'GUANARÉ' FOREST PLANTATIONS ON DEGRADED GRASSLANDS UNDER EXTENSIVE GRAZING

MONITORING REPORT

Document Prepared By Carbosur Ltda

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Project Title	*"Guanaré" Forest plantations on degraded grasslands under extensive grazing*
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1. PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The project comprises a total of 20.877 hectares of land previously under extensive grazing by beef cattle, on which forest plantations for obtaining high-value, long-lived timber products and for sequestering large amounts of carbon dioxide from the atmosphere, was established.

Forests were based mainly on *Eucalyptus grandis* and to a lesser extent *Eucalyptus globulus*, *Eucalyptus dunnii*, *Eucalyptus maidenii*, *Eucalyptus tereticornis* and *Pinus taeda* plantations in 22-year rotations, managed with pruning (to a minimum height of 12 m) and two to three thinning operations, to obtain knot-free, high-diameter logs suitable for saw-milling and veneering. Project start date was on the 24th April 2006 and plantations were completed by year 5 of project (2011). Forests will be replanted after clear-cut harvest. Practices are compatible with FSC standard for sustainable forest management. Planted forests are removing carbon dioxide from the atmosphere and storing it in different carbon pools (living above-ground and below-ground biomass, soil, litter, non-tree vegetation and dead wood). Monitoring event only covered carbon stock changes for living above-ground. Soil organic carbon, litter and dead wood pools were calculated based on assumptions provided in the methodological tool. Below ground biomass was also estimated indirectly based on above-ground biomass measurements and assumptions provided in the tool. Non-tree vegetation and harvested wood products were not accounted as per the methodology applied. The potential non-permanence of stored carbon was considered by the non-permanence risk analysis and buffer determination.

The soil preparation applied -during forest establishment- consisted in the removal of ground cover in strips following the land contour, using appropriate machinery. Plantation of seedlings was done manually, during spring or autumn seasons, to avoid extreme weather conditions in summer (droughts) and winter (frosts).

After field measurement in sampling plots and calculations done in office, the total GHG removals generated in this monitoring report equals to 3,068,303 tons of CO_2-eq.

1.2 Sectoral Scope and Project Type

The activity implemented by the project was the establishment of forests on land that had previously been under grassland for more than 50 years, and therefore corresponds to the VCS category Afforestation, Reforestation and Revegetation (ARR).

1.3 Project Proponent

Organization name	Guanaré S.A. (hereinafter called Guanaré) acting on behalf of it and Guanaré A.A.R.L. as defined during validation
Contact person	Nelson Ledesma
Title	CEO
Address	Rincón 487, Office 201
Telephone	+598 2916 2510
Email	Nelson.ledesma@fas.com.uy

Organization name	Guanaré
Contact person	Pedro Aramendía
Title	CFO
Address	Rincón 487, Office 201
Telephone	+598 2916 2510
Email	pedro.aramendía@fas.com.uy

1.4 Other Entities Involved in the Project

Organization name	Forestal Atlántico Sur S.A., hereinafter called FAS
Role in the project	All activities related to forest investments, marketing and management of Guanaré are implemented by FAS), through contractual agreement. FAS was established in 2005, and its partners are highly experienced in managing forests.
Contact person	Nelson Ledesma
Title	CEO
Address	Rincón 487, Office 201
Telephone	+59829162510
Email	Nelson.ledesma@fas.com.uy

Organization name	Pike & Co. Consultora Forestal
Role in the project	In this verification, field measurements were conducted by this outsourced third party. The company was hired -after a competitive tender process- to provide this specific service for Guanare. Technicians of Pike Consultora Forestal will be part of the technical team attending the verification site visit.
Contact person	Alvaro Perez del Castillo
Title	CEO
Address	Misiones 1372/303
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Email	Alvaro.perez@pikeconsultora.com.uy

Organization name	Carbosur Ltda

Role in the project	Carbosur has a contractual agreement with Guanaré for the development and management of the carbon component of the project
Contact person	Agustin Inthamoussu
Title	CEO
Address	Misiones 1372/304
Telephone	+598 2915 3514
Email	Agustin.inthamoussu@carbosur.com.uy

1.5 Project Start Date

The project start date was 24th April 2006, when the activities that lead to the generation of GHG emission removals (preparing land for planting) were first implemented.

1.6 Project Crediting Period

Project crediting period will be of 60 years, from 24th April 2006 to 24th April 2066.

1.7 Project Location

The project area is located in East Uruguay, in Cerro Largo and Treinta y Tres departments. It comprises several sites, which are classified in 4 regions based on geographic location. The areas are homogeneous in terms of soil types, climate, land use history and socio-economic conditions.

The following map (Figure1) shows the exact location of the project, and the cadastral units owned by Guanaré, where the project is located.

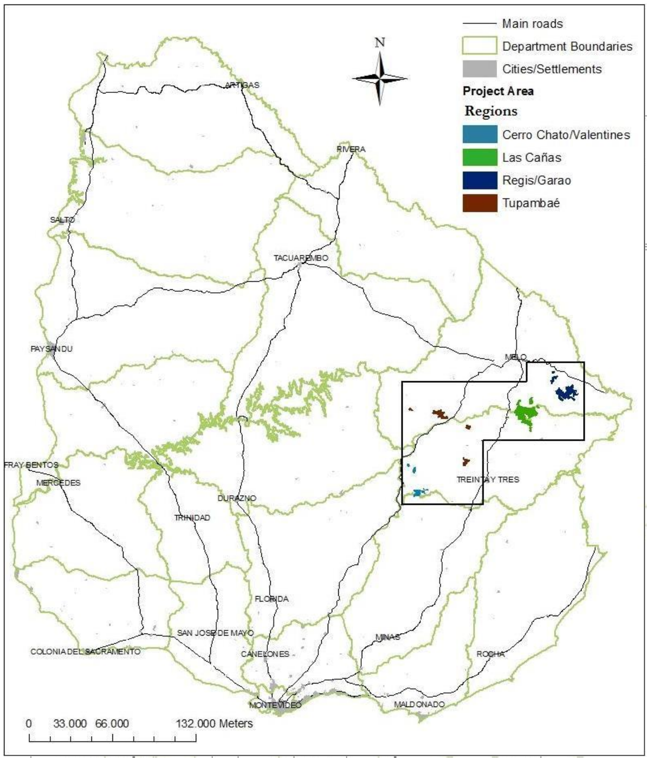

Figure 1. Map of Uruguay showing the location of the areas included in the proposed project activity (black frame).

For the purpose of defining the strata, the project area has been divided into four regions, which are shown from Figures 2 to 6. The areas are homogeneous in terms of soil types, climate, land use history and socio-economic conditions. The division into four regions is entirely based on geographic location.

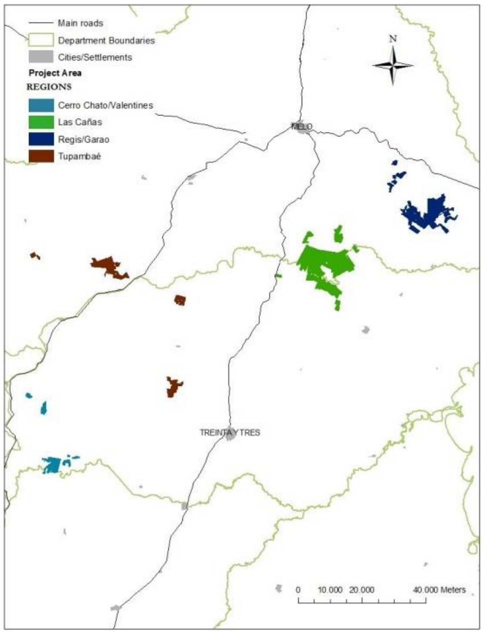

Figure 2. Map indicating the four project regions divided in four different colors.

