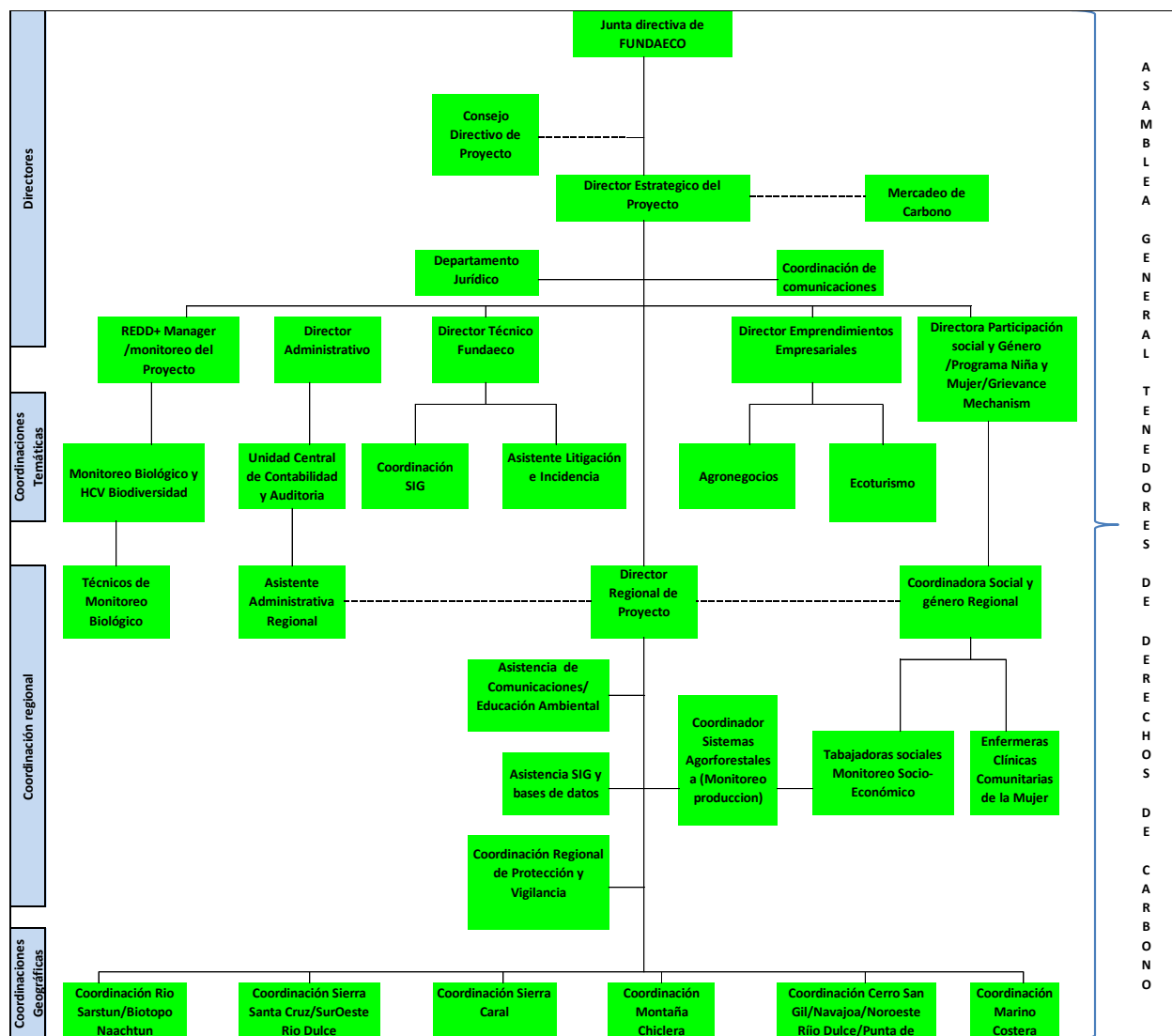
Figure 43. FUNDAECO's organizational structure

8.1.2 MONITORING METHODS

All project activities within the project area and project zone that are discussed in the PD will be monitored during the first monitoring period. If any project activities are to be phased out or incorporated at a later date due to adaptive management, the monitoring and implementation plans for the REDD+ Project for Caribbean Guatemala will be updated accordingly.

Each parameter measured will have an associated measurement SOP for each monitoring period, created by the Director for each component. If an SOP is adapted from one monitoring period to the next, the documents shall be versioned and archived and the monitoring report reference the version and title of the SOP used for that monitoring period. All updates to SOPs shall be approved by the

appropriate Component Director in the national office. The Component Directors are responsible for ensuring that all relevant SOPs are adhered to by the regional directors and staff. FUNDAECO

8.1.2.1 Climate Monitoring

FUNDAECO will quantify the net climate benefit of the REDD+ Project for Caribbean Guatemala through monitoring according to the methodology prescribed by VM0015 v1.1, including monitoring the required areas using remote sensing techniques and permanent forest plots installed and maintained in the project area.

Each monitoring period, FUNDAECO will update the LULC map of the Project and Leakage areas in order to update estimates of emissions reductions for the project. This will be done using the methods specified in section 8.1.2.1.1. Forest carbon stocks will be updated as described in section 8.1.2.1.2.

Selected pools included and excluded in the project scenario and a justification for that decision are as follows:

Carbon Pool	Included?	Justification/ Explanation of Choice
Aboveground tree biomass	Yes	Major carbon pool affected by project activities.
Aboveground non-tree biomass	No	May be conservatively excluded as it expected to decrease under the baseline scenario.
Belowground biomass	Yes	Major carbon pool affected by project activities.
Dead wood	No	May be conservatively excluded as it expected to decrease under the baseline scenario.
Litter	Yes	Major carbon pool affected by project activities
Soil organic carbon	No	May be conservatively excluded as it expected to decrease under the baseline scenario.
Wood products	Yes	Major carbon pool affected by project activities

Table 76. Selected carbon pools for monitoring

8.1.2.1.1 Project Implementation

All climate-related project activities will be monitored at specified frequencies through the use of geospatial data. Project activities implemented and monitored will likely be consistent with the project activities outlined in the TOC Matrix (see TOC Activity Matrix v1.14.xlsm), and the PD (see sections 2.2, and 5.4 of the PD). Through the use of adaptive management, monitored project activities may occasionally be updated and deviate from the PD and TOC matrix if they are found to be ineffective or have unanticipated negative consequences. Similarly, if other project activities that are not being implemented within one monitoring period are anticipated to have positive benefits for climate, communities, or biodiversity, they may be implemented and monitored at a later date. For a list of all monitored climate parameters, see Section 8.3.

8.1.2.1.2 Stocks and Emissions

The project, reference, and leakage area are delineated and monitored for LULC change using remote sensing techniques approved per the requirements of VM0015 v1.1 as described in Sections 5.3, 5.4, and 5.5 and Memoria Tecnica Completa.pdf. Class transitions in all the areas are validated using ground-truthing data. Natural disturbances will be monitored and areas severely affected re-classified as necessary. Carbon stocks will be measured using field data and updated when required by the methodology.

8.1.2.1.2 LULC Monitoring Methods

Data used to analyze deforestation in the project area will be satellite imagery which may come from a variety of different sources as specified in Chapter 3A.2.4 of the IPCC 2006 GL AFOLU document. A list of all imagery used in the LULC analysis will be provided in the Monitoring Report.
The methods used to generate Land Use and Land Cover maps for monitoring will be similar in nature to the methods described in section 5.3.2. All images used for monitoring will undergo several pre-processing steps such as orthorectification, cloud masking, and radiometric correction. The imagery will then be classified to consist of the same LULC classes used in the historical analysis (very humid forest, humid forest, annual agriculture, permanent agriculture, pasture, shrubs, wetlands, urban, other non-forest, and water). After the LULC analysis has been completed, an accuracy assessment will be conducted per VM0015 v1.1 requirements. The accounting of GHG benefits in the project area will only include cloud-free imagery.
After establishing the accuracy of the LULC classification, project and leakage emissions calculations will be completed along with all other GHG emission reduction and removal quantifications as per VM0015 requirements. Emissions from the project area and leakage area will be quantified using the LULC transitions in the project area and leakage area between the map produced for the monitoring period and the previously validated or verified LULC map. Any changes made to the project area to incorporate new project activity instances will be monitored based on the project activity instance start date and existing LULC data.

8.1.2.1.2 Forest Inventory Methods

Forest carbon stocks will only be updated as required by VM0015 and the VCS Standard v3.6, thus will only need to be re-measured and updated as part of the baseline reassessment every 10 years.

8.1.2.1.3 Leakage

 Activity displacement leakage will be monitored according to methodology requirements. Leakage will be monitored using the most up-to-date LULC map, and will be compared with the previously validated or verified LULC map. Emissions will be calculated for each transition from forest to a nonforest LULC class within the leakage area. Any updates made to the project area during subsequent monitoring periods will result in the revision of the leakage area using the methods described in section 5.5.1. Any leakage sources identified as significant in the ex-ante calculations (see section 5.5.5), will be monitored during each monitoring period.

8.1.2.2 Community Monitoring

Community impacts will be monitored according to the SOPs presented in Procedimiento para el Monitoreo Socioeconomico y Comunitario.docx as well as the Implementation Plan (Plan de Implementación REDD V6.docx). Identified indicators are part of the Project Theory of Change. A report will be prepared annually presenting all impact indicators and when possible also comparative analysis between monitoring periods will be presented.

Monitoring will be made with the beneficiaries for the different Project components; forest owner beneficiaries, productive projects beneficiaries, education beneficiaries, health beneficiaries, and community participation beneficiaries.

For each beneficiary a permanent tracing will be kept. This will allow FUNDAECO to quantify impacts at the end of the monitoring period, for each component and at the community level. Benefit tracing will be done in three steps: data generation and gathering (using data verifiers); database preparation for each component; and integrated databases, and database preparation for specific analysis. These steps will allow the program to track economic and behavioral changes within communities towards more sustainable and forest-friendly livelihoods.

Additionally, monitoring will be conducted by a yearly review of FUNDAECO programs as they reflect a Sustainable Livelihoods Framework (SLF). FUNDAECO will monitor five dimensions of the community's perception of its well-being: human, social, physical, natural, and financial. As the project proceeds, FUNDAECO will use the input gathered by the CCT to continually adapt and improve the monitoring process and ensure changes to the process have positive impacts on the populations within the project area.

Results of the community monitoring are publically available, published on the internet and disseminated to the Forest Owners Assembly and communities inside the project area.

8.1.2.3 Biodiversity Monitoring

Biodiversity impacts are monitored both within the project area and zone. The design of the data and parameters monitored is such that the project will be able to quantify its impact on biodiversity on a regional and local level. Both floral and faunal diversity will be assessed using the proxy of intact canopy cover, monitored as part of climate monitoring. While the focus of biodiversity monitoring is on forest cover and habitat integrity, which will be done through the use of remote sensing techniques described in Section 8.1.2.1.2.1, there are other monitoring activities focusing on avian and amphibian species as well.

Birds can be excellent indicators of wider environmental health or ecosystem integrity, particularly when such assessments use summarized data from a wide range of species (Stotz et al. 1996, Bibby 1999, Canterbury et al. 2000, Carignan and Villard 2002, Sutherland et al. 2004). Ornithological evaluations provide a measure to evaluate, in a quick and precise way, the ecological characteristics and the conservation status of most terrestrial communities. Periodicity of avian surveys will be on an annual basis, during the months that covers the stop-over of migratory birds in the region –October to March-. See the Implementation Plan and bird monitoring plan for more detailed procedures on bird monitoring (Plan de Implementación REDD V6.docx and FUNDAECO_BIRD_MONITORING PROGRAM.pdf).

