MONITORING REPORT FORM (CDM-MR) *
VERSION 01 – IN EFFECT AS OF: 28/09/2010

CONTENTS

* as contained within the document entitled "Guidelines for completing the monitoring report form (CDM-MR)" (EB 54 meeting report, annex 34).

MONITORING REPORT
VERSION 03 of 07/09/2012

Southern Nicaragua CDM Reforestation Project
Reference number: 3970
The 1st monitoring period: 04/07/2003 – 06/01/2012

SECTION A. General description of the project activity

A.1. Brief description of the project activity:

A.1.1 Purpose of the project and the measures taken to reduce greenhouse gas emissions.

The project consists of the reforestation of 813 ha with teak and native wood species in Southern Nicaragua. Of this 813 ha, 688.92 ha has been successfully planted while on the remaining 124.08 ha plantations were established but failed for different reasons (please see section B.1 for details).

The reforestation is carried out on former pasture lands. The objectives of this project is to contribute to the sustainable development of Nicaragua through reforestation to generate sustainable wood supplies to reduce pressure on natural forests and to serve as carbon sink.

This project will contribute to reducing poverty in one of the poorest regions of Central America. Subsistence agriculture and cattle farming are the main economic activities, and do not generate many job opportunities.

The project seeks to increase the amount of employment opportunities for rural poor and landless and prevent their emigration to neighboring Costa Rica.

This project is the major source of employment for local communities, including jobs on a permanent basis as well as seasonal jobs for tasks such as planting, maintenance, weeding, pruning, fire control, thinning and harvesting.

The wages paid to workers are above average wage, which is significantly above the minimal wage. The project also provides training and career opportunities for young people.

A.1.2 Brief description of the installed technology and equipment.

The major species planted under the project is teak ***(Tectona grandis)***, but there are also a variety of valuable native species. Most of these native species have become rare or threatened due to overexploitation of natural forest in Central America. Some are important as fruit, food and habitat for wildlife.

The environmental benefits of the project include prevention of fire and erosion, protection of groundwater, and improvement of soil and microclimate. The project obtained certification in accordance with the criteria laid out by the Forestry Stewardship Council (FSC) in 2007.

The project has a harvest cycle of 18 to 30 years, depending on site quality and species.

A.1.3 Relevant dates for the project activity

The proposed project started planting on 04/07/2003 and finished planting on 18/08/2006.

A.1.4 Total emission reductions achieved in this monitoring period

The total emission reductions achieved in this monitoring period are 90,188 t CO2-e.

A.2. Project Participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Nicaragua (host party)	Precious Woods Nicaragua SA	No
Canada	International Bank for Reconstruction and Development as Trustee of the BioCarbon Fund (BioCF) Government of Canada - Ministry of Foreign Affairs and International Trade	Yes
France	Eco-Carbone S.A.S.	No
Italy	Government of Italy - Ministry for the Environment, Land and Sea	Yes
Japan	Idemitsu Kosan Co., Ltd. ; Japan Iron and Steel Federation (JISF) ; Japan Petroleum Exploration Co., Ltd. (JAPEX) ; The Okinawa Electric Power Co., Inc. ; Sumitomo Chemical ; Sumitomo Joint Electric Power Co., Ltd ; Suntory Holdings Limited ; The Tokyo Electric Power Co., Inc.	No
Spain	Kingdom of Spain - Ministry of Environment and Rural and Marine Affairs & Ministry of Economy and Finance	Yes
Luxembourg	Ministry of Sustainable Development and Infrastructure	Yes

A.3. Location of the project activity:

The project is located on different former cattle ranches in Southern Nicaragua. Three locations were selected for plantation establishment. The first two locations are near the village of Sapoá, in Southwestern Nicaragua

between the border with Costa Rica, Lake Nicaragua and the Pacific Ocean. The topography of these sites is hilly with altitudes varying between 50 and 250 m above sea level. The third site is near the village of Esperanza east of Lake Nicaragua on the Rio San Juan, at an altitude of 40-60 m.

The coordinates of the three sites are: Site 1: 11°11’05’’ N , 85°38’14’’ O, Site 2: 11°14’42’’ N , 85°41’02’’ O, Site 3: 11°05’34’’ N , 84°32’40’’ O.

Figure A-1 The location of the project

A.4. Technical description of the project:

The plantation aims at establishing a diverse mosaic landscape that integrates plantations of teak and native species with pre-existing single trees. The planting is done manually and use of machinery is very limited for the maintenance of the plantation.

Planting

The reforestation is carried out with seedlings produced in greenhouses and nurseries from seeds and vegetative reproduction. For some species, seeds are planted directly into the soil. The topography is hilly and ploughing

was carried out only on completely flat areas. In total, 7.8% of the planting area was ploughed. Vegetation is removed only around the seedlings. The planting has been done using manual methods.

With exception of one single dose of bokashi, an organic fertilizer based on chicken manure, which is added to each planting hole, no fertilizer is applied. In total, 278 kg of bokashi is applied per ha, which totals about 230 tons for the entire project. This value has been used to calculate emissions from organic fertilizer use. By applying the A/R methodological tool "Estimation of direct nitrous oxide emission from nitrogen fertilization", it is demonstrated that the project emissions from the use of organic fertilizer do not represent more than 10% of the emission reductions from the project. The total project emissions from fertilizer use are less than 1%.

Tending

The undergrowth vegetation in the plantation is trimmed manually with machetes (chapea) at periodic intervals in order to control weed competition to the young trees. The tending activities were carried out up to 3 years after planting and have enabled the trees to reach sufficient height to withstand competition from undergrowth vegetation.

Thinning and Harvesting

Thinning is carried out at different ages to enable healthy stand growth. The harvesting cycle is expected to vary between 18 and 30 years as per the site quality and silvicultural requirements of species. For the harvest, low impact harvest techniques will be applied. The reforestation will remain in place after conclusion of the first harvesting cycle. After felling, the trees are replanted immediately or regrown from coppice shoots.

Thinning is carried out in years 6, 9 and 12 in the plantations of teak. In the case of native species, the schedule of thinning depends on growth and the relationship between the current annual increment and mean annual increment.