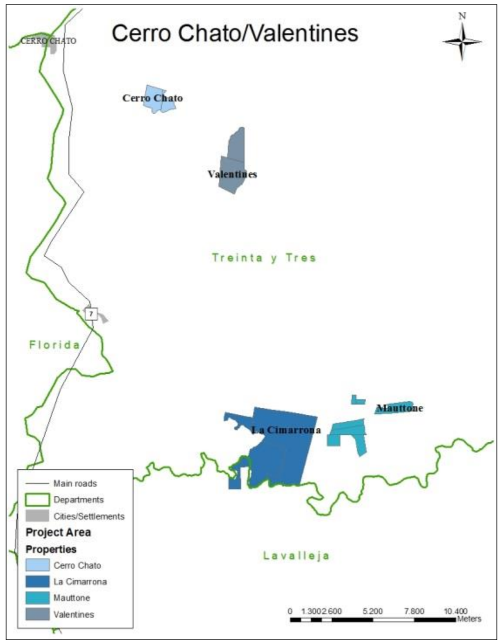

Figure 3. Location of properties which make up the region Cerro Chato/Valentines.

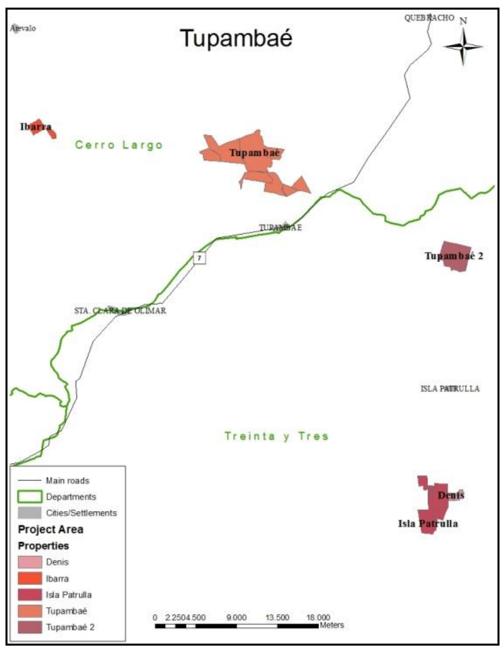

Figure 4. Location of properties which make up the region Tupambaé.

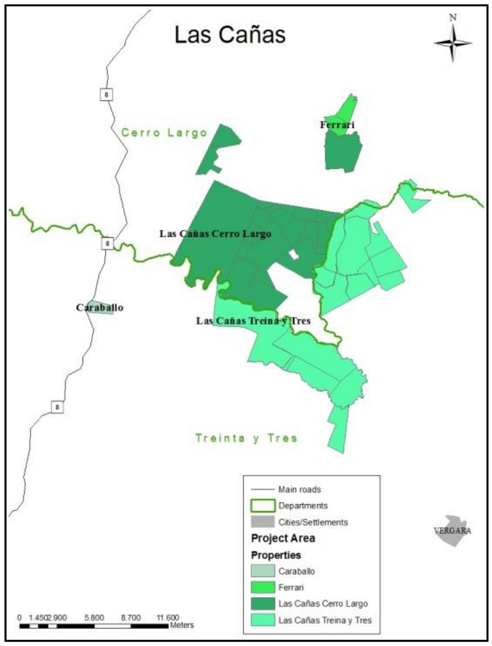

Figure 5. Location of properties which make up the region Las Cañas.

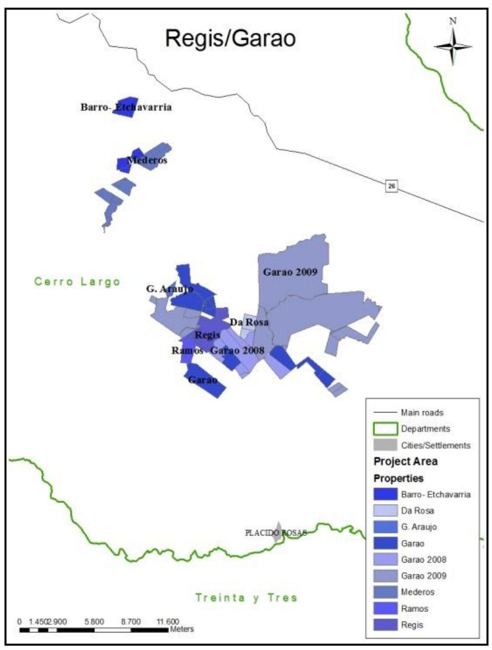

Figure 6. Location of properties which make up the region Regis/Garao.

1.8 Title and Reference of Methodology

The consolidated CDM methodology AR-ACM0001 "Afforestation and reforestation of degraded land" (version 05.2.0, EB 65) was applied.

The following methodological tools, to which the selected methodology refers to, were used:

Version 01 of “Combined tool to identify the baseline scenario and demonstrate the additionality in A/R CDM project activities”;

Version 01 of “Tool for testing significance of GHG emissions in A/R CDM project activities”;

Version 04.0.0 of “Estimation of non-CO2 GHG emissions from burning of biomass attributable to a A/R CDM project activity” (*) (Validated and registered as Version 4.0.0)

Version 01 of “Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities”;

Version 02.0.0 of “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activity”. (*) (Validated and registered as Version 2.0.0)

Version 03.0.0 of “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity”. (*) (Validated and registered as Version 3.0.0)

Version 01 of “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity”;

Version 01.1 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”;

1.9 Other Programs

The project activity is not included in any emissions trading program or any mechanism that includes GHG allowance trading; neither in other forms of environmental credit nor in other GHG Programs.

2. IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

Guanaré first areas were planted in 2006 and the last ones in 2011. The project has recently completed its seventh year. The forests had already had one thinning operation in year 2012 on those forests which had been planted in 2009 as well as three pruning events at 3, 5 and 7 meters of height. The second thinning operation has not yet been started.

As it has been stated in PD, the methodology identifies activity displacement as the only potential source of leakage (conversion from grazing land to forestry). As it was demonstrated during validation, the project implementation did not cause any displacement of activities. The only activity in the project area prior to the start date is extensive grazing by beef cattle, which continues to occur after project start. This can be audited by the verification team during on site visit. It was also stated and validated in the PD that there was no need for a leakage management plan neither for leakage mitigation options.

The information related to the non-permanence risks of the project is presented in a separate document called “Non Permanence Risk Report”.

2.2 Deviations

2.2.1 Methodology Deviations

There are no methodology deviations applied during this monitoring period, nor to criteria and procedures for monitoring or measurement, neither to other part of the methodology. Thus, there are no negatively impacts to the conservativeness of the quantification of GHG removals

2.2.2 Project Description Deviations

Guanaré Project Document was validated and ultimately registered under the VCS on the 18th January 2013. At that moment the methodology “AR-ACM0001 Afforestation and Reforestation on degraded land” (V 5.2.0, EB 65) was still valid to be used in Afforestation and Reforestation CDM (or VCS) projects. According to the CDM, the request for registration of any project using the mentioned methodology could be submitted until the day in which Guanaré was registered. After that date the methodology was substituted with the Combined Methodology: “AR-ACM0003: Afforestation and reforestation of lands except wetlands”. However, for the purpose of this project Monitoring Reports and subsequent monitoring reports, the methodology to be applied correspond to AR-ACM0001 (V 5.2.0, EB 65). There was a last minute error and Guanare PD was registered with a mention to another version of the methodology (05.1.1 EB 60), however, this was only a typographic error, all the Project Document was done following the last version available (V5.2.0, EB 65).