Amphibians are often used as a reporter group to changes habitat or the loss thereof. Because they are so dependent on the ambient humidity, their geographic ranges, ecological, behavior, and life history it is strongly influenced by the distribution and abundance of water, usually in the form of rain. In fact, the abrupt and frequent synchronized playback of some frogs and toads with the first rains is a well-known natural phenomenon, especially in areas where rainfall is highly seasonal. Amphibians will be

monitored in a biannual basis trying to cover the start and the top of the rainy season. See the FUNDAECO_BIRD_MONITORING PROGRAM.pdf for more detailed procedures on bird monitoring.

The procedures for monitoring land cover within the project area are detailed in Memoria Tecnica Completa.pdf as well as section 5.4. The data and parameters monitored are in Section 8.3.

Results of the surveys will be used in an adaptive framework to evaluate the effectiveness of the project activities in providing a net biodiversity benefit, and the metrics and project activities modified as needed by the Biodiversity Monitoring director.

Results of the biodiversity monitoring will be made publically available, published on the internet and disseminated to the Forest Owners Assembly and communities inside the project area, as well as other stakeholders such as MARN and CONAP.

8.1.3 DATA MANAGEMENT

Data produced by FUNDAECO for all project related activities are stored in paper and digital formats within the regional and national offices. Copies of the data collected at the regional level are stored in digital format at the national office for safekeeping.

8.1.4 REPORTING METHODS

Data is collected and analyzed on a regional level, and then is aggregated and reported for the project as a whole. The regional analyses are helpful in informing the specific region's implementation teams on the progress of project activities being implemented in their region. However, this information will ultimately be aggregated with information from all other regional offices to update the project's monitoring report and provide a project-specific overview of progress.

FUNDAECO will track both the rate of deforestation and changes in LULC every monitoring period. Rates of deforestation in the project area and leakage belt were measured at the end of the first monitoring period. The project baseline deforestation rate will be reassessed and submitted every ten years for third party verification. FUNDAECO will conduct an annual internal review of deforestation rates to produce data-driven models of deforestation in relation to project activities. The models will allow FUNDAECO to better understand which project activities and locations have been effective at reducing deforestation rates. Additionally, these reviews will help FUNDAECO better understand which areas need greater focus and resources to further reduce deforestation.

A GHG report will be prepared for each monitoring period to summarize evidence of the net project benefit for the selected VCS/CBBA auditor. Monitoring reports will be made publically available on the VCS and CCBA websites. Results of monitoring will be communicated in an appropriate language and format to the communities and stakeholders in the project zone.

8.1.5 QUALITY ASSURANCE AND CONTROL

The team mangers for community, biodiversity and climate are responsible for an internal audit of approximately 10% of the measurements for data and parameters monitored, using a risk-based assessment for selection. If there is a deviation of more than 5% in the measurement and re-measurement of the parameter, the deviation is to be investigated and resolved. When updating data stored electronically, the file should be versioned.

The regional directors are responsible for creation and adaption of QA/QC protocols as required, and for any technical direction of the regional directors or teams.

The FUNDAECO field teams minimize error by working as teams to check the identification of tree species and diameter measurements, and to review community and biodiversity data collected. These teams verify each other's readings. Managers for each team verify a subset of the data recorded using risk-based assessment. The regional directors also sample a subset of data recorded on a periodic basis, using a risk-based assessment.

To reduce and eliminate transcriptional error, a subset of spreadsheets is proofed by re-reading the field notebooks and comparing it to the data that has been entered.

All data will be reported to project proponents and local stakeholders and any discrepancies or disagreements will be rectified by explanation or joint visitation of activities in question. All publically available satellite data used in monitoring, validation, verification and certification will be archived and made available to auditors.

8.2 DATA AND PARAMETERS AVAILABLE AT VALIDATION (CL4)

Data Unit / Parameter:	%LKB
Data unit:	%
Description:	Percentage of the overlapping leakage belts area to be assigned to project, A, B…..N
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	At each verification
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 2.a,2.b,2.n
Any Comment:	N/A

Data Unit / Parameter:	A
Data unit:	ha
Description:	Area of error due to observed change predicted as persistence
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 9
Any Comment:	N/A

Data Unit / Parameter:	a
Data unit:	ha yr-1
Description:	Estimated intercept of the regression line
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 4a,
Any Comment:	N/A

Data Unit / Parameter:	a1 and a2
Data unit:	ha
Description:	sample plot areas
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-5
Any Comment:	N/A

Data Unit / Parameter:	Aaveragei
Data unit:	ha
Description:	Area of "average" forest land suitable for conversion to non-forest land within stratum
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 6
Any Comment:	N/A

Data Unit / Parameter:	ABSLLK

Data unit:	ha
Description:	Cumulative area of baseline deforestation within the leakage belt at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 9c, Table 11c, Table 13c, Table 14c, Table 19c
Any Comment:	N/A

Data Unit / Parameter:	$ABSLLK_{ct,t}$
Data unit:	ha
Description:	Area of category ct deforested at time t within the leakage belt in the baseline case
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	measured or estimated from literature
Any Comment:	N/A

Data Unit / Parameter:	$ABSLLK_{fcl,t}$
Data unit:	ha
Description:	Area of final (post-deforestation) forest class fcl deforested at time t within the leakage belt in the baseline case
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	calculated
Any Comment:	N/A

Data Unit / Parameter:	ABSLLKi,t
Data unit:	ha
Description:	Annual area of baseline deforestation in stratum i within the leakage belt at year t;
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 9.c
Any Comment:	N/A

Data Unit / Parameter:	ABSLLKicl,t
Data unit:	ha
Description:	Area of initial (pre-deforestation) forest class icl deforested at time t within the leakage belt in the baseline case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 30a
Any Comment:	N/A

Data Unit / Parameter:	ABSLLKt
Data unit:	ha
Description:	Annual area of baseline deforestation within the leakage belt at year t;
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 9c, Table 11c, Table 13c, Table 14c, Table 19c
Any Comment:	N/A

Data Unit / Parameter:	ABSLPA
Data unit:	ha
Description:	Cumulative area of baseline deforestation in the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table M
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 9b, Table 11b, Table 13b, Table 14b, Table 19b
Any Comment:	

Data Unit / Parameter:	ABSLPAct,t
Data unit:	ha
Description:	Area of category ct deforested at time t within the project area in the baseline case
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table AE
Monitoring equipment:	
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in

	question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 22b1
Any Comment:	

Data Unit / Parameter:	ABSLPAct,t
Data unit:	ha
Description:	Area of category ct deforested at time t within the project area in the baseline case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table AE
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 22.b.1
Any Comment:	

Data Unit / Parameter:	ABSLPAi,t
Data unit:	ha
Description:	Annual area of baseline deforestation in stratum i within the project area at year t;
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table I
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical

	experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 9b
Any Comment:	

Data Unit / Parameter:	ABSLPAicl,t
Data unit:	ha
Description:	Area of initial (pre-deforestation) forest class icl deforested at time t within the project area in the baseline case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 10
Any Comment:	N/A

Data Unit / Parameter:	ABSLPAt
Data unit:	ha
Description:	Annual area of baseline deforestation in the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table I
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders.

	Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 9b, Table 11b, Table 13b, Table 14b, Table 19b
Any Comment:	

Data Unit / Parameter:	ABSLPAz,t
Data unit:	ha
Description:	Area of the zone z "deforested" at time t within the project area in the baseline case; ha
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 10
Any Comment:	N/A

Data Unit / Parameter:	ABSLRR
Data unit:	ha
Description:	cumulative area of baseline deforestation in the reference region at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table L
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and

	certification will be archived and made available to auditors.
Calculation method:	See Table 9.a, Table 11a, Table 13a, Table 14a, Table 19a
Any Comment:	

Data Unit / Parameter:	ABSLRRct,t
Data unit:	ha
Description:	Area of category ct deforested at time t within the reference region in the baseline case
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 22.a.1
Any Comment:	N/A

Data Unit / Parameter:	ABSLRRi,t
Data unit:	ha
Description:	Annual area of baseline deforestation in stratum i within the reference region at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table H
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations 3, 4a, 4b, 4c, 5, 6, 7, 8a, 8b, 8c,
Any Comment:	

Data Unit / Parameter:	ABSLRRt
Data unit:	ha
Description:	Annual area of baseline deforestation in the reference region at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table L
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 9.a, Table 11a, Table 13a, Table 14a, Table 19a
Any Comment:	

Data Unit / Parameter:	ABSLRRtaverage,i
Data unit:	ha
Description:	Annual area of baseline deforestation in stratum i within the Reference region at a year taveragei
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of Fixed Baseline Period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 7
Any Comment:	N/A

Data Unit / Parameter:	Aforaget
Data unit:	ha

Description:	Area under forage above the baseline in leakage management areas
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 32
Any Comment:	N/A

Data Unit / Parameter:	Aoptimali
Data unit:	ha
Description:	Area of "optimal" forest land suitable for conversion to non-forest land within stratum i
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 5
Any Comment:	N/A

Data Unit / Parameter:	AP
Data unit:	m2
Description:	Plot area
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	See section 5.3.5.1 of the Project Description
Monitoring equipment:	30 meter tape, GPS, clinometer, notebooks, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in

	question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations A3-13
Any Comment:	Varies depending on carbon pool measured and LULC type

Data Unit / Parameter:	APDPAicl,t
Data unit:	ha
Description:	Areas of planned deforestation in forest class icl at year t in the project area
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 25a
Any Comment:	N/A

Data Unit / Parameter:	APFPA icl,t
Data unit:	ha
Description:	Annual area of planned fuel-wood and charcoal activities in forest class icl at year t in the project area
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 25, Table 26c
Any Comment:	N/A

Data Unit / Parameter:	APLPAicl,t
Data unit:	ha
Description:	Areas of planned logging activities in forest class icl at year t in the project area
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 25b, Table 26b
Any Comment:	N/A

Data Unit / Parameter:	APNiPAicl,t
Data unit:	ha
Description:	Annual area of forest class icl with increasing carbon stock without harvest at year t in the project area
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 26a
Any Comment:	N/A

Data Unit / Parameter:	APSLKfcl,t
Data unit:	ha
Description:	Annual area of class fcl with decreasing carbon stock in leakage management areas in the project case at year t
Source of data:	measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 30b
Any Comment:	N/A

Data Unit / Parameter:	ARRi
Data unit:	ha
Description:	Total forest area in stratum i within the reference region at the project start date
Source of data:	measured or estimated from literature

Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 4.b, 8.c
Any Comment:	N/A

Data Unit / Parameter:	ARRi,t-1
Data unit:	ha
Description:	Area with forest cover in stratum i within the reference region a year t-1
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 3
Any Comment:	N/A

Data Unit / Parameter:	AUFPAicl,t
Data unit:	ha
Description:	Areas affected by forest fires in class icl in which carbon stock recovery occurs at year t
Source of data:	measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 25e, Table 26e
Any Comment:	N/A

Data Unit / Parameter:	B
Data unit:	ha
Description:	Area correct due to observed change predicted as change
Source of data:	measured or estimated from literature
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 9
Any Comment:	N/A

Data Unit / Parameter:	b
Data unit:	dimensionless
Description:	Estimated coefficient of the time variable (or slope of the linear regression)
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 4.a, 7, 8.a, 8.b
Any Comment:	N/A