Fire prevention

Due to the frequency of fires in the region, fire prevention measures are carried out during the dry season. This includes removal of vegetation along fences, 24-hour surveillance during dry season, and permanent availability of water supply and equipment to fight fire. As the teak trees reach a height of 4-6 meters (2-3 years), the risk of mortality due to fire is substantially reduced because of the high fire resistance of the species.

Biodiversity

The proposed project differs greatly from the traditional commercial plantations as it is designed to have substantial benefits in relation to biodiversity. In addition to teak, a number of native forest species and fruit-bearing trees have been planted.

A.5. Title, reference and version of the baseline and monitoring methodology applied to the project activity:

AR-AMS0001 ver. 5 - Simplified baseline and monitoring methodologies for small-scale afforestation and reforestation project activities under the clean development mechanism implemented on grasslands or croplands.

For more information regarding the methodology, please refer to the following link.

http://cdm.unfccc.int/methodologies/DB/91OLF4XK2MEDIRIWUQ22X3ZQAOPBWY

Tool for "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 01)

A.6. Registration date of the project activity:

07/05/2011

A.7. Crediting period of the project activity and related information (start date and choice of crediting period:

The project proposes to implement several planting and harvesting cycles and has no determined end of life. The fixed crediting period of 30 years is chosen for accounting GHG removals in the project. The start date of the project is 04 July 2003.

A.8. Name of responsible person(s)/entity(ies):

Responsible person and entity for completing the monitoring report form (CDM-MR):
Mr. Victor Arce, MADERAS PRECIOSAS NICARAGUA S.A. (Precious Woods Nicaragua SA)
E-mail: victor.arce@preciouswoods.co.cr, Tel: (506)2666-2333 ext104

SECTION B. implementation of the project activity

B.1. Implementation status of the project activity:

The starting date of the project activity is 04 July 2003, when the planting of the first lot started on Pimienta and Esperanza farms. In the case of Javalina farm, the start of planting was 15 July 2005.

The fixed crediting period of the proposed project is 30 years (30 years-00-months) from 04 July 2003 to 03 July 2033.

As per the registered PDD (version 4, dated 30 November 2010), the project planned to reforest 813 ha with teak and native wood species in accordance with the following planting schedule:

Farm	2003	2004	2005	2006	**TOTAL**
Esperanza					
Teak	42	115	-	-	**157**
Native	2	8	-	-	**10**
Pimienta					
Teak	91	163	2	-	**256**
Native	5	6	2	-	**13**
Javalina					
Teak	-	-	171	180	**351**
Native	-	-	14	12	**26**
TOTAL	**140**	**292**	**189**	**192**	**813**

During the implementation of the project, some of the planted areas were unsuccessful. In some low lands, the water accumulation provoked the death of the majority of the trees. In other cases, in areas near creeks and small rivers, the growth of the existing vegetation was more aggressive than teak and planted native species, leading to a reduction in the plantation areas.

During the first monitoring period, the area that was not successful amounted to 124.08 hectares, distributed as follows: 85.39 ha. in Javalina, of which 25.5 ha were originally planted with natives and 59.88 ha with teak; and 36.35 ha in Pimienta, of which 35.04 ha was originally planted with teak and 1.31 with natives; 2.34 ha in Esperanza, of which 0.36 ha were originally planted with natives and 1.99 ha with teak.

After assessing the unsuccessful area, it was decided to replant 59.02 hectares out the 124.08 hectares with teak in 2013. For this new plantation, the preparation of the land will have to take into account the needs of the teak to ensure good growth in these areas. The remaining area (65.06 ha) will not be replanted and this will lead to a reduction in the project boundary.

As a result, the new distribution of the plantations is divided as per the following table:

Farm	2003	2004	2005	2006	2013	**TOTAL**
Esperanza						
Teak	40.68	114.33	-	-	-	**155.01**
Native	2.15	7.49	-	-	-	**9.64**
Pimienta						
Teak	83.59	137.16	0.21	-	-	**220.96**
Native	4.83	5.32	1.53	-	-	**11.69**
Javalina						
Teak	-	-	146.17	144.94	59.02	**350.14**
Native	-	-	0.49	0.01	-	**0.50**
TOTAL	**131.25**	**264.31**	**148.41**	**144.95**	**59.02**	**747.94**

Related to the thinnings, sanitary thinning was applied in the years 2007, 2008, 2009 and 2010 for the 2003, 2004, 2005 and 2006 plantings respectively. The first thinning for management was applied in the years 2010 and 2011 just for the 2003 and 2004 plantings in the Pimienta farm.

No special events occurred or events that might impact the applicability of the methodology.

B.2. Revision of the monitoring plan:

There is no revision to the monitoring plan.

B.3. Request for deviation applied to this monitoring period:

There is no deviation applied to this monitoring period.

B.4. Notification or request of approval of changes:

As discussed in section B.1, because of failing plantations, there have been changes in the year-wise areas planted, which resulted in 59.02 hectares to be replanted in 2013. A further 65.06 ha was planted before, but after the plantations failed these areas will not be replanted therefore reducing the project boundary from 813 ha to 747.94 ha.

In accordance with EB guidelines (EB 63, Annex 27), these changes are identified as minor in nature, and therefore shall be addressed through the verification stage by the designated operational entity without submitting a notification or a request for approval.