There was a modification in the procedure to measure tree heights. Firstly, the monitoring procedure stated that diameters of existing trees within a sampling plot (500m^2) would be grouped in different classes. The different classes would be formed by expert judge based on results obtained from DBH measurement. Following, one tree from the largest diameter class and one tree from the lowest diameter class will be measured in height and finally 5 additional trees would also be measured trying to cover uniformly all the diameter variation range between largest and smaller DBH classes. However, heights were measured in all trees within sample plots, avoiding the use of equations or models to estimate not-measured trees.

With regards to litter and dead wood pools, the Monitoring Report does also consider another deviation in relation to the PD. The project developer decided not to measure these two pools and to follow the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities” that offers the possibility to apply a default factor. The reason for this modification was the impossibility to measure the material (highly demanding in time and expenses) and it inconsistencies found in the tool for the carbon calculation. Finally, for the estimation of carbon stock in litter and dead wood a conservative default-factor based model was applied, and two factors were used: conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass (8%) and default factor for the relationship between carbon stock in litter and carbon stock in living trees (4%).

Between the validation and the field measurements performed for the verification process, some areas measurements were updated. The reason is the continuous monitoring of the forest area done by the company after every plantation..The following farms are the ones where the areas were updated:

- Salto de Agua
- Ibarra
- Caraballo

- Ferrari
- Barro-Echeverria
- G. Araujo
- Da Rosa

Also, two farms that were planned to be planted during 2010 and 2011 were not planted. These farms are:

- Mary Lopez with 260.6 hectares
- Julio Gonzalez with 59.6 hectares.

Due to this, final project area changed from a total of 21.298 hectares to a total of 20.877 hectares

Finally, regarding QA/QC procedures, in the PD it was stated that during field work, double check 10% of sampling measurements with an independent team or with a team different from the one that performed the initial measurement. If the difference between measurements was higher than 5%, a third definitive measurement would be run. If the difference was higher than 10%, the data or the plot would be eliminated from the Carbon stock estimations. This was note done during carbon stocks measurements because it was not mandatory and because we find a more practical and accurate method for QA/QC procedures. Considering that Guanaré yearly performes a Continuous Forest Inventory (CFI) and that the sampling intensity performed in this CFI is higher than the one performed during the verification process, the QA/QC procedure was implemented as follows:.

- Once the CFI plots and the carbon stock estimation plots were measured, a statistical analysis was performed in order to detect plots that do not belong to the measured population,
- The statistical analysis presents a statistical and visual overview of the sample (CFI plots and the carbon stock estimation plots). A histogram and a combined dot-, box-, mean-, percentile- and SD- plot give a visual summary and statistics such as the mean, standard deviation (95% Confidence Interval) and median. Normality of the distribution of the sample can be visually assessed with the histogram. Outlier box plots show whiskers extending to the furthest observations within ±1.5 IQR (interquartile ranges) of the 1st or 3rd quartile. Observations outside 3.0 IQRs are marked as far outliers and must be re-checked because these are observations outside the usual range of observations of the variable. Such values are infrequent and may be entirely valid, but should be checked to ensure they are not the result of data entry, recording or measurement errors.
- Once this “near far outlier” was checked, we concluded that this sample belonged to the population and no measurement errors took place in this case.
- As an example, the following figure shows the statistical analysis performed for stratum number 10 “Las Cañas 2007 *E.grandis*”. No near or far outliers were detected in the right side of the curve (high values probably not belonging to the population in study).

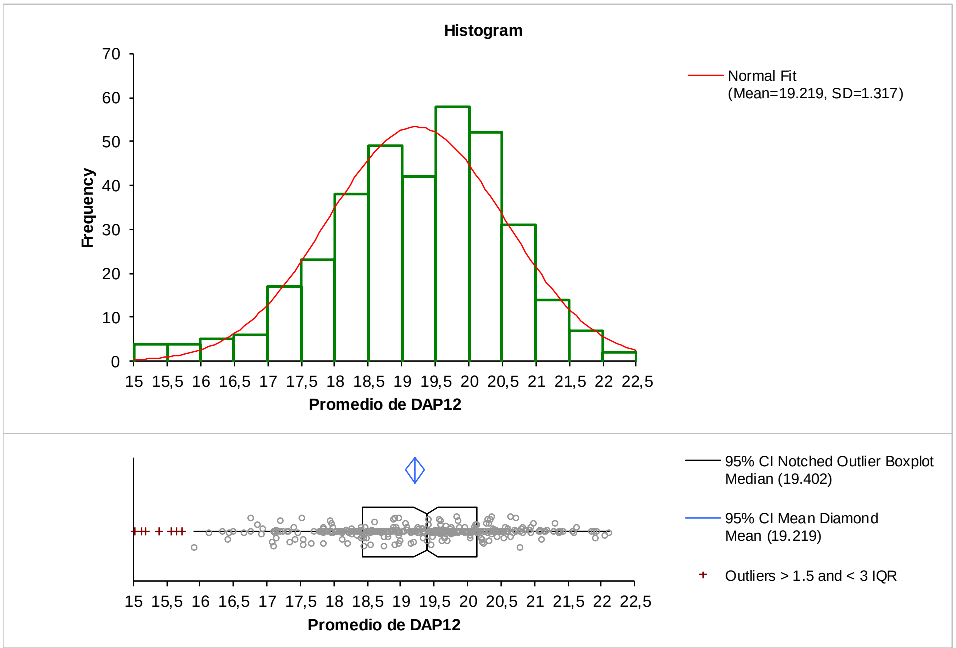

Figure 7. Statistical analysis performed

Any of these deviations presented above impacts the applicability of the methodology, additionality or the appropriateness of the baseline scenario. No project description deviations are presented in this capter from previous monitoring reports, given that this is the first monitoring report of this project.

2.3 Grouped Project

Guanaré forest plantations on degraded grasslands under extensive grazing is a single GHG Project.

3. DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	A_i
Data unit	ha
Description	Area of stratum *i*
Source of data	Monitoring of strata boundaries is done using a Geographical Information System (GIS) which allows data integration from different sources (including GPS coordinates and Remote Sensing data)
Value applied:	Variable according to stratum
Justification of choice of data or description of measurement methods and procedures applied	The method for data collection consists in the analysis of aerial photography after plantation. Professional services are hired to conduct flights for this specific work. In some cases, when boundaries are not clear enough, ground measurements are conducted with on-field GPS devices to check and control with accuracy the plantation edges. FAS is responsible for the

	measurement of this variable, which is also presented to the National Forest Direction. Measurement resulted in a total project area of 20,877 ha.
Purpose of the data	Calculation of project emissions/removals
Comments	Aerial photography and GPS is the most important tool used for measuring geographical variables: project boundaries and predefined stratum boundaries, forest area, area of disturbances (fires, droughts, harvesting, etc.). All information collected is immediately integrated to the GIS. During project monitoring, each plot coordinates were loaded on the GPS before field visit, in order to reach the exact location of each sample plot. The path took to reach each plot is also recorded by the GPS in tracks, which also includes information about waypoints, time, location and altitude.