Data Unit / Parameter:	BCEF
Data unit:	dimensionless
Description:	Biomass conversion and expansion factor for conversion of merchantable volume to total aboveground tree biomass
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-9, A3-36
Any Comment:	N/A

Data Unit / Parameter:	BEFpl
Data unit:	dimensionless
Description:	Biomass expansion factor for converting volumes of extracted round wood to total above-ground biomass (including bark), applicable to tree tr, in plot pl

Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-21
Any Comment:	N/A

Data Unit / Parameter:	BLDA, BLDB, … BLDN
Data unit:	ha
Description:	Total area of projected baseline deforestation during the fixed baseline period of Project A
Source of data:	PD of project A; PD of project B, … PD of Project N;
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 2.a, 2.b, 2.n
Any Comment:	N/A

Data Unit / Parameter:	C
Data unit:	ha
Description:	Area of error due to observed persistence predicted as change
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 9
Any Comment:	N/A

Data Unit / Parameter:	Cabcl
Data unit:	t CO2e ha-1
Description:	Average carbon stock per hectare in the above-ground biomass carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature

Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-6, A3-14,A3-36
Any Comment:	N/A

Data Unit / Parameter:	Cabfcl
Data unit:	t CO2e ha-1
Description:	Average carbon stock per hectare in the above-ground biomass carbon pool of final post-deforestation class fcl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	See Accounting Model, PD Template, Tables X, Y, Z, AA, AB, AC, AD
Monitoring equipment:	GPS, compass, clinometer, notebooks, water, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 16, Table 17
Any Comment:	

Data Unit / Parameter:	Cabicl
Data unit:	t CO2e ha-1
Description:	Average carbon stock per hectare in the above-ground biomass carbon pool of initial forest class icl
Source of data:	measured or estimated from literature
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	Cabicl
Value applied:	See Accounting Model, PD Template, Table V
Monitoring equipment:	GPS, compass, clinometer, notebooks, water, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 15a, A3-38
Any Comment:	

Data Unit / Parameter:	Cabntcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the above-ground non-tree biomass carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-7, A3-24
Any Comment:	N/A

Data Unit / Parameter:	Cabtcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the above-ground tree biomass carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A

Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-7
Any Comment:	N/A

Data Unit / Parameter:	Cabz
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the above-ground biomass carbon pool per zone z
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 17
Any Comment:	N/A

Data Unit / Parameter:	Cacl
Data unit:	tCO2-eha-1
Description:	Average carbon stock per hectare in above-ground biomass in LU/LC class cl
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-14
Any Comment:	N/A

Data Unit / Parameter:	Cbbcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare below-ground biomass carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A

QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-6, A3-17
Any Comment:	N/A

Data Unit / Parameter:	Cbbfcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare below-ground biomass carbon pool of final post-deforestation class fcl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	See Accounting Model, PD Template, Tables X, Y, Z, AA, AB, AC, AD
Monitoring equipment:	GPS, compass, clinometer, notebooks, water, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 16, Table 17
Any Comment:	

Data Unit / Parameter:	Cbbicl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare below-ground biomass carbon pool of initial forest class icl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	See Accounting Model, PD Template, Table V
Monitoring equipment:	GPS, compass, clinometer, notebooks, water, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive

	is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 15
Any Comment:	

Data Unit / Parameter:	Cbbntcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare below-ground non-tree biomass carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-8
Any Comment:	N/A

Data Unit / Parameter:	Cbbtcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare below-ground tree biomass carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-8
Any Comment:	N/A

Data Unit / Parameter:	Cbbz

Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare below-ground tree biomass carbon pool per zone z
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 17
Any Comment:	N/A

Data Unit / Parameter:	Cdwcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the in the dead wood biomass carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-6, A3-25
Any Comment:	N/A

Data Unit / Parameter:	Cdwfcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the in the dead wood biomass carbon pool of final post-deforestation class fcl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	See Accounting Model, PD Template, Tables X, Y, Z, AA, AB, AC, AD
Monitoring equipment:	GPS, compass, clinometer, notebooks, water, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and

	signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 16, Table 17
Any Comment:	

Data Unit / Parameter:	Cdwicl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the in the dead wood biomass carbon pool of initial forest class icl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	See Accounting Model, PD Template, Table V
Monitoring equipment:	GPS, compass, clinometer, notebooks, water, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 15
Any Comment:	

Data Unit / Parameter:	Cdwz
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the in the dead wood biomass carbon pool per zone z
Source of data:	measured or estimated from literature
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 17
Any Comment:	N/A

Data Unit / Parameter:	CEp,icl
Data unit:	dimensionless
Description:	Average combustion efficiency of the carbon pool p in the forest class
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 14
Any Comment:	N/A

Data Unit / Parameter:	CFdc
Data unit:	tonnes C (tonne d. m.)-1
Description:	Carbon fraction of the density class dc
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-30
Any Comment:	N/A

Data Unit / Parameter:	CFj
Data unit:	tonnes C (tonne d. m.) -1
Description:	Carbon fraction for tree tr, of species, group of species or forest type j
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start

Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-11, A3-21, A3-24
Any Comment:	N/A

Data Unit / Parameter:	CFpl
Data unit:	tonnes C (tonne d. m.) -1
Description:	Carbon fraction of sample pl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-24
Any Comment:	N/A

Data Unit / Parameter:	Ci
Data unit:	
Description:	Cost to select and measure a plot of the LU/LC class cl
Source of data:	estimated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-3; A3-4
Any Comment:	N/A

Data Unit / Parameter:	cl
Data unit:	dimensionless
Description:	1, 2, 3 … Cl LU/LC classes
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A

Calculation method:	See equation A3-3
Any Comment:	N/A

Data Unit / Parameter:	Clcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the litter carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-6
Any Comment:	N/A

Data Unit / Parameter:	Cldwcl
Data unit:	t CO2-e
Description:	Average carbon stock per hectare in the lying dead wood carbon pool of the LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-25, A3-30
Any Comment:	N/A

Data Unit / Parameter:	Cldwfcl
Data unit:	t CO2-e
Description:	Average carbon stock per hectare in the lying dead wood carbon pool of final post-deforestation class fcl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	Cldwfcl
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A

Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	Cldwicl
Data unit:	t CO2-e
Description:	Average carbon stock per hectare in the lying dead wood carbon pool of initial forest class icl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	Clfcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the litter carbon pool of LU/LC class fcl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	See Accounting Model, PD Template, Tables X, Y, Z, AA, AB, AC, AD
Monitoring equipment:	GPS, compass, clinometer, notebooks, water, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 16, Table 17
Any Comment:	

Data Unit / Parameter:	Clicl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the litter carbon pool of LU/LC class icl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	See Accounting Model, PD Template, Table V
Monitoring equipment:	GPS, compass, clinometer, notebooks, water, writing utensils
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 15
Any Comment:	

Data Unit / Parameter:	Clz
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the litter carbon pool per zone z
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 17
Any Comment:	N/A

Data Unit / Parameter:	Cp
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the carbon

	pool p
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 7b
Any Comment:	N/A

Data Unit / Parameter:	$C_{p,icl,t}$
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the carbon pool p burnt at year t in the forest class icl;
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 14
Any Comment:	N/A

Data Unit / Parameter:	C_{sdwcl}
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the standing dead wood carbon pool of the LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-25
Any Comment:	N/A

Data Unit / Parameter:	C_{soccl}
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the soil organic carbon pool of LU/LC class cl

Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-6, A3-33
Any Comment:	N/A

Data Unit / Parameter:	Csocfcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the soil organic carbon pool of final post-deforestation class fcl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 16, table 17
Any Comment:	N/A

Data Unit / Parameter:	Csocicl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the soil organic carbon pool of initial forest class icl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 15
Any Comment:	N/A

Data Unit / Parameter:	Csocpl
Data unit:	t CO2-e ha-1
Description:	Carbon stock per hectare in the soil organic carbon pool estimated for the plot pl;

Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-33
Any Comment:	N/A

Data Unit / Parameter:	Csocz
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the soil organic carbon pool per zone z
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 17
Any Comment:	N/A

Data Unit / Parameter:	ct
Data unit:	dimensionless
Description:	1, 2, 3 … Ct categories of LU/LC change (from initial forest classes icl to final post-deforestation classes fcl)
Source of data:	each renewal of fixed baseline period
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	calculated
Any Comment:	N/A

Data Unit / Parameter:	Ctotcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in all accounted carbon pools of LU/LC class cl

Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-6
Any Comment:	N/A

Data Unit / Parameter:	Ctotfcl,t
Data unit:	CO2-e ha-1
Description:	Average carbon stock of all accounted carbon pools in non-forest class fcl at time t;
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 30b
Any Comment:	N/A

Data Unit / Parameter:	Ctoticl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock of all accounted carbon pools in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 15
Any Comment:	N/A

Data Unit / Parameter:	Ctoticl,t
Data unit:	t CO2-e ha-1
Description:	Average carbon stock of all accounted carbon pools in forest class icl at time t
Source of data:	calculated

Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 25a, Table 30a
Any Comment:	N/A

Data Unit / Parameter:	Ctotz
Data unit:	t CO2-e ha-1
Description:	Average carbon stock of all accounted carbon pools per zone z
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 17
Any Comment:	N/A

Data Unit / Parameter:	ctz
Data unit:	dimensionless
Description:	1, 2, 3 … Ctz categories of LU/LC change (from initial forest classes icl to post deforestation zones z)
Source of data:	each renewal of fixed baseline period
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	calculated
Any Comment:	N/A

Data Unit / Parameter:	CV%
Data unit:	%
Description:	The highest coefficient of variation (%) reported in the literature from different volume or biomass forest inventories in forest plantations, natural

	forests, agro-forestry and/or silvo-pastoral systems
Source of data:	literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-1, A3-5
Any Comment:	N/A

Data Unit / Parameter:	Cwpcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the harvested wood products carbon pool of LU/LC class cl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-6, A3-35, A3-37
Any Comment:	N/A

Data Unit / Parameter:	Cwpfcl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the harvested wood products carbon pool of final post-deforestation class fcl
Source of data:	only once at project start and when mandatory
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	See Accounting Model, PD Template, Tables X, Y, Z, AA, AB, AC, AD
Monitoring equipment:	
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders.

	Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 16, Table 17
Any Comment:	

Data Unit / Parameter:	Cwpicl
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the harvested wood products carbon pool of initial forest class icl
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	See Accounting Model, PD Template, Table V
Monitoring equipment:	
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	SeeTable 15, equations A3-35,A3-36, A3-37, A3-39, A3-40, A3-41
Any Comment:	

Data Unit / Parameter:	Cwplt,icl,t
Data unit:	
Description:	Carbon stock in the long-term wood products carbon pool at the time of deforestation t of the initial forest class icl
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	

Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-37, A3-41
Any Comment:	N/A

Data Unit / Parameter:	Cwpmt,icl,t
Data unit:	
Description:	Carbon stock in the medium-term wood products carbon pool at the time of deforestation t of the initial forest class icl
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-36, A3-40
Any Comment:	N/A

Data Unit / Parameter:	Cwpz
Data unit:	t CO2-e ha-1
Description:	Average carbon stock per hectare in the harvested wood products carbon pool per zone z
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 17
Any Comment:	N/A

Data Unit / Parameter:	CXBw,icl,t
Data unit:	t CO2-e ha-1
Description:	Mean carbon stock per hectare of extracted biomass carbon by class of wood product w from forest class icl at time t
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-34, A3-35, A3-39
Any Comment:	N/A

Data Unit / Parameter:	d1, d2, …, dn
Data unit:	cm
Description:	Diameters of intersecting pieces of dead wood
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-29
Any Comment:	N/A

Data Unit / Parameter:	DBH
Data unit:	cm
Description:	Diameter at Breast Height
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	See Forest Carbon Stock Inventory workbook
Monitoring equipment:	DBH tape
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation A3-18
Any Comment:	

Data Unit / Parameter:	DBI
Data unit:	kg d.m. head-1 day-1
Description:	Daily biomass intake
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A4-2, Table 31
Any Comment:	N/A

Data Unit / Parameter:	dc
Data unit:	dimensionless
Description:	1, 2, 3 dead wood density classes
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-30
Any Comment:	N/A

Data Unit / Parameter:	DC
Data unit:	dimensionless
Description:	Total number of density classes (3)
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-30
Any Comment:	N/A

Data Unit / Parameter:	Ddc
Data unit:	tonnes d. m. m-3
Description:	Dead wood density of class dc

Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-30
Any Comment:	N/A

Data Unit / Parameter:	Dj
Data unit:	t d.m.m-3
Description:	Mean wood density of species j
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-34
Any Comment:	N/A

Data Unit / Parameter:	DLF
Data unit:	%
Description:	Displacement Leakage Factor
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	0.163
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.