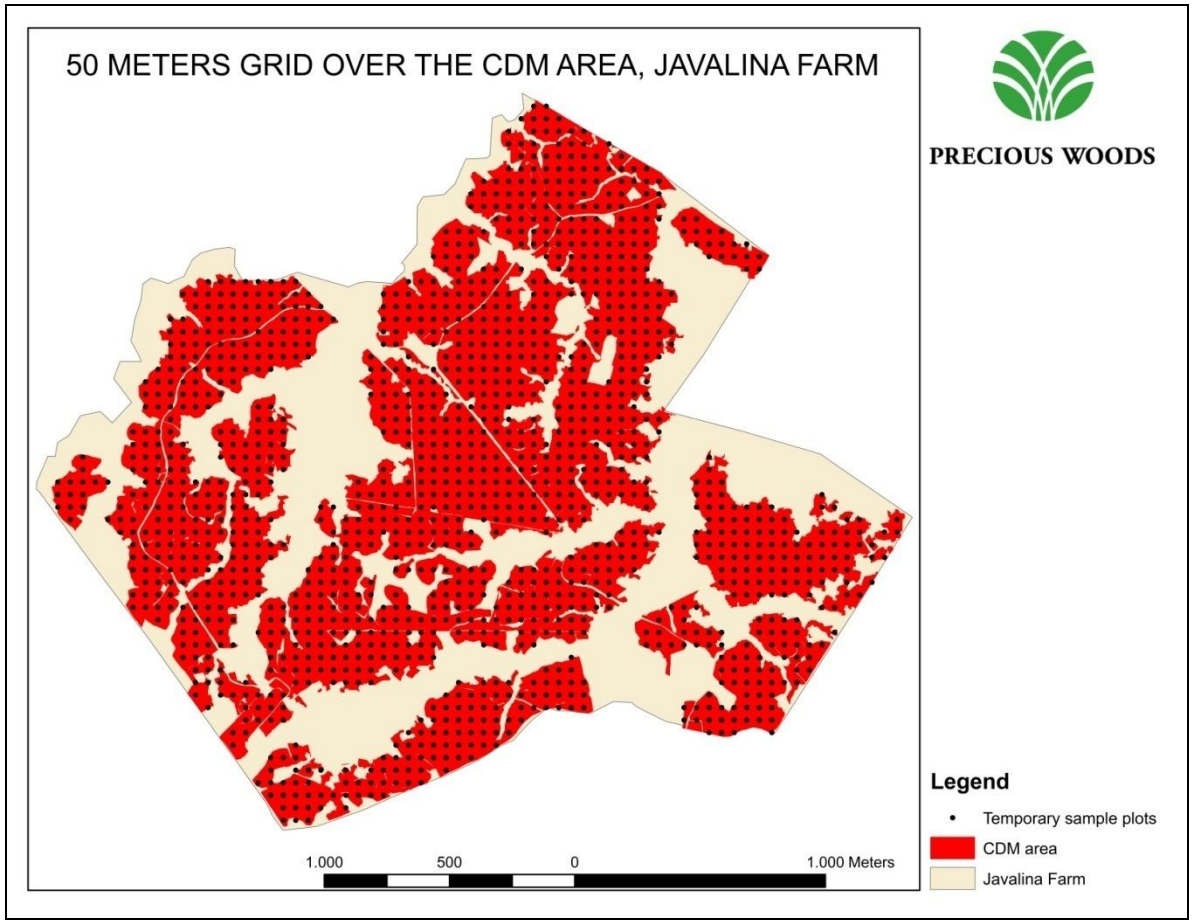
There is no notification or request of approval of changes from the proposed project as described in the registered CDM-PDD (version 04).

SECTION C. Description of the monitoring system

1. Stratification

The project area is stratified. Parameters for initial stratification are tree species (native species and teak) and planting year (2003 to 2006).

In year 4 after planting, the stratification was refined with strata that represent the growth conditions. These are mapped based on a grid of geo-referenced systematically distributed circular temporary sample plots of 100 m^2 with a distance of 50 m between every plot, as is shown in the next figure for Javalina farm:



In each plot diameter at breast height (DBH) of every tree is measured. Total volume of the tree is calculated as a function of DBH, using an allometric formula. The average volume of each plot is then assigned to a growth class. With the help of a GIS computer program with interpolation functionality, a growth map with homogeneous growth conditions is produced.

The final stratification thus separates:

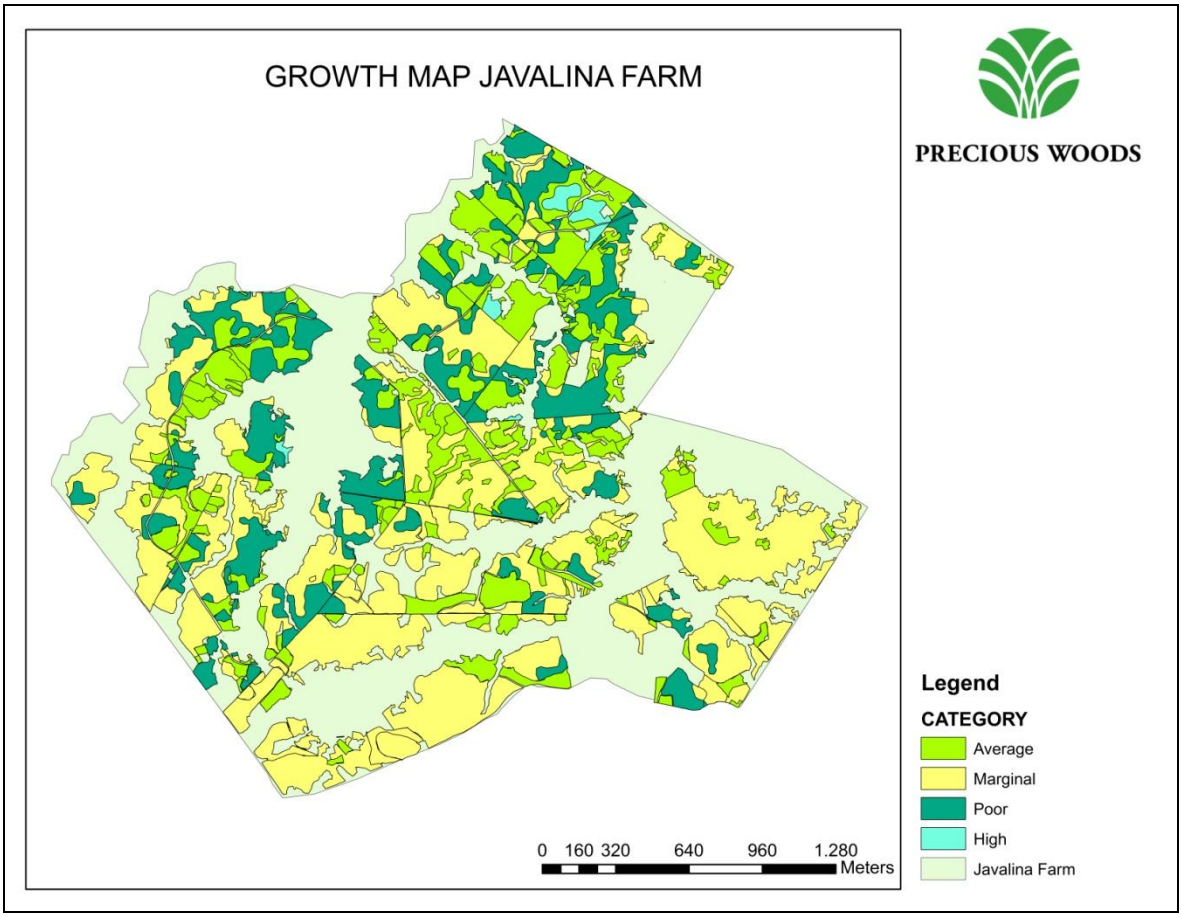
1. Tree species / species group

2. Planting year

3. Growth class

Stratification

Tree species /species group	**Planting year**	**Growth class**	**Stratum ID**
Natives	2003	Average	N03A
Natives	2004	Average	N04A
Natives	2005	Average	N05A
Natives	2006	Average	N06A
Teak	2003	High	T03H
Teak	2003	Marginal	T03M
Teak	2003	Poor	T03P
Teak	2004	Marginal	T04M
Teak	2005	Average	T05A
Teak	2005	Marginal	T05M
Teak	2006	Marginal	T06M
Teak	2006	Poor	T06P
Teak	2013 (planned)	Marginal	T13M



2. Calculation of the number of sample plots

For the determination of the number of sample plots per stratum, the Methodical Tool "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 01) is used.

To calculate the number of permanent sample plots used for monitoring, the formula of method II (samples drawn with replacement) of this tool are used. The number of plots per stratum is determined according to a targeted precision level of ±10 % of the mean at a 95% confidence level. The standard deviation within each stratum is derived from the data underlying the growth map.

The resulting number of sample plots is shown in the following table:

Stratum	**Ha**	**Number of plots**
N03A	6.9826	7
N04A	12.8165	14
N05A	2.0244	0

N06A	0.0077	0
T03H	48.4463	43
T03M	55.2806	41
T03P	20.54	22
T04M	251.4934	217
T05A	0.2108	1
T05M	146.1742	131
T06M	114.0138	138
T06P	30.928	34
T13M	59.024	0
Total		648

3. Sample plot size

The area of the permanent sample plots is 500 m^2. The plots are circular.

4. Permanent sample plot location

The plots are located systematically with a random location of the starting plot, identified prior to establishment using a GIS program, geo-referenced and marked in the field. Series number, stratum and GPS coordinates are registered in a database.

5. Data record

The measurements are made by three groups of two workers each. They take the DBH of each tree inside of the permanent sample plot, following the procedure of the company for forestry measurements. In this step the field workers have to do a preliminary revision, comparing the measurement with the last measurement made.

Then the data on paper are given to the person responsible for digitizing those data in an Excel spreadsheet that contains the last measurements, so that through subtraction this person can know if the value of the DBH is correct or not. After this revision, those data are copied and pasted on the SMART - Forms for AR-AMS0001 ver. 5.

To ensure the net anthropogenic GHG removals by sinks are measured and monitored precisely, credibly, verifiably and transparently, a quality assurance and quality control (QA/QC) procedure is implemented.

6. QA/QC Procedures

a) Reliable field measurements

To ensure reliable field measurements, Standard Operating Procedures (SOPs) for each step of the field measurements, including all detailed phases of the field measurements and provision of documentation for verification purposes, are proposed in this document and will be adjusted periodically.

Training courses on field data collection and data analysis will be held for persons involved in the field measurement work. The training courses will ensure that each field-team member is fully aware of all procedures and the importance of collecting data as accurately as possible.

b) Verification of field data collection

To verify that plots have been installed and measurements taken correctly,

- Randomly selected plots are re-measured by teams other than those involved in the prior plot measurements.
- Key re-measurement elements include the location of plots, DBH and tree height.
- The re-measurement data are compared with the original measurement data. Errors assessed in the prior measurements will be corrected and recorded and will be used to calculate the measurement error.

c) Verification of data entry and analysis

To minimize the possible errors in the process of data entry, the entry of both field data and laboratory data are reviewed by an independent expert team and compared with independent data to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data are used to resolve any apparent anomalies before the final analysis of the monitoring data is completed.

d) Data maintenance and archiving

Data archiving takes both electronic and paper forms, and copies of all data are provided to each project participant. All electronic data and reports are be copied on durable media such as CDs, and copies of the CDs are stored in multiple locations. The archives include:

- Copies of all original field measurement data, laboratory data, and data analysis spreadsheets;
- Estimates of the carbon stock changes in all pools and non-CO2 GHG and corresponding calculation spreadsheets;
- GIS products.

All the media will be stored for at least 5 years after verification.

8. Organizational structure

The structure of the CDM Monitoring Office set up is outlined below:

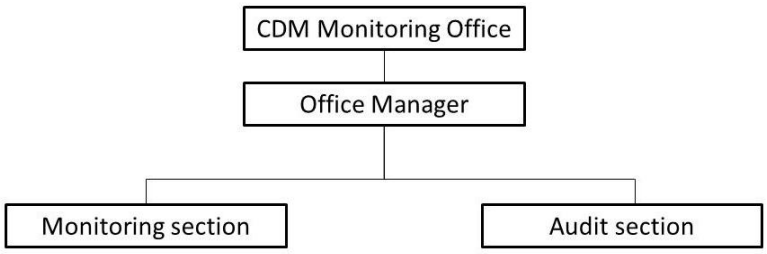


Figure C-1. The organization of the CDM project management office

The information collected and the flow of this information is outlined below

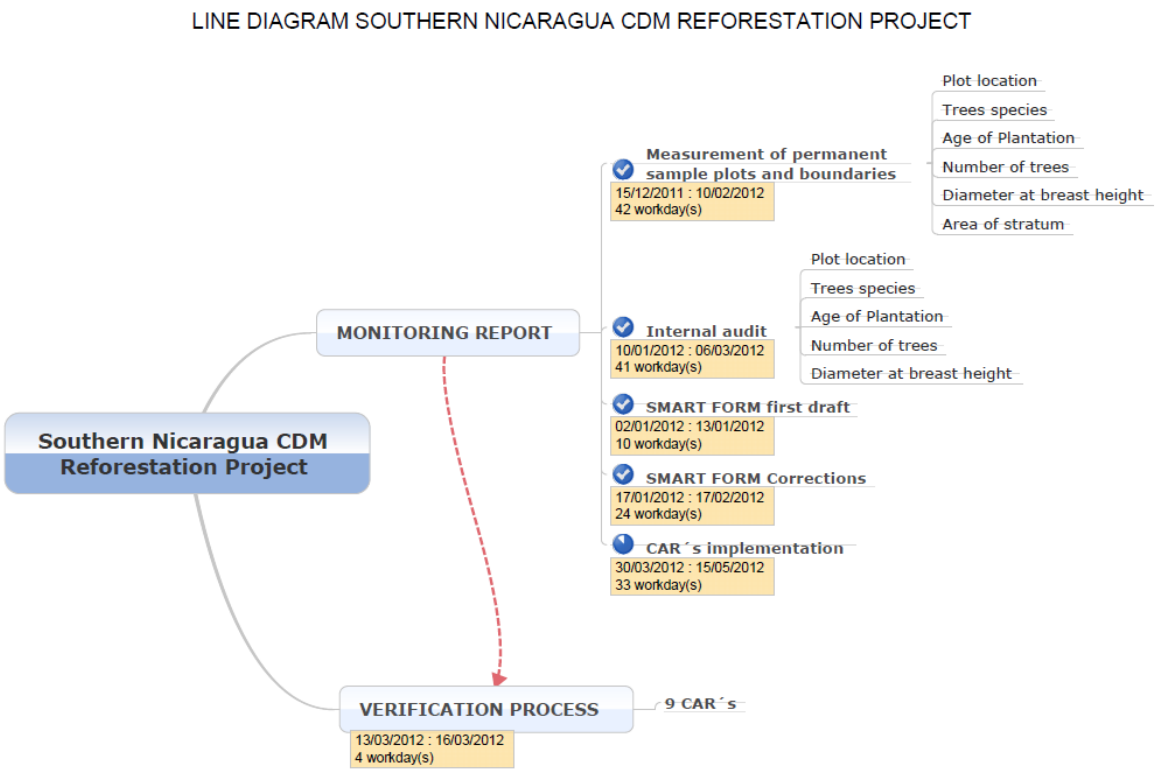


Figure C-2. Line diagram of the information flow in the CDM project

9. Roles and responsibilities

Office manager / manager of research of Precious Woods Central America: Mr. Victor Arce is the responsible person for coordinating and managing the work of the CDM Monitoring Office and is in charge of all matters relevant to the monitoring activity.

Monitoring section: Mr. Dennis Martinez is responsible for collecting, processing and archiving the data.

Audit section: Mr. Mario Espinoza is responsible for auditing the work of the monitoring section.

SECTION D. Data and parameters

D.1. Data and parameters determined at registration and not monitored during the monitoring period, including default values and factors

Data / Parameter:	Stratum ID
Data unit:	Alpha numeric
Description	Area that has a particular combination of soil type, climate, existing vegetation and land form
Source of data used:	Stratification map
Value(s)	Stratum 1 - Area planted with teak for harvesting at 30 years Stratum 2 - Area planted with teak for harvesting at 18 years Stratum 3 - Area planted with native tree species
Indicate what the data are used for:	Actual net GHG removals by sinks (this data are used to calculate the number of sample plots needed in each stratum).
Additional comment:	

Data / Parameter:	Sub-stratum ID
Data unit:	Alpha numeric
Description	Area that has a particular year to be planted and a particular site quality under each stratum
Source of data used:	Stratification map
Value(s)	N03A N04A N05A N06A T03H T03M T03P T04M T05A T05M T06M T06P T13M
Indicate what the data are used for:	Actual net GHG removals by (this data are used to calculate the number of sample plots needed in each stratum).
Additional comment:	

Data / Parameter:	Confidence level
Data unit:	%
Description	Is the range of values (calculated in a sample) in which is the true value of the parameter with a given probability.
Source of data used:	Prescribed in methodology
Value(s)	90%
Indicate what the data are used for:	Actual net GHG removals by sinks (this data is used to calculate the number of sample plots needed in each stratum)
Additional comment:	In the registered PDD, this was originally set to 95%. This was changed following the guidelines from the CDM EB (EB 68, Annex 31) that for all methodologies sets the maximum allowable relative margin of error of the mean, for estimation of aboveground tree biomass, to ± 10% at 90% confidence level

Data / Parameter:	Precision level
Data unit:	%
Description	Is the probability of error
Source of data used:	Prescribed in methodology and calculated using data from plot measurements
Value(s)	10%
Indicate what the data are used for:	This data is used to calculate the number of sample plots
Additional comment:	In the registered PDD, this was originally set to 5%. This was changed following the guidelines from the CDM EB (EB 68, Annex 31) that for all methodologies sets the maximum allowable relative margin of error of the mean, for estimation of aboveground tree biomass, to ± 10% at 90% confidence level

Data / Parameter:	Standard deviation of each stratum
Data unit:	m^3

Description	Measure of centralization or dispersion of data
Source of data used:	Measurements used for the development of growth maps
Value(s)	See attached EXCEL sheet 'NPW-ARAMS0001V10 Report', worksheet 'Margin of Error'
Indicate what the data are used for:	Actual net GHG removals by sinks (used for estimating numbers of sample plots of each stratum and substratum).
Additional comment:	

Data / Parameter:	Number of sample plot
Data unit:	
Description	Quantity of permanent sample plots established
Source of data used:	Stratum ID, Sub-stratum ID, Growth maps, Confidence level, Precision level and Standard deviation.
Value(s)	648 permanent sample plots
Indicate what the data are used for:	Actual net GHG removals by sinks (used to calculate the amount of CO2 fixed, according to the confidence level).
Additional comment:	