Data / Parameter	$BEF_{2,j}$
Data unit	Dimensionless
Description	Biomass expansion factor for conversion of stem biomass to above ground biomass for tree species or group of species *j*
Source of data	IPCC default values (table 3A.1.10 of IPCC GPG-LULUCF 2003)
Value applied:	From 1.15 to 3.4, depending on the tree age and species
Justification of choice of data or description of measurement methods and procedures applied	The technique applied for estimation of *ex-post* changes in carbon stocks within the project boundary is the biomass expansion factor. There are no national values for this parameter.
Purpose of the data	Calculation of project emissions/removals
Comments	N/A

Data / Parameter	CF_j
Data unit	tC t^{-1}d.m.
Description	Carbon fraction of tree biomass for species or group of species *j*
Source of data	The IPCC default value
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied	There are no national values for this parameter.
Purpose of the data	Calculation of project emissions/removals

Comments	N/A

Data / Parameter	D*j*
Data unit	t d.m. m^{-3}
Description	Basic wood density for species or group of species *j*
Source of data	IPCC 2003. Table 3A.1.9-1 Basic wood densities of stem wood; Technical Note N° 8 INIA-LATU “Evaluación de parámetros de calidad de *Eucalyptus globulus* y *Eucalyptus maidennii* de plantaciones uruguayas para pulpa de celulosa”
Value applied:	0.46; 0.56; 0.521; 0.482 and 0.44 for *E. grandis*, *E. maidenii*, *E. globulus*, *E. dunnii* y *P. taeda* respectively
Justification of choice of data or description of measurement methods and procedures applied	Data was obtained from national sources when existent and from international literature where applicable.
Purpose of the data	Calculation of project emissions/removals
Comments	N/A

Data / Parameter	R*j*
Data unit	Dimensionless
Description	Root-shoot ratio for species or group of species *j*
Source of data	Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs"
Value applied:	0.236 to 0.349 depending on an equation which used the aboveground biomass as an input (specific values are presented in the ex-post carbon estimations) $$R = \frac{exp[-1.085 + 0.9256 \times ln(A)]}{A}$$
Justification of choice of data or description of measurement methods and procedures applied	Value obtained from corresponding tool and above-ground biomass measured during monitoring event
Purpose of the data	Calculation of project emissions/removals
Comments	N/A

Data / Parameter	Tree shape factor
Data unit	Dimensionless

Description	Factor used to transform the cylinder volume (basal area x height) to the real value of volume
Source of data	Local peer-reviewed studies in the country (under same climate and soil conditions), also national forest and GHG inventories in Uruguay.
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied	Commonly used tree shape factors in forestry sector in Uruguay, which in fact is conservative
Purpose of the data	Calculation of stem volume
Comments	N/A

Data / Parameter	$V_{TREE\ j\ p\ i}$
Data unit	m^3
Description	Stem volume of trees of species or group of species *j* in plot *p* in stratum *i*
Source of data	Local Growth models
Value applied:	N/A
Justification of choice of data or description of measurement methods and procedures applied	Local growth models were the most accurate source to estimate volume
Purpose of the data	Calculation of project emissions/removals
Comments	In case of ex ante calculation, growth was estimated based on average growth according to specific site conditions presented in the project site. Local growth models were used for ex-ante estimation to describe the yield curve and determine the Long Term Average of available carbon credits. Local growth models will not be used for ex-post estimation which was based on field measurements: DBH and height.

Data / Parameter	Bark volume
Data unit	m^3/ha
Description	Bark volume of trees of species
Source of data	Methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs"
Value applied:	15% of total stem volume

Justification of choice of data or description of measurement methods and procedures applied	Data obtained from the corresponding tool.
Purpose of the data	Calculation of ex-ante removals
Comments	The bark volume is a variable used in the ex-ante calculation. During field measurement, the volume of trees is estimated with bark when diameters are measured over bark.

Data / Parameter	$f_{IN,j}$
Data unit	Dimensionless
Description	Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum *i*
Source of data	Tables 6 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied	The data source is the corresponding tool
Purpose of the data	Calculation of project emissions/removals
Comments	N/A

Data / Parameter	$f_{MG,i}$
Data unit	Dimensionless
Description	Relative stock change factor for baseline management regime in stratum i of the areas of land.
Source of data	Table 6 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities
Value applied:	0.95
Justification of choice of data or description of measurement methods and procedures applied	The data source is the corresponding tool
Purpose of the data	Calculation of project emissions/removals
Comments	N/A

Data / Parameter	$f_{LU,i}$
Data unit	Dimensionless
Description	Relative stock change factor for baseline land-use in stratum i of the areas of land; dimensionless
Source of data	Tables 6 of "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project" activities
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied	The data source is the corresponding tool
Purpose of the data	Calculation of project emissions
Comments	N/A

Data / Parameter	SOC_{REF}
Data unit	$t\ C\ ha^{-1}$
Description	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation normally forest) by climate region and soil type applicable to stratum *i* of the areas of land.
Source of data	Table 3 of "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project" activities
Value applied:	88
Justification of choice of data or description of measurement methods and procedures applied	The data was obtained from the corresponding tool.
Purpose of the data	Calculation of project emissions/removals
Comments	N/A

Data / Parameter	Dead wood
Data unit	$t\ C\ ha^{-1}$
Description	Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass
Source of data	Tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities".
Value applied:	8% of carbon stock in trees biomass

Justification of choice of data or description of measurement methods and procedures applied	The data was obtained from the corresponding tool.
Purpose of the data	Calculation of project emissions/removals
Comments	N/A

Data / Parameter	Litter
Data unit	tC ha^{-1}
Description	Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass
Source of data	Tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”
Value applied:	4% of carbon stock in trees biomass
Justification of choice of data or description of measurement methods and procedures applied	The data was obtained from the corresponding tool.
Purpose of the data	Calculation of project emissions/removals
Comments	N/A

3.2 Data and Parameters Monitored

Data / Parameter	A_i
Data unit	ha
Description	Area of stratum *i*
Source of data	Monitoring of strata and stand boundaries was done using a Geographical Information System (GIS).
Description of measurement methods and procedures to be applied	Strata area were measured based on cartography documents, related with GIS.
Frequency of monitoring/recording	Every time the project boundaries are modified. When disturbances events take place, the project participants will re-built the stratum adding the area of the project under disturbance under a different category, if applicable.
Value monitored:	<table><tr><td>Stratum</td><td>Area</td></tr><tr><td>1</td><td>22,2</td></tr><tr><td>2</td><td>962,4</td></tr></table>

	3	335,4
	4	119,4
	5	290,8
	6	4.508,8
	7	5.203,9
	8	375,6
	9	221,9
	10	352,7
	11	772,3
	12	58,6
	13	879,3
	14	3.139,0
	15	39,5
	16	81,5
	17	371,2
	18	1.801,9
	19	331,5
	20	849,3
	21	160,6
	Total	20.877
Monitoring equipment	Garmin GPS	
QA/QC procedures to be applied	N/A	
Purpose of the data	Calculation of project emissions/removals	
Calculation method	N/A	
Comments	N/A	

Data / Parameter	DBH
Data unit	cm
Description	Diameter at Breast Height of tree
Source of data	Field measurements
Description of measurement methods and procedures to be applied	DBH is measured at 1.3 m above ground, over the bark. In case of stem deformation at this level (knots, forked trees, etc.), measurement was done over the deformation once the stem takes its normal shape, with the purpose of being conservative. DBH was measured in all trees within the plots.
Frequency of monitoring/recording	Every tree within sample plots and 5 trees outside the plot of one plot per stratum
Value monitored:	3546 values in 21 strata in 141 plots

Monitoring equipment	The equipment used was calipers; model "Mantax Blue" of Haglof, Sweden, see image below. 
QA/QC procedures to be applied	A quality control procedure consisted in staff member periodical training. The staff members were trained to make DBH measurements without errors: using firstly a measuring tape (to determine exactly where 1.3 meters height is located in their own bodies). Afterwards, they measured DBH in front of experts and member´s staff to achieve procedures consistency. Quality assurance of DBH measurement was done through statistical analysis with other plots (see chapter 2.2 Project Description Deviations). This is also useful to demonstrate that sample plots, on which carbon stock is measured, were not treated differently from the rest of the forests (for instance treated with irrigation or fertilization). Instruments were checked and tested before starting the verification process. Items checked: -Correct visualization if numbers in the calliper. -The straightness of the calliper and the lack of mechanical problems. The calliper length is not a problem since it is impossible the equipment stretches.Bark that is not stick to the stem was removed before measuring. Measurement was done once per tree, in one position pointing to the center of the plot with the caliper´s blade.
Purpose of the data	Calculation of project emissions
Calculation method	N/A.
Comments	The trees are considered to be inside the plot if more than 50% of DBH is inside the plot. Diameters were measured by taking one measure, always pointing the instrument´s shaft in direction to the middle of the plot.