Calculation method:	
Any Comment:	

Data Unit / Parameter:	Dm
Data unit:	g cm-3
Description:	Deadwood density
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-28
Any Comment:	N/A

Data Unit / Parameter:	DMpl
Data unit:	tonnes of d.m.
Description:	Dry mass of sample pl;
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-24
Any Comment:	N/A

Data Unit / Parameter:	e
Data unit:	dimensionless
Description:	Euler number (2,71828)
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 4.b, 8.c
Any Comment:	N/A

Data Unit / Parameter:	E
Data unit:	%
Description:	allowable error (⬚10% of the mean)
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	See Uncertainty Estimates for Forest and Non-forest carbon stocks in carbon stock workbooks
Monitoring equipment:	
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation A3-3
Any Comment:	

Data Unit / Parameter:	E%
Data unit:	%
Description:	allowable sample error in percentage (⬚10%)
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-1
Any Comment:	N/A

Data Unit / Parameter:	EADLK
Data unit:	t CO2-e
Description:	Cumulative total increase in GHG emissions due to displaced forest fires
Source of data:	calculated
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 34, Table 35
Any Comment:	N/A

Data Unit / Parameter:	EADLKt
Data unit:	t CO2-e
Description:	Total ex ante increase in GHG emissions due to displaced forest fires at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 34, Table 35
Any Comment:	N/A

Data Unit / Parameter:	EBBBSLPAt
Data unit:	t CO2-e
Description:	Sum of (or total) baseline non-CO2 emissions from forest fire at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 19, Table 24, Table 36
Any Comment:	N/A

Data Unit / Parameter:	EBBBSLtoticl
Data unit:	t CO2-e
Description:	Sum of (or total) actual non-CO2 emissions from forest fire at year t in strata i in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 24
Any Comment:	N/A

Data Unit / Parameter:	EBBBSPA
Data unit:	t CO2-e
Description:	Cumulative baseline non-CO2 emissions from forest fire at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 17, 19, Table 24, Table 36
Any Comment:	N/A

Data Unit / Parameter:	EBBCH4icl
Data unit:	t CO2-e
Description:	CH4 emission from biomass burning in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 11, 13
Any Comment:	N/A

Data Unit / Parameter:	EBBCO2icl
Data unit:	t CO2-e ha-1
Description:	Per hectare CO2 emission from biomass burning in slash and burn in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start

Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 12, 13, 14
Any Comment:	N/A

Data Unit / Parameter:	EBBN2Oicl
Data unit:	t CO2-e
Description:	N2O emission from biomass burning in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 11, 12
Any Comment:	N/A

Data Unit / Parameter:	EBBPSPA
Data unit:	t CO2-e
Description:	Cumulative (or total) actual non-CO2 emissions from forest fire at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 28, Table 29, Table 36
Any Comment:	N/A

Data Unit / Parameter:	EBBPSPAt
Data unit:	t CO2-e
Description:	Sum of (or total) actual non-CO2 emissions from forest fire at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A

Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 17,19, Table 28, Table 29, Table 36
Any Comment:	N/A

Data Unit / Parameter:	EBBtoticl
Data unit:	t CO2-e
Description:	Total GHG emission from biomass burning in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 11
Any Comment:	N/A

Data Unit / Parameter:	ECH4fermt
Data unit:	t CO2-e
Description:	CH4 emissions from enteric fermentation at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 18, A4-1
Any Comment:	N/A

Data Unit / Parameter:	ECH4mant
Data unit:	t CO2-e
Description:	CH4 emissions from manure management at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 18, A4-3

Any Comment:	N/A

Data Unit / Parameter:	EdirN2Omant
Data unit:	t CO2-e
Description:	Direct N2O emissions from manure management at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A4-4, A4-5, Table 32
Any Comment:	N/A

Data Unit / Parameter:	EF1
Data unit:	kg CH4 head-1 yr-1
Description:	Enteric CH4 emission factor for the livestock group
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A4-1, Table 31
Any Comment:	N/A

Data Unit / Parameter:	EF2
Data unit:	kg CH4 head-1 yr-1
Description:	Manure management CH4 emission factor for the livestock group
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A4-3, Table 31
Any Comment:	N/A

Data Unit / Parameter:	EF3
Data unit:	kg N2O-N (kg N-1) head-1 yr-1
Description:	Emission factor for N2O emissions from manure management for the livestock group
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A4-5, Table 31
Any Comment:	N/A

Data Unit / Parameter:	EF4
Data unit:	kg N2O-N (kg NH3-N and NOx-N emitted)-1 head-1 yr-1
Description:	Emission factor for N2O emissions from atmospheric deposition of forage-sourced nitrogen on soils and water surfaces
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A4-6, Table 31
Any Comment:	N/A

Data Unit / Parameter:	EgLK
Data unit:	t CO2-e
Description:	Cumulative Emissions from grazing animals in leakage management areas at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 32, Table 33, Table 35
Any Comment:	N/A

Data Unit / Parameter:	EgLKt
Data unit:	t CO2-e
Description:	Emissions from grazing animals in leakage management areas at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 18, Table 32, Table 33, Table 35
Any Comment:	N/A

Data Unit / Parameter:	EI
Data unit:	%
Description:	Ex ante estimated Effectiveness Index
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	0.71
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 16
Any Comment:	

Data Unit / Parameter:	EindNOmant
Data unit:	t CO2-e
Description:	Indirect N2O emissions from manure management at year t

Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A4-4, A4-5
Any Comment:	N/A

Data Unit / Parameter:	ELK
Data unit:	t CO2-e
Description:	Cumulative sum of ex ante estimated leakage emissions at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template, Table AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 19, Table 35, Table 36
Any Comment:	

Data Unit / Parameter:	ELKt
Data unit:	t CO2-e
Description:	Sum of ex ante estimated leakage emissions at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template, Table AO

Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 19, Table 35, Table 36
Any Comment:	

Data Unit / Parameter:	ELPMLK
Data unit:	t CO2-e
Description:	Cumulative total ex increase in GHG emissions due to leakage prevention measures
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template, Table AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 33
Any Comment:	

Data Unit / Parameter:	ELPMLKt
Data unit:	t CO2-e
Description:	Annual total increase in GHG emissions due to

	leakage prevention measures at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template, Table AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 33
Any Comment:	

Data Unit / Parameter:	EN2Omant
Data unit:	t CO2-e
Description:	N2O emissions from manure management at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 18, A4-4, Table 32
Any Comment:	N/A

Data Unit / Parameter:	ERCH4
Data unit:	dimensionless
Description:	Emission ratio for CH4 (IPCC default value = 0.012)
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A

Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 13
Any Comment:	N/A

Data Unit / Parameter:	ERN2O
Data unit:	dimensionless
Description:	Emission ratio for N2O (IPCC default value = 0.007)
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 12
Any Comment:	N/A

Data Unit / Parameter:	f(t)
Data unit:	
Description:	A function of time
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 4.c
Any Comment:	N/A

Data Unit / Parameter:	Fburnticl
Data unit:	%
Description:	Proportion of forest area burned during the historical reference period in the forest class icl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 14, Table 23

Any Comment:	N/A

Data Unit / Parameter:	fcl
Data unit:	dimensionless
Description:	1, 2, 3 … Fcl final (post-deforestation) non-forest classes
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation
Any Comment:	N/A

Data Unit / Parameter:	fj(DBH,H)ab
Data unit:	A3-10
Description:	an allometric equation for species, or group of species, or forest type j, linking above-ground tree biomass (in kg tree-1) to diameter at breast height (DBH) and possibly tree height (H).
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation
Any Comment:	N/A

Data Unit / Parameter:	fj(DBH,H)V
Data unit:	
Description:	a commercial volume equation for species or species group j, linking commercial volume to diameter at breast height (DBH) and possibly tree height (H)
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A

Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-20
Any Comment:	N/A

Data Unit / Parameter:	Fracgas
Data unit:	kg NH3-N and NOx-N emitted (Kg N)-1
Description:	Fraction of managed livestock manure nitrogen that volatilizes as NH3 and NOx in the manure management phase
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See Table 31
Any Comment:	N/A

Data Unit / Parameter:	GWPCH4
Data unit:	dimensionless
Description:	Global Warming Potential for CH4 (IPCC default value = 21 for the first commitment period)
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 13
Any Comment:	N/A

Data Unit / Parameter:	GWPN2O
Data unit:	dimensionless
Description:	Global Warming Potential for N2O (IPCC default value = 310 for the first commitment period)
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A

Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 12
Any Comment:	N/A

Data Unit / Parameter:	H
Data unit:	meters
Description:	Height of the tree
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-27
Any Comment:	N/A

Data Unit / Parameter:	L
Data unit:	m
Description:	Length of the line
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-29
Any Comment:	N/A

Data Unit / Parameter:	LTFw
Data unit:	
Description:	Fraction of wood products that are considered permanent (i.e. carbon is stored for 100 years or more); it may be assumed no carbon is released
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A

Calculation method:	See equations A3-36, A3-40
Any Comment:	N/A

Data Unit / Parameter:	MTFw
Data unit:	
Description:	Fraction of wood products that are retired between 3 and 100 years
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-37, A3-41
Any Comment:	N/A

Data Unit / Parameter:	NCR
Data unit:	dimensionless
Description:	Nitrogen/Carbon ratio (IPCC default value = 0.01)
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 12
Any Comment:	N/A

Data Unit / Parameter:	Nex
Data unit:	kg N head-1 yr-1
Description:	Annual average N excretion per livestock head
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A4-6, Table 31
Any Comment:	N/A

Data Unit / Parameter:	ni
Data unit:	
Description:	Number of samples units to be measured in LU/LC class cl that is allocated proportional to the size of the class. If estimated ncl < 3, set ncl = 3
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-2
Any Comment:	N/A

Data Unit / Parameter:	Ni
Data unit:	
Description:	Maximum number of possible sample units for LU/LC class cl, calculated by dividing the area of class cl by the measurement plot area
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-2
Any Comment:	N/A

Data Unit / Parameter:	OFw
Data unit:	dimensionless
Description:	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-35, A3-37

Any Comment:	N/A

Data Unit / Parameter:	p
Data unit:	dimensionless
Description:	Carbon pool that could burn (above-ground biomass, dead wood, litter)
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 10
Any Comment:	N/A

Data Unit / Parameter:	Pburntp,icl
Data unit:	%
Description:	Average proportion of mass burnt in the carbon pool p in the forest class icl;
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 14
Any Comment:	N/A