Data / Parameter:	Sample plot ID
Data unit:	Alpha numeric
Description:	Numeric series ID of each permanent sample plot
Source of data used:	Project and plot map
Value(s)	See attached EXCEL sheet 'NPW-ARAMS0001V10 Report', worksheet 'TreeBiomass'
Indicate what the data are used for:	Actual net GHG removals by sinks (this data is used to identify each sample plot)
Additional comment:	

Data / Parameter:	Carbon fraction
Data unit:	tC (t d.m)-1
Description:	content of C of the dry matter
Source of data used:	IPCC default value
Value(s)	0.5
Indicate what the data are used for:	Actual net GHG removals by sinks
Additional comment:	

D.2. Data and parameters monitored

Data / Parameter:	Plot location
Data unit:	Degrees, minutes and seconds latitude longitude projection (Datum WGS84)
Description:	Geographic location of each permanent sample plot.
Measured/Calculated/Default	Measured
Source of data used:	Project and plot map and GPS locating
Value(s)	See annex # 1
Indicate what the data are used for :	Actual net GHG removals by sinks (used to find the permanent sample plots, during the measurements)
Monitoring Equipment (type accuracy class, serial number, calibration)	GPS Garmin map 76CSx, accuracy of $\pm$ 3 meters
Measuring/Reading/ Recording frequency:	Measuring/reading and record every 5 years
Calculation method (if Applicable):	Not applicable
QA/QC procedures applied:	Protocol for measurement and installation of permanent simple plots and design of growth maps in plantations. 2012

	("Protocolo de medicion e instalación de parcelas permanentes y diseño de mapas de crecimiento en plantaciones forestales. 2012")

Data / Parameter:	Trees species
Data unit:	
Description:	Identification of the species of each tree measured
Measured/Calculated/ Default:	Measured
Source of data used:	Project design map
Value(s):	See annex # 2
Indicate what the data are used for	Actual net GHG removals by sinks
Monitoring Equipment (type accuracy class, serial number, calibration	
Measuring/Reading/ Recording frequency:	Measuring/reading and record every 5 years
Calculation method (if Applicable):	Not applicable
QA/QC procedures applied:	Protocol for measurement and installation of permanent simple plots and design of growth maps in plantations. 2012 ("Protocolo de medicion e instalación de parcelas permanentes y diseño de mapas de crecimiento en plantaciones forestales. 2012")

Data / Parameter:	Age of plantation
Data unit:	Years
Description:	Years older of the plantation, counted since planted year
Measured/Calculated/ Default:	Calculated
Source of data used:	Plot measurement

Value(s) of monitored Parameter:	See annex # 3
Indicate what the data are used for	Actual net GHG removals by sinks
Monitoring Equipment (type accuracy class, serial number, calibration	
Measuring/Reading/ Recording frequency:	Measuring/reading and record every 5 years
Calculation method (if Applicable):	Age years = (Planting date – measure date)/365
QA/QC procedures applied:	Protocol for measurement and installation of permanent simple plots and design of growth maps in plantations. 2012 ("Protocolo de medicion e instalación de parcelas permanentes y diseño de mapas de crecimiento en plantaciones forestales. 2012")

Data / Parameter:	Number of trees
Data unit:	Number
Description:	Quantity of trees include in the sample plots
Measured/Calculated/ Default:	Measured
Source of data used:	Plot measurement
Value(s) of monitored Parameter:	21523, See attached EXCEL sheet 'NPW-ARAMS0001V10 Report', worksheet 'TreeBiomass'
Indicate what the data are used for (Baseline/project Leakage emission calculations)	Actual net GHG removals by sinks
Monitoring Equipment (type accuracy class, serial number, calibration	This parameter can be measured without any equipment
Measuring/Reading/	Measuring/reading and record every 5 years

Recording frequency:	
Calculation method (if Applicable):	
QA/QC procedures applied:	Protocol for measurement and installation of permanent simple plots and design of growth maps in plantations. 2012 ("Protocolo de medicion e instalación de parcelas permanentes y diseño de mapas de crecimiento en plantaciones forestales. 2012")

Data / Parameter:	Diameter at breast height (DBH)
Data unit:	cm
Description:	Diameter of each tree inside of the plot at 1,30 m height
Measured/Calculated/ Default:	Measured
Source of data used:	Plot measurement
Value(s) of monitored Parameter:	See attached EXCEL sheet 'NPW-ARAMS0001V10 Report', worksheet 'TreeBiomass'
Indicate what the data are used for (Baseline/project Leakage emission calculations)	Actual net GHG removals by sinks
Monitoring Equipment (type accuracy class, serial number, calibration	Stewe Diameter tape, with accuracy of $\pm$0.05 cm
Measuring/Reading/ Recording frequency:	Measuring/reading and record every 5 years
Calculation method (if Applicable):	
QA/QC procedures applied:	Protocol for measurement and installation of permanent simple plots and design of growth maps in plantations. 2012 ("Protocolo de medicion e instalación de parcelas permanentes y diseño de mapas de crecimiento en plantaciones forestales. 2012")

Data / Parameter:	Above ground biomass
Data unit:	M^3ha^{-1}
Description:	Dry matter contained in each tree over the ground
Measured/Calculated/ Default:	Calculated
Source of data used:	Field measurements of DBH
Value(s) of monitored Parameter:	See attached EXCEL sheet 'NPW-ARAMS0001V10 Report', worksheet 'TreeBiomass'
Indicate what the data are used for (Baseline/project Leakage emission calculations)	Actual net GHG removals by sinks
Monitoring Equipment (type accuracy class, serial number, calibration	
Measuring/Reading/ Recording frequency:	Measuring/reading and record every 5 years
Calculation method (if Applicable):	Calculated using the equations (3) and (4) as per as PDD via DBH
QA/QC procedures applied:	

Data / Parameter:	Area of stratum
Data unit:	ha
Description:	Actual area of each stratum
Measured/Calculated/ Default:	Measured
Source of data used:	Stratification map an data