	Parameter used indirectly in Equation N° 1 of the Methodological tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities“ (Version 03.0.0); for calculation of basal area and volume. Field data collected was compared with Guanare´s Continuous Forest Inventory (Inventario Forestal Continuo - IFC).

Data / Parameter	h
Data unit	m
Description	Height of trees within sample plots
Source of data	Field measurements
Description of measurement methods and procedures to be applied	According to the most common practices applied in biometrics, all trees are measured in height. The measurement was done according to the following procedure: • Identification of the individual tree to measure. • at the same level (independently that the measuring equipment corrects the value according to the slope), • The expert always stood at a certain distance to each tree, equivalent to the height of the tree..
Frequency of monitoring/recording	Every tree within sample plots and 5 trees outside the plot of one plot per stratum
Value monitored:	3,547 different height values
Monitoring equipment	Clinometer. See the following figure of the type of clinometer used during the monitoring events to measure tree heights. This image represents an electronic clinometer of Haglof, Sweden. 
QA/QC procedures to be applied	Quality assurance of height measurement was done through statistical analysis with other plots (see chapter 2.2 Project Description Deviations). This will also be useful to demonstrate that sample plots measured for carbon stocks calculations were not treated differently

	(for example with irrigation or fertilizers) from the rest of the forests. When referring to this electronic device, it was checked the correct visualization of the display. The clinometer was always kept in safe places in order to avoid display rupture. The equipment was always full charge of batteries and back up batteries were always available in case of emergency. Make control measurements using all involved equipment (human error should be minimized at minimum with well training and cross-checked control measurement activities).
Purpose of the data	Calculation of project emissions/removals
Calculation method	N/A
Comments	Field data collected was compared with Guanare´s Continuous Forest Inventory (Inventario Forestal Continuo - IFC).

Data / Parameter	D_n
Data unit	cm
Description	Diameter of the n^{th} piece of lying dead wood intersecting a transect line
Source of data	N/A
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	N/A
Value monitored:	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	N/A
Calculation method	N/A
Comments	The variable was classified in the PD as a variable to be monitored. However, given the simplicity and costly-effective mechanism to determine dead wood based on a conservative default value, it was decided not to monitor the variable. The estimation of dead wood was done using a conservative default-factor method provided in the tool “Estimation of carbon stocks and change in

	carbon stocks in dead wood and litter in A/R DM project activities". Dead wood is a percentage of carbon stock in tree biomass: 8% according to the tool in Temperate biome region

Data / Parameter	N
Data unit	Dimensionless
Description	Total number of wood pieces intersecting the transect
Source of data	N/A
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	N/A
Value monitored:	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	N/A
Calculation method	N/A
Comments	The variable was classified in the PD as a variable to be monitored. However, given the simplicity and costly-effective mechanism to determine dead wood based on a conservative default value, it was decided not to monitor the variable. The estimation of dead wood was done using a conservative default-factor method provided in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R DM project activities". Dead wood is a percentage of carbon stock in tree biomass: 8% according to the tool in Temperate biome region

Data / Parameter	$B_{LI\_WET,p,i}$
Data unit	Kg
Description	Wet weight of the composite litter sample
Source of data	N/A
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	N/A

Value monitored:	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	N/A
Calculation method	N/A
Comments	The variable was classified in the PD as a variable to be monitored. However, given the simplicity and costly-effective mechanism to determine litter based on a conservative default value, it was decided not to monitor the variable. The estimation of litter was done using a conservative default-factor method provided in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R DM project activities”. Litter is a percentage of carbon stock in tree biomass: 4% according to the tool in Temperate biome region

Data / Parameter	$DWR_{LI, p, i}$
Data unit	dimensionless
Description	Dry-to-wet weight ratio of the litter sub-sample collected from plots
Source of data	N/A
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	N/A
Value monitored:	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	N/A
Calculation method	N/A
Comments	The variable was classified in the PD as a variable to be monitored. However, given the simplicity and costly-effective mechanism to determine litter based on a conservative default value, it was decided not to monitor the variable. The estimation of litter was done using a conservative default-factor method provided in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R DM project activities”. Litter is a percentage of carbon stock in tree

	biomass: 4% according to the tool in Temperate biome region

Data / Parameter	Ap,i
Data unit	m^2
Description	Area of sampling plot
Source of data	Field measurement
Description of measurement methods and procedures to be applied	The center of the plot was marked with the assistance of a GPS. One staff member stayed at the center of the plot taking notes of the diameters and heights measured while the other expert of the team walked inside the plot measuring them. Both experts were always connected with a measuring tape, and every tree measured was previously checked in order to determine if the distance to the center was minor to 12.62 m (radius of a circular plot of $500m^2$).
Frequency of monitoring/recording	Every plot measured in Guanaré, 141 in total.
Value monitored:	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	In order to avoid over and under-estimations, every tree was considered inside the plot when the mark of 12.62 m overpassed the 50% of the diameter of every tree.
Purpose of the data	Calculation of project emissions
Calculation method	$500m^2 = r^2(12.62).\pi$
Comments	Sample plots are permanent and circular. The plots were laid down in a shapefile, positioned systematically with a random start. The location of the plots within the forest plantation was done with a GPS. The area of each plot is not a variable but a fixed value, but must be measured by its radius in order to determine the variable "number of trees within the plot"

3.3 Monitoring Plan

The aim of the Monitoring Plan is to record and monitor a number of different parameters in order to ensure that the project followed the corresponding methodology in the validated and registered PD and that the inputs to the carbon calculations are both accurate and up-to-date.

Monitoring was done according to the consolidated methodology AR-ACM 0001 “Afforestation and reforestation of degraded lands” (version 05.2.0, EB 65). The PD was registered mentioning the version 5.1.1 of the referred methodology but the applicable version is the one stated above. Analysis of its applicability conditions have been developed in section 2.2 of the PD.

Monitoring stage comprised gathering information, performing calculations and making estimations of GHG removals. In this monitoring event, it is ensured that commonly established principles of forest inventory and management were put into practice. All data gathered as part of the monitoring plan was archived electronically and in hard copies, and will be kept at least for two years after the end of the crediting period.

According to the methodology applied, monitoring covered carbon stock changes for living above-ground, litter and dead wood pools. Below ground biomass was estimated indirectly based on above-ground biomass measurements and litter and dead wood were also estimated as a percentage of carbon stock in tree biomass.