Data Unit / Parameter:	PCabpl
Data unit:	tC ha-1
Description:	Carbon stock in above-ground biomass in plot pl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-13
Any Comment:	N/A

Data Unit / Parameter:	PCbbpl
Data unit:	tC ha-1
Description:	Carbon stock in below-ground biomass in plot pl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-16
Any Comment:	N/A

Data Unit / Parameter:	PCxi
Data unit:	$/t
Description:	Average in situ production costs for one ton of product Px in stratum i
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 1
Any Comment:	This variable may have different values within different strata of the reference region

Data Unit / Parameter:	Pforaget
Data unit:	kg d. m. yr-1
Description:	Production of forage at year t
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A4-2, Table 32
Any Comment:	N/A

Data Unit / Parameter:	Po

Data unit:	g
Description:	Anhydrous weight of sample
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-28
Any Comment:	N/A

Data Unit / Parameter:	Population$_t$
Data unit:	number of heads
Description:	Equivalent number of forage-fed livestock at year t
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A4-1, Table 32
Any Comment:	N/A

Data Unit / Parameter:	PP$_{i,t}$
Data unit:	%
Description:	Proportion of stratum i that is within the project area at time t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	PP$_{xl}$
Data unit:	$/t
Description:	Potential profitability of product Px at the location l (pixel or polygon)

Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 1
Any Comment:	N/A

Data Unit / Parameter:	Ps
Data unit:	g
Description:	Saturated weight of sample
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-28
Any Comment:	N/A

Data Unit / Parameter:	Px
Data unit:	dimensionless
Description:	Product x produced in the reference region
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 1
Any Comment:	N/A

Data Unit / Parameter:	r1
Data unit:	meters
Description:	Radius at the base of the tree
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory

Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-27
Any Comment:	N/A

Data Unit / Parameter:	r2
Data unit:	meters
Description:	Radius at the top of the tree
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-27
Any Comment:	N/A

Data Unit / Parameter:	RBSLRRi,t
Data unit:	%
Description:	Percentage of remaining forest area at year t -1 in stratum i to be deforested at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template, Table H
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 3
Any Comment:	Used as an alternative to ABSLRR i,t in baseline approach "c"

Data Unit / Parameter:	RFt
Data unit:	%
Description:	Risk factor used to calculate VCS buffer credits
Source of data:	estimated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, Ex Post Reporting Parameters
Monitoring equipment:	
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 21
Any Comment:	

Data Unit / Parameter:	Rj
Data unit:	dimensionless
Description:	Root-shoot ratio appropriate for species, group of species or forest type j
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-18
Any Comment:	N/A

Data Unit / Parameter:	Rj,pl,tr
Data unit:	dimensionless
Description:	Root-shoot ratio, applicable to tree tr of species j

	in plot pl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-22
Any Comment:	N/A

Data Unit / Parameter:	S$x
Data unit:	$/t
Description:	Selling price of product Px
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 1
Any Comment:	N/A

Data Unit / Parameter:	Scl
Data unit:	
Description:	standard deviation of LU/LC class cl
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-4
Any Comment:	N/A

Data Unit / Parameter:	SLFw
Data unit:	dimensionless
Description:	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest
Source of data:	measured or estimated from literature
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-35, A3-37
Any Comment:	N/A

Data Unit / Parameter:	SPxl
Data unit:	map
Description:	Selling point l of product Px
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 1
Any Comment:	N/A

Data Unit / Parameter:	STFw
Data unit:	
Description:	Fraction of wood products and waste that will be emitted to the atmosphere within 3 years; all carbon shall be assumed to be lost immediately; dimensionless
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-35, A3-37, A3-40, A3-41
Any Comment:	N/A

Data Unit / Parameter:	t
Data unit:	dimensionless
Description:	1, 2, 3 … T a year of the proposed project crediting period
Source of data:	defined
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See almost all equations
Any Comment:	N/A

Data Unit / Parameter:	t*
Data unit:	dimensionless
Description:	the year at which the area ABSLPAicl,t is deforested in the baseline case
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 10, A3-34
Any Comment:	N/A

Data Unit / Parameter:	t1
Data unit:	dimensionless
Description:	Start date of the historical reference period
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	t2
Data unit:	dimensionless
Description:	End date of the historical reference period
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A

Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	Taveragei
Data unit:	yr
Description:	Number of years in which Aaveragei is deforested in the baseline case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	taveragei
Data unit:	yr
Description:	Year at which Taveragei ends
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 6, 7
Any Comment:	N/A

Data Unit / Parameter:	TBabj
Data unit:	kg tree-1 or t tree-1
Description:	above-ground biomass of a tree of species, or species group, or forest type j
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A

Calculation method:	See equation A3-10
Any Comment:	N/A

Data Unit / Parameter:	TBabtr
Data unit:	kg tree-1 or t tree-1
Description:	Above-ground biomass of tree tr
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-11, A3-13, A3-21
Any Comment:	N/A

Data Unit / Parameter:	TCabtr
Data unit:	kg C tree-1 or t C tree-1
Description:	Carbon stock in above-ground biomass of tree tr
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-11, A3-21
Any Comment:	N/A

Data Unit / Parameter:	TCbbtr
Data unit:	kg C tree-1
Description:	Carbon stock in below-ground biomass of tree tr
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-16, A3-22
Any Comment:	N/A

Data Unit / Parameter:	TCv
Data unit:	$/t/km
Description:	Average Transport Cost per kilometer for one ton of product Px on land, river or road of type v
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 1
Any Comment:	N/A

Data Unit / Parameter:	TDv
Data unit:	$/t/km
Description:	Transport Distance on land, river or road of type v
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 1
Any Comment:	N/A

Data Unit / Parameter:	Thrp
Data unit:	yr
Description:	Duration of the historical reference period
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	Toptimali
Data unit:	yr
Description:	Number of years since the start of the AUD project

	activity in which Aoptimal in stratum i is deforested in the baseline case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	toptimali
Data unit:	yr
Description:	Year at which Toptimali ends
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations 5, 6
Any Comment:	N/A

Data Unit / Parameter:	tr
Data unit:	dimensionless
Description:	1, 2, 3, … TRpl number of trees in plot pl
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-13
Any Comment:	N/A

Data Unit / Parameter:	tst
Data unit:	dimensionless
Description:	t-student value for a 95% confidence level (initial value t = 2)
Source of data:	

Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	tst
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-1
Any Comment:	N/A

Data Unit / Parameter:	Tsub-optimali
Data unit:	yr
Description:	Number of years in which Asub-optimali is deforested in the baseline case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	v
Data unit:	dimensionless
Description:	1,2,3, …V type of surface on which transport occurs
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 1
Any Comment:	N/A

Data Unit / Parameter:	V1i,t; V2i,t; …;Vni,t
Data unit:	
Description:	Variables included in a deforestation model
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 8
Any Comment:	Unit of each variable to be specified by the project proponent

Data Unit / Parameter:	VBCt
Data unit:	t CO2-e
Description:	Number of Buffer Credits deposited in the VCS Buffer at time t;
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations 20, 21, Table 36
Any Comment:	

Data Unit / Parameter:	VCUt
Data unit:	t CO2-e
Description:	Number of Verified Carbon Units (VCUs) to be made available for trade at time t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive

	is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 20,Table 36
Any Comment:	

Data Unit / Parameter:	VEF
Data unit:	dimensionless
Description:	Volume Expansion Factor
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-9
Any Comment:	N/A

Data Unit / Parameter:	VEXw,j,fcl,t
Data unit:	m3
Description:	Volume of timber for product class w, of species j, extracted from within forest class fcl at time t
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-34
Any Comment:	N/A

Data Unit / Parameter:	VOB10
Data unit:	m3

Description:	Volume Over Bark above 10 cm DBH
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-9
Any Comment:	N/A

Data Unit / Parameter:	VOB30
Data unit:	m3
Description:	Volume Over Bark above 30 cm DBH
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-9
Any Comment:	N/A

Data Unit / Parameter:	Volumedc
Data unit:	m3
Description:	Volume of lying dead wood in the density class dc
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-30
Any Comment:	N/A

Data Unit / Parameter:	Vpl
Data unit:	m3 plot-1
Description:	Commercial volume of plot pl
Source of data:	
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-19
Any Comment:	N/A

Data Unit / Parameter:	Vtr
Data unit:	m3
Description:	Commercial volume of tree tr
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-18, A3-21
Any Comment:	N/A

Data Unit / Parameter:	w
Data unit:	dimensionless
Description:	1, 2, 3 … W Wood product class (sawn-wood, wood-based panels, other industrial round-wood, paper and paper board, and other);
Source of data:	defined
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-34
Any Comment:	N/A

Data Unit / Parameter:	Wcl
Data unit:	
Description:	Ncl/N
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A

Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation A3-4
Any Comment:	N/A

Data Unit / Parameter:	WWw
Data unit:	dimensionless
Description:	Wood waste for wood product class w. The fraction immediately emitted through mill inefficiency
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-35, A3-37
Any Comment:	N/A

Data Unit / Parameter:	XF
Data unit:	dimensionless
Description:	Plot expansion factor from per plot values to per hectare values
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equations A3-12, A3-13, A3-16, A3-19, A3-20, A3-24
Any Comment:	N/A

Data Unit / Parameter:	z
Data unit:	
Description:	1, 2, 3, … Z post deforestation zones having a characteristic mixture of final post-deforestation classes (fcl)
Source of data:	
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	N/A

Data Unit / Parameter:	ΔCabBSLLKt
Data unit:	t CO2-e
Description:	Total baseline carbon stock changes for the above-ground biomass pool in the leakage belt
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AI
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 22.c.1
Any Comment:	

Data Unit / Parameter:	ΔCabBSLLKt
Data unit:	t CO2-e
Description:	Cumuativel baseline carbon stock changes for the above-ground biomass pool in the leakage belt
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AI
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical

	experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 22.c.1
Any Comment:	

Data Unit / Parameter:	ΔCabBSLPA
Data unit:	t CO2-e
Description:	Cumulative baseline carbon stock changes for the above-ground biomass pool in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AE
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 22.b.1
Any Comment:	

Data Unit / Parameter:	ΔCabBSLPAt
Data unit:	t CO2-e
Description:	Total baseline carbon stock changes for the above-ground biomass pool in the project area
Source of data:	calculated
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AE
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 22.b.1
Any Comment:	

Data Unit / Parameter:	ΔCabBSLRR
Data unit:	t CO2-e
Description:	Cumulative baseline carbon stock changes for the above-ground biomass pool in the reference region
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 22.a.1
Any Comment:	

Data Unit / Parameter:	ΔCabBSLRRt
Data unit:	t CO2-e
Description:	Total baseline carbon stock changes for the above-ground biomass pool in the reference region
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	NA
Monitoring equipment:	NA

QA/QC procedures to be applied:	NA
Calculation method:	See Table 22.a.1
Any Comment:	

Data Unit / Parameter:	ΔCabct
Data unit:	t CO2-e ha-1
Description:	Average carbon stock change factor in the above-ground biomass carbon pool of category ct
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 22.a.1
Any Comment:	

Data Unit / Parameter:	ΔCADLK
Data unit:	t CO2-e
Description:	Cumulative total decrease in carbon stocks due to displaced deforestation
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Tables AN and AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 34, Table 35
Any Comment:	

Data Unit / Parameter:	ΔCADLKt
Data unit:	t CO2-e
Description:	Total decrease in carbon stocks due to displaced deforestation at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Tables AN and AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 34, Table 35
Any Comment:	