<table>
<tr><td>Value(s) of monitored

Parameter:</td><td>
<table>
<tr><td>Stratum</td><td>Area ha</td></tr>
<tr><td>N03A</td><td>6.9826</td></tr>
<tr><td>N04A</td><td>12.8165</td></tr>
<tr><td>N05A</td><td>2.0244</td></tr>
<tr><td>N06A</td><td>0.0077</td></tr>
<tr><td>T03H</td><td>48.4463</td></tr>
<tr><td>T03M</td><td>55.2806</td></tr>
<tr><td>T03P</td><td>20.54</td></tr>
<tr><td>T04M</td><td>251.4934</td></tr>
<tr><td>T05A</td><td>0.2108</td></tr>
<tr><td>T05M</td><td>146.1742</td></tr>
<tr><td>T06M</td><td>114.0138</td></tr>
<tr><td>T06P</td><td>30.928</td></tr>
<tr><td>T13M</td><td>59.024</td></tr>
</table>
</td></tr>
<tr><td>Indicate what the data are used for (Baseline/project Leakage emission calculations)</td><td>Actual net GHG removals by sinks</td></tr>
<tr><td>Monitoring Equipment (type accuracy class, serial number, calibration</td><td>GPS garmin 76csx, accuracy $\pm$ 3 m</td></tr>
<tr><td>Measuring/Reading/

Recording frequency:</td><td>Measuring/reading and record every 5 years</td></tr>
<tr><td>Calculation method (if

Applicable):</td><td></td></tr>
<tr><td>QA/QC procedures applied:</td><td>“Protocol for measurement and installation of permanent simple plots and design of growth maps in plantations. 2012 (“Protocolo de medicion e instalación de parcelas permanentes y diseño de mapas de crecimiento en plantaciones forestales. 2012”) AND “ Protocol for the measurement of areas 2012 (“Protocolo de medicion de areas 2012”)</td></tr>
</table>

Data / Parameter:	Project boundary
Data unit:	
Description:	Boundary of the project verified at the start of the project and at time of each field measurement
Measured/Calculated/	Measured

Default:	
Source of data used:	Project map and GPS locating
Value(s) of monitored Parameter:	See annex 1 and 2
Indicate what the data are used for (Baseline/project Leakage emission calculations)	Actual net GHG removals by sinks
Monitoring Equipment (type accuracy class, serial number, calibration	GPS garmin 76csx, accuracy $\pm$ 3 m
Measuring/Reading/ Recording frequency:	Measuring/reading and record every 5 years
Calculation method (if Applicable):	
QA/QC procedures applied:	"Protocol for measurement and installation of permanent simple plots and design of growth maps in plantations. 2012 ("Protocolo de medicion e instalación de parcelas permanentes y diseño de mapas de crecimiento en plantaciones forestales. 2012") AND " Protocol for the measurement of areas 2012 ("Protocolo de medicion de areas 2012")

In accordance with the guidelines from the CDM EB (EB 68, Annex 31), only data and parameters obtained from field measurement are required to be monitored and monitoring is not required for data, parameters, or variables appearing as intermediate values in calculation steps and those taken from existing sources (e.g. published literature). In accordance with these guidelines, the following parameters that were listed in the monitoring section of the registered PDD have not been monitored:

ID number	**Data variable**	**Data unit**	**Recording frequency**	**Proportion of data to be monitored**
V.13	*Mean DBH*	*cm*	*5 years*	*100% of sampling plots*
V.16	*Carbon stock in above-ground biomass of plots*	*t C ha-1*	*5 year*	*100% of Sampling plots*
V.17	*Carbon stock in below-ground*	*t C*	5 years	*100% of*

	biomass of plots	*ha^{-1}*		*sampling plots*
V.18	*Mean Carbon stock in above-ground biomass per stratum per species*	*t C ha^{-1}*	*5 years*	*100% of strata and sub-strata*
V.19	*Mean Carbon stock in belowground biomass per stratum per species*	*t C ha^{-1}*	*5 years*	*100% of strata and sub-strata*
	Total carbon stock change	*t CO_2-e yr^{-1}*	*5 year*	*100% project area*

In addition the following paramaters that are listed in the methodology were identified in the PDD as parameters that are not applicable in case of this project:

ID number	**Data variable**	**Comment**
N/A	*Height of trees*	*The biomass is calculated with formula using as input parameter only DBH and not height of trees (formula 5, p. 24). Therefore it is not necessary to monitor this variable.*
N/A	*Basic wood density*	*The biomass is calculated with a formula using as input parameter only DBH and not basic wood density (formula 5, p. 24). Therefore it is not necessary to monitor this variable. The value for basic wood density itself that is used in the formula comes from existing published data and so monitoring is not required.*

SECTION E. Emission reductions calculation

E.1. Baseline emissions calculation

As per the registered PDD, the baseline net GHG removals by sinks for this project are considered as zero.

E.2. Project emissions calculation

Actual net greenhouse gas removals by sinks

The actual net greenhouse gas removals by sinks in year t are equal to:

$$\Delta C_{ACTUAL,t} = \Delta C_{PROJ,t} - GHG_{PROJ,t}$$

where:

$\Delta C_{ACTUAL,t}$ Actual net greenhouse gas removals by sinks in year *t* (t CO_2-e/year)

$\Delta C_{PROJ,t}$ Project GHG removals by sinks (t CO_2-e/year)

$GHG_{PROJ,t}$ Project emissions (t CO_2-e/year)

In accordance with the requirements of the methodology, the project emissions are considered insignificant and therefore:

$$GHG_{PROJ,t} = 0$$

Project GHG removals by sinks

The carbon stocks expressed in tCO2-e shall be based on the following equations:

$$P(t) = \sum_{i=1}^{I} (P_{A(t)\,i} + P_{B(t)\,i}) * A_i * (44/12)$$

where:

$P_{(t)}$ carbon stocks within project boundary at time t achieved by the project (tCO2e)
$P_{A(t)\,I}$ carbon stocks in above-ground biomass at time t of stratum i achieved by the project activity during the monitoring interval (t C/ha)
$P_{B(t)\,i}$ carbon stocks in below-ground biomass at time t of stratum i achieved by the project activity during the monitoring interval (t C/ha)
A_i project activity area of stratum i (ha)
i stratum i (I= total number of strata)

The calculations shown below are performed for each stratum.