Monitoring events were conducted in the period of time comprised between July 2012 and January 2013. The third party involved in this stage was “Pike & Co. Consultora Forestal” which is a Uruguayan consultancy and services company, specialized in forest inventories. The reason why the measuring events were done in such extended period of time is that the measurements were made at the same time to the Continuous Forest Inventory (”Inventario Forestal Continuo” in spanish or IFC), that this company performes yearly to Guanaré.

Pike & Co.´s staff was compound by 8 persons during the monitoring events. They worked divided by project zones in two groups: 4 members were assigned to Cerro Largo zone and another 4 were assigned to Treinta y Tres zone. Besides, those groups were sub-divided, resulting in two teams composed by 2 persons each. During this work the locomotion consisted of two trucks and four motorbikes.

Sampling design and stratification

Project boundaries were defined at the beginning of project activity, was updated for this monitoring event and will be updated along the crediting period, since boundaries may vary or new strata may be created after disturbances effects (pests, droughts, fire). Geographic coordinates are established, recorded and archived. A Geographic Information System was implemented for the validation and is updated for verification. All the geographical information will be available for the verification team. Note that the project boundaries will always be the same. The reduction in the forest area does not represent a reversal (according to the VCS document Program Definitions) or a catastrophic event, then the project participant did not communicate this to the VCS. None of these situations have occurred within Guanare´s project boundaries

With the purpose of developing the monitoring plan, Guanaré was stratified into 21 strata. Stratification was done considering region; age class (plantation date); and species planted (*E. globulus, E. maidennii*, *E. dunnii, E. grandis, E. tereticornis* and *P. taeda)*.

Permanent sampling plots are selected, since these are considered to be more efficient for estimating changes in carbon stocks by filtering out any variance due to plot effect. The plots allocation is registered in a GIS and can always be located. The plots were established at the field with a stick painted in white at the center of the plot and are highly probable to be found after two or more years.

The location of the plots followed the guidance given by the corresponding methodological tool, as well as IPCC Good Practice Guidance for LULUCF (2002), chapter 4.3. An Arc-Map software (NAPA) developed by Pike & Co. was used to randomly locate the permanent sampling plots (location is systematic, with random start). This software has a feature to enable the location of all plots on forest areas (i.e., it avoids plots from being located in firebreaks and other non-planted areas). The map with the location of the sampling plots was loaded on the GPS receptors used by forest inventory crews, so that they can reach the plots accurately. An example of the software output for two contiguous strata is shown in figure 8.

The following table shows the number of plots calculated *ex-ante* and *ex-post* by strata.

Table 1. Number of plots per stratum.

Stratum	**Stratum**	**Species**	**N°plots per stratum estimated in PD**	**Measured Plots**
1	CCH/V 2006 globulus	*E. globulus*	3	6
2	CCH/V 2006 dunnii	*E. dunnii*	1	2
3	CCH/V 2009 maidenii	*E. maidenii*	1	2
4	CCH/V 2009 globulus	*E. globulus*	1	2
5	CCH/V 2010 maidenii	*E. maidenii*	1	2
6	Las cañas 2010 grandis	Not Planted	1	0
7	Las cañas 2011 grandis	*E. grandis*	1	2
8	Las cañas 2009 grandis	*E. grandis*	2	2
9	Las cañas 2008 grandis	*E. grandis*	29	29
10	Las cañas 2007 grandis	*E. grandis*	25	31
11	R/G 2007 taeda	*P. taeda*	1	2
12	R/G 2009 taeda	*P. taeda*	1	2
13	R/G 2009 tereticornis	*E. tereticornis*	1	2
14	R/G 2006 grandis	*E. grandis*	2	4
15	R/G 2007 grandis	*E. grandis*	4	5
16	R/G 2011 grandis	*E. grandis*	4	3
17	R/G 2008 grandis	*E. grandis*	5	5
18	R/G 2009 grandis	*E. grandis*	18	19
19	Tup 2009 grandis	*E. grandis*	5	5
20	Tup 2011 grandis	*E. grandis*	1	2
21	Tup 2008 grandis	*E. grandis*	2	2
22	Tup 2007 grandis	*E. grandis*	10	12
TOTAL			**119**	**141**

As shown in table 1, the number of plots finally measured during the field work was higher than the number calculated *ex-ante*. The reason of this increment was:

- If the *ex-ante* calculated number of plots per strata was 1, an additional plot was included.
- Due to an initial wrong *ex-ante* estimation, more than the requested number of plots were measured in some strata (example stratum 10)
- During *ex-ante* calculations, Guanaré was planning to install *E. grandis* plantations on year 2010 in Las Cañas region (Stratum 6). Finally, this plantation was cancelled.

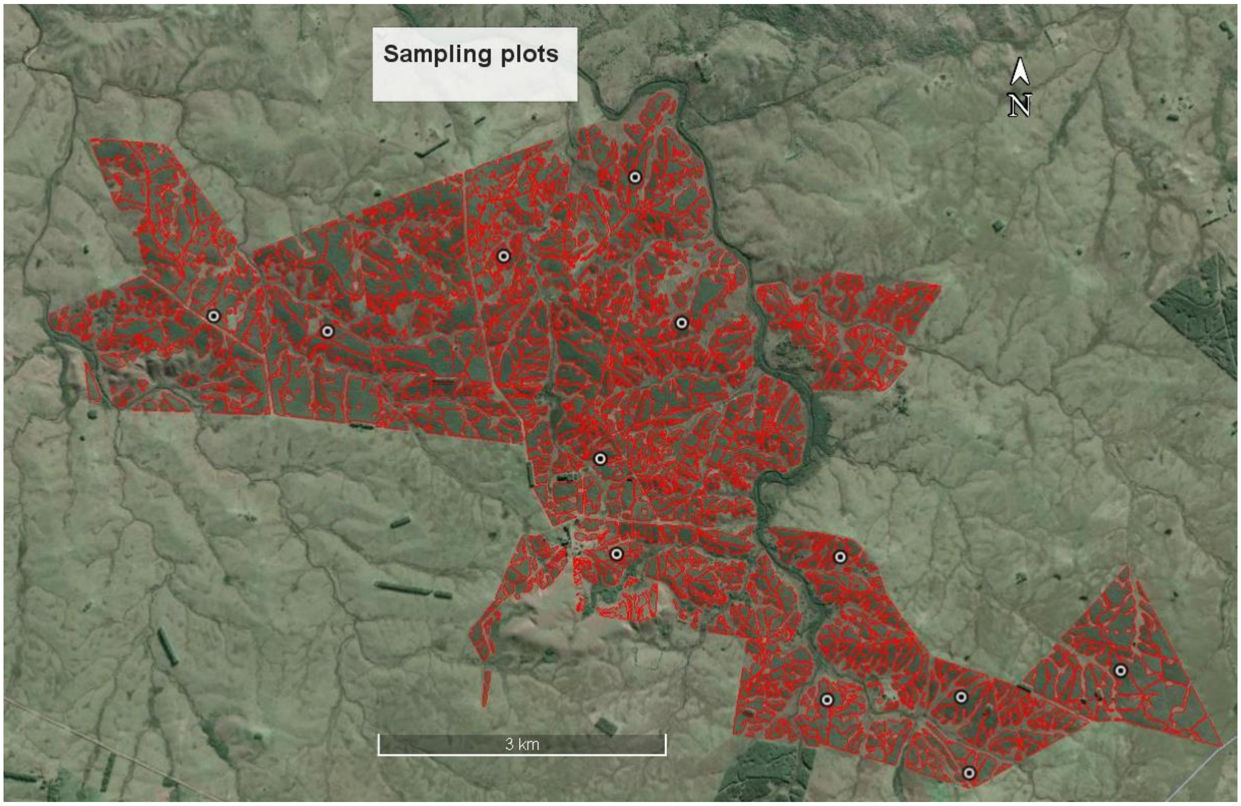

Figure 8. Example of location of permanent sampling plots

Each carbon pool was measured following the methodology procedures and IPCC Good Practice Guidance for LULUCF (2003). Carbon stocks in above and below ground biomass of trees are estimated by applying the BEF method, which calculates the biomass of trees of each species per unit area in each stratum at a given point of time, based on the following two dimensions: diameter and height, obtained from field measurements. These variables are used to estimate basal area and after application of a taper function, the total volume is estimated. By applying BEF method, stem volume of trees is then converted to above-ground biomas. Total tree biomass (above ground and below-ground) is estimated using basic wood density (D) and root-to-shoot ratio (R). Default carbon fraction (CF) value was used in order to estimate the carbon stock.