Data Unit / Parameter:	ΔCbbct
Data unit:	t CO2-e ha-1
Description:	Average carbon stock change factor in the below-ground biomass carbon pool of category ct
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCBSLLK
Data unit:	t CO2-e
Description:	Cumulative carbon stock changes in leakage

	management areas in the baseline case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, MR Template Table BG
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 21d, Table 30a, Table 30c
Any Comment:	

Data Unit / Parameter:	$\Delta CBSLLKt$
Data unit:	t CO2-e
Description:	Annual carbon stock changes in leakage management areas in the baseline case at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, MR Template Table BG
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 21d, Table 30a, Table 30c

Any Comment:	

Data Unit / Parameter:	ΔCBSLPA
Data unit:	t CO2-e
Description:	Total baseline carbon stock changes in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 36
Any Comment:	

Data Unit / Parameter:	ΔCBSLPA
Data unit:	t CO2-e
Description:	Total net cumulative baseline carbon stock change in final classes within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by

	explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 10
Any Comment:	

Data Unit / Parameter:	ΔCBSLPAf
Data unit:	t CO2-e
Description:	Total cumulative baseline carbon stock change in final classes within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCBSLPAft
Data unit:	t CO2-e
Description:	Total baseline carbon stock change in final classes within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive

	is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCBSLPAft
Data unit:	t CO2-e
Description:	Total annual baseline carbon stock change in final classes within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCBSLPAi
Data unit:	t CO2-e
Description:	Total cumulative baseline carbon stock change in initial forest classes within the project area at year t

Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCBSLPAit
Data unit:	t CO2-e
Description:	Total baseline carbon stock change in initial forest classes within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCBSLPAt
Data unit:	t CO2-e
Description:	Total baseline carbon stock change within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations 19, 21, Table 36
Any Comment:	

Data Unit / Parameter:	ΔCBSLt
Data unit:	tCO2-e
Description:	Total baseline carbon stock change at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in

	question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 16
Any Comment:	

Data Unit / Parameter:	ΔCdwct
Data unit:	t CO2-e ha-1
Description:	Average carbon stock change factor in the dead wood biomass carbon pool of category ct
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔClct
Data unit:	t CO2-e ha-1
Description:	Average carbon stock change factor in the litter carbon pool of category ct
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	See Accounting Model, PD Template
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical

	experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCLK
Data unit:	t CO2-e
Description:	Total cumulative decrease in carbon stocks within the leakage belt at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Tables AO and AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 35, Table 36
Any Comment:	

Data Unit / Parameter:	ΔCLKt
Data unit:	t CO2-e
Description:	Total decrease in carbon stocks within the leakage belt at year t
Source of data:	calculated

Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Tables AO and AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See 19,Table 35, Table 36
Any Comment:	

Data Unit / Parameter:	ΔCLPMLK
Data unit:	
Description:	Cumulative carbon stock decrease due to leakage prevention measures
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 30c, Table 33, Table 35
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCLPMLKt
Data unit:	
Description:	Carbon stock decrease due to leakage prevention measures at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 30c, Table 33, Table 35
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPAdPA
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to all planned activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in

	question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 25d, Table 27, Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPAdPAt
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to all planned activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 26d, Table 27, Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPAiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to all planned activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical

	experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 26d, Table 27, Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta CPAiPAt$
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to all planned activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25a
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta CPDdPA$
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to planned deforestation at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25a
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta CPDdPAt$
Data unit:	t CO2-e

Description:	Total decrease in carbon stock due to planned deforestation at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25c, Table 25d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPFdPA
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to planned fuel-wood and charcoal activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPFdPAt
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to planned fuel-wood and charcoal activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25c, Table 25d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPFiPA

Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to planned fuel-wood and charcoal activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26c, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta CPFiPAt$
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to planned fuel-wood and charcoal activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26c, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta Cpicl, t=t*$
Data unit:	$tCO_2\text{-}e\ ha^{-1}$
Description:	Average carbon stock change factor for carbon pool p in the initial forest class icl applicable at time t
Source of data:	
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 10
Any Comment:	N/A

Data Unit / Parameter:	$\Delta CPLdPA$
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to planned logging activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25b, Table 25d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta CPLdPAt$
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to planned logging activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25b, Table 25d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta CPLiPA$
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to planned logging activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26b, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPLiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to planned logging activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26b, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPNiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to planned protection of growing forest classes in the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26a, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPNiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to planned protection of growing forest classes in the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26a, Table 26d

Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPSLK
Data unit:	t CO2-e
Description:	Total cumulative carbon stock change in leakage management areas in the project case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 30b, Table 30c
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPSLKt
Data unit:	t CO2-e
Description:	Total annual carbon stock change in leakage management areas in the project case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 30b, Table 30c
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPSPA
Data unit:	t CO2-e
Description:	Cumulative project carbon stock change within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation,

	verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 27, Table 29, Table 36
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPSPAt
Data unit:	t CO2-e
Description:	Total project carbon stock change within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See 19, 21, Table 27, Table 29, Table 36
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCpt
Data unit:	t CO2-e
Description:	Carbon stock change factor applicable to pool p at time t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	each renewal of fixed baseline period
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 25d, Table 27, Table 29
Any Comment:	

Data Unit / Parameter:	$\Delta C_{pz,t=t*}$
Data unit:	tCO_2-e ha-1
Description:	Average carbon stock change factor for carbon pool p in zone z applicable at time t = t*
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of tha baseline
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	See equation 10
Any Comment:	N/A

Data Unit / Parameter:	ΔC_{socct}
Data unit:	$t\ CO_2$-e ha-1
Description:	Average carbon stock change factor in the soil organic carbon pool of category ct
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	

Any Comment:	

Data Unit / Parameter:	ΔCtotct
Data unit:	t CO2-e ha-1
Description:	Average carbon stock change factor in all accounted carbon pools of category ct
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCtotct,t
Data unit:	t CO2-e ha-1
Description:	Carbon stock change factor (also called emission factor) for all accounted carbon pools in category ct at time t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔCtoticl,t
Data unit:	t CO2-e ha-1
Description:	Average carbon stock change of all accounted carbon pools in forest class icl at time t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	each renewal of tha baseline
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25b, Table 25c, Table 25e, Table 25f,

	Table 26a, Table 26b, Table 26c, Table 26e, Table 26f
Any Comment:	

Data Unit / Parameter:	ΔCUDdPA
Data unit:	t CO2-e
Description:	Cumulative actual carbon stock change due to unavoided unplanned deforestation at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 27, Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCUDdPAt
Data unit:	t CO2-e
Description:	Total actual carbon stock change due to unavoided unplanned deforestation at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation,

	verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See 16,Table 27 Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCwpct
Data unit:	t CO2-e ha-1
Description:	Average carbon stock change factor in the harvested wood products carbon pool of category ct
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	only once at project start and when mandatory
Value applied:	NA
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	
Any Comment:	

Data Unit / Parameter:	ΔREDD
Data unit:	t CO2-e
Description:	Cumulative met anthropogenic greenhouse gas emission reduction attributable to the AUD project activity
Source of data:	calculated

Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 21
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔREDDt
Data unit:	t CO2-e
Description:	Net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations 19, 20, 23, Table 36
Any Comment:	ex ante and ex post

8.3 DATA AND PARAMETERS MONITORED (CL4, CM4 & B4)

8.3.1 CLIMATE MONITORING (CL4)

Data Unit / Parameter:	$APDPA_{icl,t}$
Data unit:	ha
Description:	Areas of planned deforestation in forest class icl at year t in the project area
Source of data:	measured or estimated from literature
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25a
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$APFPA_{icl,t}$
Data unit:	ha
Description:	Annual area of planned fuel-wood and charcoal activities in forest class icl at year t in the project area
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25, Table 26c
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$APLPA_{icl,t}$
Data unit:	ha
Description:	Areas of planned logging activities in forest class icl at year t in the project area
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA

QA/QC procedures to be applied:	NA
Calculation method:	See Table 25b, Table 26b
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$APNiPAicl,t$
Data unit:	ha
Description:	Annual area of forest class icl with increasing carbon stock without harvest at year t in the project area
Source of data:	calculated ex ante, measured ex post
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26a
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$CUCdPAt$
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to catastrophic events at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25f, Table 25g
Any Comment:	ex post

Data Unit / Parameter:	EADLK
Data unit:	t CO2-e
Description:	Cumulative total increase in GHG emissions due to displaced forest fires
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Tables AN and AO

Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 34, Table 35
Any Comment:	ex ante and ex post

Data Unit / Parameter:	EADLKt
Data unit:	t CO2-e
Description:	Total ex ante increase in GHG emissions due to displaced forest fires at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Tables AN and AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 34, Table 35
Any Comment:	ex ante and ex post

Data Unit / Parameter:	EBBBSLPAt
Data unit:	t CO2-e

Description:	Sum of (or total) baseline non-CO2 emissions from forest fire at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equation 19, Table 24, Table 36
Any Comment:	ex ante and ex post

Data Unit / Parameter:	EBBBSLtoticl
Data unit:	t CO2-e
Description:	Sum of (or total) actual non-CO2 emissions from forest fire at year t in strata i in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 24
Any Comment:	ex ante and ex post

Data Unit / Parameter:	EBBBSPA
Data unit:	t CO2-e
Description:	Cumulative baseline non-CO2 emissions from forest fire at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations 17, 19, Table 24, Table 36
Any Comment:	ex ante and ex post

Data Unit / Parameter:	EBBCH4icl
Data unit:	t CO2-e
Description:	CH4 emission from biomass burning in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See equations 11, 13
Any Comment:	ex ante and ex post

Data Unit / Parameter:	EBBN2Oicl
Data unit:	t CO2-e
Description:	N2O emission from biomass burning in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See equations 11, 12

Any Comment:	ex ante and ex post

Data Unit / Parameter:	EBBPSPA
Data unit:	t CO2-e
Description:	Cumulative (or total) actual non-CO2 emissions from forest fire at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 28, Table 29, Table 36
Any Comment:	ex ante and ex post

Data Unit / Parameter:	EBBPSPAt
Data unit:	t CO2-e
Description:	Sum of (or total) actual non-CO2 emissions from forest fire at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by

	explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations 17,19, Table 28, Table 29, Table 36
Any Comment:	ex ante and ex post

Data Unit / Parameter:	EBBtoticl
Data unit:	t CO2-e
Description:	Total GHG emission from biomass burning in forest class icl
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See equation 11
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCFCdPA
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to forest fires and catastrophic events at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	CFCdPA
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to

	auditors.
Calculation method:	See Table 25g, Table 27
Any Comment:	ex post

Data Unit / Parameter:	ΔCFCdPAt
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to forest fires and catastrophic events at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 25g, Table 27
Any Comment:	ex post

Data Unit / Parameter:	ΔCFCiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to forest fires and catastrophic events at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation,

	verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 26g, Table 27
Any Comment:	ex post

Data Unit / Parameter:	ΔCFCiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to forest fires and catastrophic events at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 26g, Table 27
Any Comment:	ex post