For above-ground biomass, $P_{A(t)}$ is calculated per stratum i as follows:

$$P_{A(t)} = E_{(t)i} * 0.5$$

where:

$P_{A(t)}$ carbon stocks in above-ground biomass at time t achieved by the project activity during the monitoring interval (t C/ha)
$E_{(t)i}$ estimate of above-ground biomass at time t achieved by the project activity (t dm/ha)

0.5 carbon fraction of dry matter (t C/t dm) - IPCC default value / AR-AMS0001 ver. 5

Calculation of above-ground biomass

The above-ground tree biomass (kg of dry matter per tree) is determined using the allometric equations relating biomass to DBH given in GPG LULUCF Table 4.A.1 for native species in tropical moist forests and Table 4.A.3 for Teak. The value for teak has been determined in this region by Kanninen and Perez at CATIE, Costa Rica. The value for native species is a general value for tropical moist forest because there are no specific values for most of the species. The results are multiplied with the number of trees per hectare to obtain kg of dry matter per hectare.

For teak: $AGB(t)teak = 0.153*DBH^{2.382}$
For native species: $AGB_{(t)\ native} = \exp^{[-2.289 + 2.649*\ln(DBH) - 0.021 \bullet (\ln(DBH))2]}$
Biomass per hectare $E_{(t)i} = AGB_{(t)i} *NT_i$

where:

DBH diameter at breast height
NT number of trees per hectare

Calculation of Below-ground biomass

Below-ground carbon stocks per hectare are determined by one allometric equation for both teak and native species relating belowground biomass to aboveground biomass in tropical forests (GPG LULUCF Table 4.A.4), as follows:

PB = 0.5* BGBi
BGB = exp[-1.085+0.9256*lnAGB]

Where:
EB estimated below ground biomass per tree
0.5 carbon fraction of dry matter (t C/t dm) (IPCC default value / AR-AMS0001 ver. 5)

The attached spreadsheet 'NPW-ARAMS0001V10 Report' calculates the carbon stock changes by applying actual values (please refer to worksheet 'TreeBiomass').

E.3. Leakage calculation

As defined in the methodology, leakage is considered to be zero if evidence can be provided that the activity shift of the previous owners does not lead to deforestation or if the lands surrounding the areas that receive the activity shift are not forested.

In the registered PDD, it was stated that leakage is expected to be zero and does not need monitoring. This was based on the analysis that the three different project sites had three previous owners, all of them cattle farmers. At project start, interviews with them were conducted. In order to obtain more detailed information on the

current status, a second interview was conducted in 2009. The goal was to evaluate their future plans regarding location and businesses. The following table summarizes the outcome of these interviews[1].

Summary of the interviews with previous owners

Site	Previous owner	New planned occupation	Assessment of leakage
Finca Pimienta	Salvador Monterrey	Cattle farming	Mr. Monterrey possessed roughly 300 animals on his lands. 70% were displaced to his other finca, the rest was brought to the slaughterhouse. Mr. Monterrey moved the animals that were not slaughtered to his finca in Nandaime, a region along the Pan-American highway that has been deforested long ago and is traditionally and currently used for grazing. All the lands were already deforested at the time of displacement and used by Mr. Monterrey for cattle farming. No deforestation took place. He already owned this finca before project start. The displacement of the animals to that area did not and will not lead to deforestation. No leakage due to deforestation occurs.
Finca Javalina	Henry Urcuyo	Cattle farming/ Tourism	Mr. Urcuyo still lives in the same area.. As stated in the interview at the site visit of the DOE, all his cattle was brought to the slaughterhouse and was not displaced to another area. He continues being a cattle farmer in the same area but also has other business activities.
Finca Esperanza	Antonio Mendoza	Transport services and some agriculture	Mr. Mendoza stays in the same region. He owned 85 cows. In the second interview which took place in 2009, he stated that he had bought a new finca which was already deforested and used as pasture at that time. All the animals were displaced to this new finca.

According to the interviews it becomes clear that some animals were dislocated to other areas. The previous owners of the fincas reinvested the money they earned from the sale of their properties into new businesses or other lands. Two of them stay in the same areas. The third one displaced his activities from Rivas to Nandaime where he already possessed farmland before he sold the finca Pimienta. The animals themselves were often not displaced to other grazing areas but to the slaughterhouse.

Based on these findings, leakage is considered as zero for this project.

[1] Please note that these interviews took place during the validation process and have already been discussed in the registered PDD.

E.4. Emission reductions calculation / table

The net anthropogenic GHG removals by sinks are calculated as,

$ER_{AR\,CDM,\,t} = \Delta C_{PROJ,\,t} - \Delta C_{BSL,\,t} - GHG_{PROJ,\,t} - L_t$

where:

$ER_{AR\,CDM,\,t}$	Net anthropogenic GHG removals by sinks (t CO2-e)
$\Delta C_{PROJ,\,t}$	Project GHG removals by sinks at time t (t CO2-e)
$\Delta C_{BSL,t}$	Baseline net GHG removals by sinks (t CO2-e)
$GHG_{PROJ,\,t}$	Project emissions (t CO2-e)
L_t	Leakage attributable to the project activity at time t (t CO2-e)

Project GHG removals by sinks at time t *t CO2-e*	**Baseline net greenhouse gas removals by sinks** *t CO2-e*	**Project emissions** *t CO2-e*	**Leakage attributable to the project activity at time t** *t CO2-e*	**Net anthropogenic greenhouse gas removals by sinks** *t CO2-e*
90,188	0	0	0	90,188

E.5. Comparison of actual emission reductions with estimates in the CDM-PDD

Item	Values applied in ex-ante calculation of the registered CDM-PDD	Actual values reached during the monitoring period
Emission reductions (tCO_2e)	157,509 (cumulative net anthropogenic GHG removals by sinks for period 2003 – 2011)	90,188

E.6. Remarks on difference from estimated value in the PDD

The net anthropogenic GHG removals by sinks achieved in the monitoring period are lower than ex-ante calculation of the registered CDM-PDD. As discussed in section B.1 this is mainly caused by bad growth of the teak and the native species in some low lands, where the water accumulation provoked the death of the majority of the trees. In other cases, specifically some protected areas near creeks and little rivers, the growth of the existing vegetation was more aggressive than teak and planted native species, leading to a reduction in the plantation areas.

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