Prior to the start of the inventory, all equipment used during the field work was checked and calibrated. The project developer will manage the sampling uncertainties evaluating and trying to reduce the type of errors.

Managing data quality

A Quality Control System will be implemented for routinely checking for data consistency, correctness and completeness; for identifying and correcting errors and omissions; and for properly documenting and archiving data and documentation related with the monitoring activities. Quality Assurance measures will be implemented, in order to verify that data quality objectives are met, and in general, to support the effectiveness of the QC system.

QA/QC plan includes a number of activities aiming at achieving accuracy and precision of data, and transparency of procedures, such as:

-development of Standard Operating Procedures for field measurements, clearly defining all staff responsibilities and raising awareness about the importance of each tasks for producing reliable results;

-proper training of field measuring teams;

-periodical check and maintenance of measuring instruments; all mechanical, optical and electronic instruments will be periodically checked by qualified personnel. In addition, consistency on field data will be permanently monitored, in order to detect any malfunctioning.

-perform area measurements using different methods (e.g., aerial photograph, cadastral data, satellite images, ground measurements), and check for accuracy and consistency.

-development of electronic worksheets for data processing; special software may be designed for the monitoring process, with graphical capabilities and data consistency checking functions.

-fully document and archive field and processed data, as well as all procedures used; to ensure data preservation, all relevant data, data analyses, static factors, photos, images, GIS output and other data shall be stored in electronic and paper format.

-establish procedures for eliminating inconsistent or erroneous field data; perform random checks of field measurements in order to detect measurement errors or systematic biases; some of such measures are: 1) use field computers and automatic data loggers (e.g., electronic recording caliper), and hire independent workers for transferring field data to digital media. (IPCC GPG 5.3.6.1); 2) Quality assurance of DBH and height measurement was done through statistical analysis with other plots (see chapter 2.2 Project Description Deviations);

-establish procedures to ensure representativeness of PSPs (i.e., to avoid biased estimates due to differential management of PSPs); The allocation of samples in the field will be systematic with random start, so, the differences between population and sample mean and variance will tend to neutralized, as the sample fraction is wide enough; identification of plots in the field should be coded and apparent only to the monitoring team; periodical checks will be performed on simple measurements (e.g., DBH) outside PSPs, in order to correlate these values with plot measurements;

-development of allometric equations and emission/C-stock-change factors; project-specific equations and stock change factors would minimize errors, as compared to the use of default factors.

-check project data with benchmarks; this will help detecting possible inconsistencies in data collection or processing.

Operational and management structure

The monitoring was coordinated by the property manager and implemented by a qualified contractor. One staff member of Guanaré was identified as the focal point.

Entity applying monitoring plan

Company: ´Guanaré S.A.´

Address: Rincón 487, Office 201

City: Montevideo

Zip code: 11.000

Country: Uruguay

Phone: +598 2916 2510

Monitoring events and initial data processing were developed by the consultant Pike & Co.

Entity applying monitoring event in 2012-2013

Company: ´Pike & Co. Consultora Forestal´

Phone: +598 2 916 1085

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Figure 9. Measuring events on Guanaré´s plantations

4. QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Since continuation of an activity that has been applied without changes for more than 20 years has been selected as the baseline scenario, it is assumed, in agreement with IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (2003) that the net GHG removals by sinks in the baseline equals zero.

4.2 Project Emissions

Guanaré project activity does not have GHG emissions. However, this chapter refers to the removals of GHG within this project activity.

Net anthropogenic GHG removals by sinks is estimated as the actual net GHG removals by sinks minus the baseline net GHG removals, minus leakage. The following general formula described in the methodology is used to calculate the net anthropogenic GHG removals by sinks of an A/R project activity, in t CO_2-e:

$$C_{AR-CDM} = \triangle\, C_{ACTUAL} - \triangle\, C_{BSL} - LK$$

Where:

C_{AR-CDM}	Net anthropogenic GHG removals by sinks; t CO_2-e.
$\triangle\, C_{ACTUAL}$	Actual net GHG removals by sinks; t CO_2-e.
$\triangle\, C_{BSL}$	Baseline net GHG removals by sinks; t CO_2-e.
LK	Total GHG emissions due to leakage; t CO_2-e.

The actual net greenhouse gas removals by sinks were estimated using the following equation described in the methodology:

$$\triangle\, C_{ACTUAL} = \triangle\, C_P - GHG_E$$

Where:

$\triangle\, C_{ACTUAL}$	Actual net greenhouse gas removals by sinks; t CO_2-e.
$\triangle\, C_P$	Sum of the changes in above-ground and below-ground tree biomass, dead wood, litter and soil organic carbon stocks in the project scenario; t CO_2-e.
GHG_E	Increase in GHG emissions as a result of the implementation of the proposed A/R CDM project activity within the project boundary; t CO_2-e.

The following formula described in the methodology is used in order to estimate GHG emission:

$$GHG_E = \sum_{t=1}^{t*} GHG_{E,t}$$

Where:

GHG_E Increase in GHG emissions as a result of the implementation of the proposed A/R CDM project activity within the project boundary; t CO_2-e.

$GHG_{E,t}$ Increase in non-CO_2 emissions due to biomass burning of existing vegetation as part of site preparation in year t; t CO2-e.

t 1,2,3,……..,t* years elapsed since the start of the A/R CDM project activity.

The tool for "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" has been considered. The use of fire for site preparation and/or to clear the land of harvest residue prior to replanting is specifically excluded from the project management and therefore project emissions are estimated as zero.

Carbon stock changes

ΔC_P is the sum of the changes in above-ground and below-ground tree biomass, dead wood, litter and soil organic carbon stocks in the project scenario. For *ex-ante* estimation, all pools were accounted. Following is presented the equation for the estimation of ΔC_P. Calculations are described below.

$$\Delta\, c_P = \Delta\, c_{TREE} + \Delta\, c_{SHRUB} + \Delta\, c_{DW} + \Delta\, c_{LI} + \Delta\, c_{SOC}$$

Where:

$\Delta\, c_P$ Change in carbon stock in all selected carbon pools in the project scenario, t CO_2-e.

$\Delta\, c_{TREE}$ Change in carbon stock in tree biomass in project, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e.

$\Delta\, c_{SHRUB}$ Change in carbon stock in shrub biomass in project, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities". The project developer decided not to measure this pool given that carbon stock in shrub biomass in project is not expected to increase.

$\Delta\, c_{DW}$ Change in carbon stock in dead wood biomass in project, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e.

$\Delta\ c_{LI}$ Change in carbon stock in litter biomass in project, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”; t CO_2-e.