Data Unit / Parameter:	ΔCLPMLK
Data unit:	
Description:	Cumulative carbon stock decrease due to leakage prevention measures
Source of data:	calculated
Description of measurement methods and	

procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 30c, Table 33, Table 35
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCLPMLKt
Data unit:	
Description:	Carbon stock decrease due to leakage prevention measures at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AO
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 30c, Table 33, Table 35
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPAdPA
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to all planned activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 25d, Table 27, Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPAdPAt
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to all planned activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and

	certification will be archived and made available to auditors.
Calculation method:	See Table 26d, Table 27, Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPAiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to all planned activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 26d, Table 27, Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPAiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to all planned activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25a
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPDdPA
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to planned deforestation at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25a
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPDdPAt
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to planned deforestation at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25c, Table 25d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPFdPA
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to planned fuel-wood and charcoal activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPFdPAt
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to planned fuel-wood and charcoal activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25c, Table 25d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPFiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to planned fuel-wood and charcoal activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26c, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPFiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to planned fuel-wood and charcoal activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26c, Table 26d

Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPLdPA
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to planned logging activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25b, Table 25d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPLdPAt
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to planned logging activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25b, Table 25d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPLiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to planned logging activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA

Calculation method:	See Table 26b, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPLiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to planned logging activities at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26b, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPNiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock due to planned protection of growing forest classes in the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26a, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPNiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock due to planned protection of growing forest classes in the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA

QA/QC procedures to be applied:	NA
Calculation method:	See Table 26a, Table 26d
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPSLK
Data unit:	t CO2-e
Description:	Total cumulative carbon stock change in leakage management areas in the project case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 30b, Table 30c
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPSLKt
Data unit:	t CO2-e
Description:	Total annual carbon stock change in leakage management areas in the project case
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 30b, Table 30c
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCPSPA
Data unit:	t CO2-e
Description:	Cumulative project carbon stock change within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Tables AM and AP
Monitoring equipment:	GIS software, Landsat imagery

QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 27, Table 29, Table 36
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta CPSPАt$
Data unit:	t CO2-e
Description:	Total project carbon stock change within the project area at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Tables AM and AP
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations 19, 21, Table 27, Table 29, Table 36
Any Comment:	ex ante and ex post

Data Unit / Parameter:	$\Delta CUCdPA$
Data unit:	t CO2-e
Description:	Cumulative decrease in carbon stock due to

	catastrophic events at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25f, Table 25g
Any Comment:	ex post

Data Unit / Parameter:	ΔCUCiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock in areas affected by catastrophic events (after such events) at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	Na
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26f, Table 26g
Any Comment:	ex post

Data Unit / Parameter:	ΔCUCiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock in areas affected by catastrophic events (after such events) at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	Na
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26f, Table 26g
Any Comment:	ex post

Data Unit / Parameter:	ΔCUDdPA
Data unit:	t CO2-e

Description:	Cumulative actual carbon stock change due to unavoided unplanned deforestation at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See Table 27, Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCUDdPAt
Data unit:	t CO2-e
Description:	Total actual carbon stock change due to unavoided unplanned deforestation at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, PD Template Table AM
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and

	certification will be archived and made available to auditors.
Calculation method:	See equation 16,Table 27 Table 29
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔCUFdPA
Data unit:	t CO2-e
Description:	Cumulative otal decrease in carbon stock due to unplanned (and planned – where applicable) forest fires in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25e, Table 25g
Any Comment:	ex post

Data Unit / Parameter:	ΔCUFdPAt
Data unit:	t CO2-e
Description:	Total decrease in carbon stock due to unplanned (and planned – where applicable) forest fires at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 25e, Table 25g
Any Comment:	ex post

Data Unit / Parameter:	ΔCUFiPA
Data unit:	t CO2-e
Description:	Cumulative increase in carbon stock in areas affected by forest fires (after such events) in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	

Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26e, Table 26g
Any Comment:	ex post

Data Unit / Parameter:	ΔCUFiPAt
Data unit:	t CO2-e
Description:	Total increase in carbon stock in areas affected by forest fires (after such events) at year t in the project area
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	NA
Monitoring equipment:	NA
QA/QC procedures to be applied:	NA
Calculation method:	See Table 26e, Table 26g
Any Comment:	ex post

Data Unit / Parameter:	ΔREDD
Data unit:	t CO2-e
Description:	Cumulative met anthropogenic greenhouse gas emission reduction attributable to the AUD project activity
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, MR Template Table BJ
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to

	auditors.
Calculation method:	See equation 21
Any Comment:	ex ante and ex post

Data Unit / Parameter:	ΔREDDt
Data unit:	t CO2-e
Description:	Net anthropogenic greenhouse gas emission reduction attributable to the AUD project activity at year t
Source of data:	calculated
Description of measurement methods and procedures to be applied:	
Frequency of monitoring/recording:	annually
Value applied:	See Accounting Model, MR Template Table BJ
Monitoring equipment:	GIS software, Landsat imagery
QA/QC procedures to be applied:	Data is to be entered into internal archive. Archive is accessed by qualified, authorized technical experts. All documents for monitoring, validation, verification and certification are reviewed and signed off by several team members. Data will be reported to project proponents and stakeholders. Discrepancies or disagreements will be justified by explanation or by visitation of the activities in question. All available satellite data for monitoring, validation, verification and certification will be archived and made available to auditors.
Calculation method:	See equations 19, 20, 23, Table 36
Any Comment:	ex ante and ex post

8.3.2 COMMUNITY MONITORING (CM4)

Project Activity Group	Number	Project Activity	Indicator	Frequency	Data Source/Reference
Resource Protection, Governance, and Monitoring	3	Registered land into PINFOR or PINPEP	# hectares of lands FUNDAECO helped to register with PINFOR/PINPEP	Annually	PINFOR/PINPEP database
Resource Protection, Governance,	12	Protection and management of community	# hectares of water source protected	Annually	conservation agreements, watershed

and Monitoring		water sources			protection database
Resource Protection, Governance, and Monitoring	14	Conflict resolution roundtable	# meetings participated in on roundtable	Annually	meeting records/reports/ minutes
Resource Protection, Governance, and Monitoring	14	Conflict resolution roundtable	Records of meetings	Annually	records
Sustainable Enterprises	25	FUNDAECO nurseries	# nurseries established	Annually	nurseries database
Sustainable Enterprises	27	Community nurseries	# nurseries established	Annually	nurseries database/nurseri es contracts
Sustainable Enterprises	30	Hire agroforestry promoters/techn ician from the project region	# agroforestry promotors hired from the project region	Annually	invoices/agreeme nts
Sustainable Enterprises	18	Creation of agroforestry plots	# farmers participating in agroforestry projects	Annually	agroforestry database
Sustainable Enterprises	22	Reforestation and Agroforestry PINFOR or PINPEP	# landowners participating in program	Annually	
Sustainable Enterprises	30	Hire agroforestry promoters from project region	# agroforestry promotors hired from project region	Annually	payrolls (planillas)
Sustainable Enterprises	27	Community nurseries	# community entrepeneurs	Annually	invoices/agreeme nts
Sustainable Enterprises	23	Construction of ecotourism sites	# of ecotourism sites established	Annually	ecotourism infraestrcuture investments inventory
Sustainable Enterprises		Support to women in sustainable enterprises productive projects	# of women supported	Annually	records
Sustainable Enterprises	22	Reforestation and Agroforestry PINFOR or PINPEP	$ per hectare of benefits for landowners in program	Annually	PINFOR/PINPEP databas
Community Empowerment	33	Legalized private and community	# hectares newly registered in both local	Annually	database for land legalization

& Inclusiveness		land	and national land registry		
Community Empowerment & Inclusiveness	39	Creation of health facilities: women clinics and communitary first-aid cabinets clinics	# of women clinics and communitary first-aid cabinets clinicsestablished	Annually	database for sexual and reproductive health services
Community Empowerment & Inclusiveness	39	coomunity management of of health facilities	# of health community commisions (community management bodies)	Annually	community health commisions minutes
Community Empowerment & Inclusiveness		Community participation in protected area management	# of communities particpating in second level associations and protected areas councils	Annually	CEL minutes
Community Empowerment & Inclusiveness	37	Engage fishermen in reef monitoring	# of community fishermen attended	Annually	monitoring reports
Community Empowerment & Inclusiveness	42	support to cultural religious activities	# of events supported	Annually	event minutes, pictures, etc
Community Empowerment & Inclusiveness	39	Creation and working of women health clinics	# of midwives engaged in the clinics	Annually	engagement inform consents (consetimientos informados)
Community Empowerment & Inclusiveness	42	Protection of sacred sites	# of patrols	Annually	Patrol reports
Community Empowerment & Inclusiveness	41	Supporting community-led nurseries	$funds from FUNDAECO going to support nuerseries	Annually	agreements (seed funding)
Education	45	Train community members on marine biodiversity and monitoring	# of community members attended	Annually	training reports
Education	47	Provision of health services	# of workshops held	Annually	workshops reports
Education	47	Provision of health services	# outreach events held within communities	Annually	event reports
Education	47	Provision of health services	# peer-to-peer health educators	Annually	volunteering agreements
Education	48	Training and workshops on agroforestry production and care	# farmers attended	Annually	logbook, sworkshops reports/participants lists
Education	55	Provide access to FUNDAECO agronomist	# of landowners/communities attended	Annually	logbooks

Education	56	Teaching new designs for handicrafts	# of people attended	Annually	workshop reports/participants lists
Education	56	Teaching new designs for handicrafts	# of workshops held	Annually	workshop reports/participants lists
Education	59	Training on how to manage a business (organizational skills)	# of people participated	Annually	workshop reports/participants lists
Education	59	Training on how to manage a business (organizational skills)	# of trainings held	Annually	workshop reports/participants lists
Education	62	General community training	# of people participated	Annually	workshop reports/participants lists
Education	62	General community training	# of trainings held	Annually	workshop reports/participants lists
Education	63	Training for ecotourism services	# of ecotourism vendors and ecotourism staff participated	Annually	workshop reports/participants lists
Education	63	Training for ecotourism services	# of trainings held	Annually	workshop reports/participants lists
Education	45	Train community members on marine biodiversity and monitoring	# of community members attended	Annually	training reports
Education	47	Provision of health services	# of workshops held	Annually	training report/participants lists
Education	47	Provision of health services	# outreach events held within communities	Annually	training report/participants lists
Education	47	Provision of health services	# peer-to-peer health educators	Annually	volunteering agreements
Education	48	Training and workshops on agroforestry production and care	# of people attended	Annually	training reports/participants list
Education	48	Training and workshops on agroforestry production and care	# of workshops held	Annually	training reports/participants list

Education	50	Environmental education for schools	# schools participating with FUNDAECO	Annually	event reports/participants list
Education	50	Environmental education for schools	# students visiting ecotourism centers	Annually	event reports/participants list
Education	51	Environmental education for interested communities	# workshops or events held	Annually	event reports/participants list
Education	56	Teaching new designs for handicrafts	# of people attended	Annually	training reports/participants list
Education	56	Teaching new designs for handicrafts	# of workshops held	Annually	training reports/participants list
Education	58	Training on ecotourism services	# people trained	Annually	training reports/participants list
Education	59	Training on how to manage a business (organizational skills)	# trainings held	Annually	training reports/participants list
Education	62	General community training	# trainings held	Annually	training reports/participants list
Improved Access to Resources	70	PINFOR or PINPEP payments	# families receiving PINFOR/PINPEP payments	Annually	PINFOR/PINPEP database
Improved Access to Resources	71	support to management plan implementation for PINFOR or PINPEP	# landowners FUNDAECO helped with management plans devised	Annually	PINPEP/PINFOR files with forestry regent
Improved Access to Resources	72	Legal services	# landowners/communities FUNDAECO assisted with legal services	Annually	denonciation records
Improved Access to Resources	73	Process and travel logisitics for land legalization	# landowners, individuals, communities FUNDAECO assisted with transportation and logistics for land legalization	Annually	activity report
Improved Access to Resources	76	Provision of health services	# of patients treated	Annually	sexual and reproductive health database
Improved Access to	76	Provision of health services	# of women using contraceptive methods	Annually	sexual and reproductive

Resources					health database
Improved Access to Resources	76	Provision of health services	# of communities with access to services	Annually	sexual and reproductive health database
Improved Access to Resources	78	Agroforestry stock for new and existing plots	# seedlings/plants provided for new plots	Annually	nurseries database
Improved Access to Resources	82	Nursery establishment	# nurseries established	Annually	nurseries contracts
Improved Access to Resources	83	Buy nursery stock from communities	# plants bought by FUNDAECO	Annually	nurseries contracts/invoices
Improved Access to Resources	84	Protection and management of community water sources	# hectares of water source protected	Annually	conservation agreements, patrol reports
Improved Access to Resources	86	Provide access to FUNDEACO agronomist	# of communities/landowners receiving access to agronomist	Annually	logbooks, agroforestry contracts

8.3.2 BIODIVERSITY MONITORING (B4)

Project Activity Group	Number	Project Activity	Indicator	Frequency	Data Source/Reference
Resource Protection, Governance, and Monitoring	1	Legalized private and community land	# hectares newly registered in both local and national land registry	Annually	land legalization database
Resource Protection, Governance, and Monitoring	3	Registered land into PINFOR or PINPEP	# hectares of lands FUNDAECO helped to register with PINFOR/PINPEP	Annually	PINFOR/PINPEP database
Resource Protection, Governance, and Monitoring	7	Engage fishermen to reef monitoring	# of workshops held	Annually	monitoring reports

Resource Protection, Governance, and Monitoring	7	Engage fishermen to reef monitoring	amount of coastline surveyed	Annually	monitoring reports
Resource Protection, Governance, and Monitoring	8	Implementation of fishing restriction zones	#of fishing restriction zones	Annually	community agreements/techn ical reports
Resource Protection, Governance, and Monitoring	9	Purchase land for protection	# of hectares purchased	Annually	land aquisition files
Resource Protection, Governance, and Monitoring	10	Manage protected areas	# of hectares managed, # of patrols	Annually	patrol reports, logbooks
Resource Protection, Governance, and Monitoring	11	Creation of protected areas	Records of FUNDAECO's input/assistance in creation of protected areas	Annually	meetings records
Resource Protection, Governance, and Monitoring	12	Protection and management of community water sources	# hectares of water source protected	Annually	conservation agreements, patrol reports, logbooks
Resource Protection, Governance, and Monitoring	13	Forest patrols	forest patrol logs including reports of any incidents requiring higher forms of enforcement (police, military, etc.)	Annually	patrol reports, logbooks
Resource Protection, Governance, and Monitoring	17	Environmental litigation and advocacy	# advocacy events attended/partici pated in	Annually	reports

Resource Protection, Governance, and Monitoring	17	Environmental litigation and advocacy	records of any litigation with FUNDAECO involvement	Annually	reports
Resource Protection, Governance, and Monitoring	38	Participate on CEL for protected areas	Records of CEL meetings	Annually	minutes
Community Empowerment & Inclusiveness	37	Engage fishermen in reef monitoring	# of community fishermen attended	Annually	monitoring reports
Education	43	Biodiversity Monitoring	# of monitoring events	Annually	logbooks, reports
Education	45	Engage community members on marine biodiversity and monitoring	# of community members attended	Annually	reports, participants lists
Education	45	Marine biodiversity monitoring	# of monitoring events	Annually	reports, participants lists
Education	46	Support university research on marine sciences	# of research expeditions conducted	Annually	reports, participants lists
Education	46	Support university research on marine sciences	# of students participating in research with FUNDAECO	Annually	reports, participants lists
Education	46	Support university research on marine sciences	types of research activities conducted	Annually	support letters, research reports
Education	50	Environmental education for schools	# schools participating with FUNDAECO	Annually	reports, participants lists
Education	50	Environmental education for schools	# students visiting ecotourism centers	Annually	reports, participants lists
Education	51	Environmental education for interested communities	# communities participating in environmental education opportunities	Annually	reports, participants lists
Education	51	Environmental education for interested	# workshops or educational events held	Annually	reports, participants lists

		communities			
Education	57	Ecotourism site establishment	# visitors	Annually	visitors records
Education	66	Train park guards to prevent transfer of amphibian fungus to amphibian conservation areas	# of guards trained	Annually	reports, participants lists
Education	66	Train park guards to prevent transfer of amphibian fungus to amphibian conservation areas	# of trainings held	Annually	reports, participants lists
Improved Access to Resources	84	Protection and management of community water sources	# hectares of water source protected	Annually	conservation agreements, patrol reports

9 REFERENCES

Calderón Quiñónez, A.P.
2013. Evaluación de Corredores para el Movimiento de Jaguares en el este de Guatemala. College of Environmental Science and Forestry. State University of New York. 22pp.

Calvo-González, Oscar
 2016   Economic Slowdown Puts the Brakes on Middle Class Growth in Latin America. Text. The Data Blog. http://blogs.worldbank.org/opendata/economic-slowdown-puts-brakes-middle-class-growth-latin-america, accessed June 29, 2016.

Cerezo et al. 2010. Landscape-level impact of tropical forest loss and fragmentation on bird occurrence in eastern Guatemala Ecological Modelling. 17pp

Cerezo, A., J.F. Hernández, C.S. Robbins, B. Dowelll, M. Ramírez, A. López, O. Javier, M. Barrientos, S.Ramírez, K. Mejía. 2013. Descripción de las comunidades de aves de bosque tropical del oriente deGuatemala, con comentarios para su conservación. Revista Mexicana de Biodiversidad.
En revisión

Consejo de Desarrollo del Municipio de Morales., Secretaría de Planificación y Programación de la Presidencia.

2010. Plan de Desarrollo Municipal de Morales, Izabal. Guatemala, SEGEPLAN/DPT, 2011 (SERIE PDM SEGEPLAN)

Consejo de Desarrollo del Municipio de Livingston., Secretaría de Planificación y Programación de la Presidencia.
2010. Plan de Desarrollo Municipal de Livingston, Izabal. Guatemala, SEGEPLAN/DPT, 2011 (SERIE PDM SEGEPLAN)

Consejo de Desarrollo Departamental de Izabal., Secretaría de Planificación y Programación de la Presidencia.
2011. Plan de Desarrollo Departamental de Izabal. Guatemala, SEGEPLAN 2011 (SERIE PDD, SEGEPLAN)

Consejo de Desarrollo del Municipio de Puerto Barrios., Secretaría de Planificación y Programación de la Presidencia.

2011. Plan de Desarrollo Municipal de Puerto Barrios, Izabal. Guatemala, SEGEPLAN/DPT, 2011 (SERIE PDM SEGEPLAN)

CONAP, FUNDAECO, TNC.
2006. Plan Maestro de la Reserva Protectora de Manatiales Cerro San Gil. guatemala

Consorcio para la Coadministración, la conservación de los recursos naturales y el desarrollo integral de los pueblos indígenas del Á rea Protegida —Área de Uso Múltiple Río Sarstún .
2009. Plan Maestro 2010-2014 Área de Uso Múltiple Río Sarstún. Guatemala. 140 p

FUNDAECO.
Informe de Evaluación Social para el Proyecto REDD+ del Caribe de Guatemala. Sin Publicar

FUNDAECO
Plan de Socialización Proyecto REDD+ Caribe de Guatemala. Sin Publicar.

FUNDACIÓN MARIO DARY RIVERA (FUNDARY), Consejo Nacional de Áreas Protegidas (CONAP), The Nature Conservancy (TNC).
2006. *Plan Maestro 2007-2011 Refugio De Vida Silvestre Punta De Manabique*. Guatemala. FUNDARY-PROARCA-TNC, p. 155

DeFries, Ruth S., Thomas Rudel, Maria Uriarte, and Matthew Hansen
 2010 Deforestation Driven by Urban Population Growth and Agricultural Trade in the Twenty-First Century. Nature Geoscience 3(3): 178–181.

Geist, Helmut J., and Eric F. Lambin
 2002 Proximate Causes and Underlying Driving Forces of Tropical Deforestation. BioScience 52(2): 143–150.

Global Economic Monitor (GEM) Commodities| World DataBank
 N.d. http://databank.worldbank.org/data/reports.aspx?source=global-economic-monitor-(gem)-commodities, accessed July 1, 2016.

Grandia Liza.
2009. T'zaptz'ooqueb' El despojo recurrente al pueblo q'eqchi'. Asociación para el Avance de las Ciencias sociales en Guatemala

Hijmans, Robert J, Susan E Cameron, Juan L Parra, G Jones, and Andy Jarvis
 2005   VERY HIGH RESOLUTION INTERPOLATED CLIMATE SURFACES FOR GLOBAL LAND AREAS 1978: 1965–1978.

Holdridge, L. R., and W. C. et al Grenke
 1971   Forest Environments in Tropical Life Zones: A Pilot Study. CABDirect2: xxxi + 747 pp.

Instituto Nacional de Estadística.
2016. Encuesta Nacional de Condiciones de Vida 2014. INE Guatemala.

IUCN. 2015. The IUCN Red List of Threatened Species. Version 2015.2. <www.iucnredlist.org>. Downloaded 03/8/2015.

Kinnaird, Margaret F., Eric W. Sanderson, Timothy G. O'Brien, Hariyo T. Wibisono, and Gillian Woolmer
 2003   Deforestation Trends in a Tropical Landscape and Implications for Endangered Large Mammals. Conservation Biology 17(1): 245–257.

Macedo, Marcia N., Ruth S. DeFries, Douglas C. Morton, et al.
 2012   Decoupling of Deforestation and Soy Production in the Southern Amazon during the Late 2000s. Proceedings of the National Academy of Sciences 109(4): 1341–1346.

National Protected Areas Council (CONAP). 2001. Listas Rojas de Fauna y Flora. CONAP. http://www.conap.gob.gt.

National Protected Areas Council (CONAP). 2007. List of timber species of Guatemala. www.conap.gob.gt:7778/informacion/biodiversidad/vida-silvestre/flora

Proyecto FFEM, and Unidad De Investigaciones Biológicas De FUNDAECO. "El Conocimiento Y Monitoreo De La Biodiversidad Como Motor Del Ordenamiento Territorial Y De La Conservación De áreas Protegidas En El Caribe De Guatemala." (2010).

Rudel, Tom, and Jill Roper
 1997   The Paths to Rain Forest Destruction: Crossnational Patterns of Tropical Deforestation, 1975–1990. World Development 25(1): 53–65.

Swenson, Jennifer J., Catherine E. Carter, Jean-Christophe Domec, and Cesar I. Delgado
 2011   Gold Mining in the Peruvian Amazon: Global Prices, Deforestation, and Mercury Imports. PLOS ONE 6(4): e18875.

Jane Robb[1], Alma Quilo[2], Danai Fernandez Perez[2], Jeremy Haggar[1], Richard Lamboll[1]

Using Exploratory Factor Analysis to Explore the Drivers of Deforestation in the Sarstun Motagua Region of Guatemala. [1]*Natural Resources Institute, University of Greenwich, UK,* [2]*Centre for Environment and Biodiversity Studies, University del Valle de Guatemala*

Trejo, Irma, and Rodolfo Dirzo
 2000   Deforestation of Seasonally Dry Tropical Forest: A National and Local Analysis in Mexico. Biological Conservation 94(2): 133–142.