$\Delta\ c_{SOC}$ Change in carbon stock in SOC in project, in areas of land meeting the applicability conditions of the tool “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”, as estimated in the same tool; t CO_2-e.

Biomass carbon pools

Above and below ground biomass have been estimated according to the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity”. Carbon estimations in trees are based on field measurements of monitored parameters, chapter 3.2 of the Monitoring Report. Estimations are archived as part of the project verification and will be available for the verification team.

The aboveground biomass corresponds to tree biomass, no shrubs are considered for estimation. The method used for estimating change in carbon stock in trees is the “stock change method”. Change in carbon stock in trees in two successive points in time is calculated as the difference between the two estimated stocks. As this is the first monitoring report the carbon values in every pool is the final result, the starting point of the crediting period is zero carbon.

As in *ex-ante* estimations, the following equations were used in order to estimate above and below ground biomass *ex-post* measurements:

$$B_{TREE\,j,p,i,t} = V_{TREE\,j,p,i,t} * \ D_J * BEF_{2,J} * (1 + R_J)$$

Where:

$B_{TREE,j,p,i,t}$ Biomass of trees of species *j* in sample plot *p* of stratum *i* at early 2013.

$V_{TREE\,j,p,i,t}$ Stem volume of tree species using field measurements of tree parameters (DBH and height), default values (tree shape factor) and complemented with worksheets data processing; m^3.

The applied equation for volume estimation is no other formula than the cylinder volume equation corrected by a taper value:

$$V_{TREE} = Basal\ area \times \ height\ \times\ TSF$$

Where:

$$Basal\ area = \frac{\pi \times DBH^2}{4}$$

Being DBH Diameter at Breast Height and TSF the tree shape factor value.

According to the methodology, for ex-post estimation, the volume equation used must be demonstrated to be appropriate for the purpose of estimation of tree biomass by applying the tool “Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities". The appropriateness of the equations is demonstrated through the satisfaction of the following conditions, in the sense that the formula is very generic and applicable in any case:

- The equation is used both in the national forestry inventory and the national GHG inventory of Uruguay, and
- The equation has been used in commercial forestry sector in Uruguay for 10 years or more.

The tree shape factor (TSF) used is 0.5 (the same generic value for all species that the project comprises) and the appropriateness of it was demonstrated during validation, it is a parameter available at validation and is not monitored. It is neither mentioned in the methodology as a monitored parameter.

However, it is preferred to demonstrate the appropriateness of this value with some other documents that support it[1].

D_J Basic wood density of tree species j. The species j corresponds to the species used in this project: *Pinus taeda*., with a basic density of 44 t.d.m./m^3; *Eucalyptus grandis* with a basic density of 46 t.d.m./m^3*; Eucalyptus maidenii* with a basic density of 54 t.d.m./m^3*; Eucalyptus globulus* with a basic density of 52 t.d.m./m^3, *Eucalyptus dunnii* with a basic density of 48.2 t.d.m./m^3 and *E. tereticornis* with a basic density of 56.0 t.d.m./m^3. This parameter was established as "available at validation" in the Project Design, thus it was not measured or monitored. Source of data is IPCC 2003, table 3A.1.9-1[2] and technical Note N° 8 INIA-LATU "Evaluación de parámetros de calidad de *Eucalyptus globulus* y *Eucalyptus maidennii* de plantaciones uruguayas para pulpa de celulosa".

$BEF_{2,J}$ Biomass expansion factor for conversion of stem biomass to above-ground tree biomass, for tree species *j* (*Pinus taeda, Eucalyptus grandis, Eucalyptus maidenii, Eucalyptus globulus, Eucalyptus tereticornis* and *Eucalyptus dunnii*); dimensionless. The BEF2 is to be used in connection to growing stock biomass data and not with increment data, as described in chapter 3.2 of the GPG for LULUCF (2003)). The value was also available at validation and not monitored, it ranged from 3.4 (for young forest) to 1.15 (mature forests) and the exact values applied for different plantation dates are reported in the final worksheet for carbon stock calculation.

R_J Root-shoot ratio for tree species j; dimensionless. The values applied were taken from the suggested equation from the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs":

$$R = \frac{exp[-1.085+0.9256\times ln(A)]}{A}.$$

Where A is aboveground biomass content (t.d.m./ha). The aboveground biomass was calculated per year of plantation and different values were obtained.

Finally, the carbon stock in tree biomass within the project boundary is estimated as follows:

$$C_{TREE} = \frac{44}{12} * B_{TREE} * CF_{TREE}$$

[1] "Proyecto Regional de alternativas para la inversión forestal", Cap. VI, cuadro 6.7 (http://www.oas.org/dsd/publications/Unit/oea20s/ch08.htm)

[2] http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/Chp3/Anx_3A_1_Data_Tables..pdf

Where:

C_{TREE} Carbon stock in tree biomass within the project boundary; t CO_2-e.

B_{TREE} Biomass of trees within the project boundaries.

CF_{TREE} Carbon fraction of tree biomass; 0.5 t C td.m^3.

Soil organic carbon

Estimations of soil organic carbon (SOC) stocks were done in accordance to the "Tool for the estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activity". As suggested by the tool, it is assumed that the implementation of the project activity increases the SOC content of the lands from the pre-project level to the level that is equal to the steady-state SOC content under native vegetation. The increase in SOC content in the project scenario takes place at a constant rate over a period of 20 years from the year of planting. The project meets the applicability conditions of this tool -as demonstrated in validation- since the areas of land to which the tool is applied do not fall into wetland category, do not contain organic soils and are not subject to any of the land management practices and application of inputs listed in the tool.

Litter remains on site and is not removed and soil disturbance is in accordance with appropriate conservation practices, limited to site preparation and not repeated within 20 years.

Table 8. Parameters used for estimation of Soil Organic Carbon (SOC).

Parameter	Symbol	Value	Source (SOC estimation tool, V01.1.0)
Reference SOC (tC/ha)	$SOC_{REF,i}$	88	Table 3. HAC soils, warm temperate
Land use factor	$f_{LU,i}$	1	Table 6. All permanent grassland
Management factor	$f_{MG,i}$	0.95	Table 6. Moderately degraded grassland Overgrazed or moderately degraded grassland, with somewhat reduced productivity (relative to the native or nominally managed grassland) and receiving no management inputs.
Input factor	$f_{IN,i}$	1	Table 6. Grassland without input of fertilizer

SOC at the beginning of the project ($SOC_{INICIAL,i}$) is estimated by multiplying the factors in Table 8 by the reference SOC. As per the tool, a loss in SOC ($SOC_{LOSS,i}$) is applied in the case that soil disturbance occurs on more than 10 per cent of the land area, which is the case of Guanaré project. The following methodological formula is used for calculating the annual change in SOC stock:

$$dSOC_{t,i} = \frac{SOC_{REF,i} - (SOC_{INICIAL,i} - SOC_{LOSS,i})}{20}$$

Where:

$dSOC_{t,i}$ The rate of change in SOC stock in stratum i of the area of land, in year t; t C/ha/yr.

$SOC_{REF,i}$ Reference SOC stock corresponding to the reference condition in native lands by climate region and soil types applicable to stratum i of the area of land; tC/ha.

$SOC_{INICIAL,i}$ SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the areas of land.

$SOC_{LOSS,i}$ Loss of SOC caused by soil disturbance attributable to the A/R CDM project activity, in stratum *i* of the areas of land; tC/ha.

From the project start day there has passed 2.190 days and the correspondent carbon sequestration is presented to the verification team in the calculation worksheet.

Litter and Dead Wood

Estimations were done in accordance with the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities" using a default and conservative value of 8% and 4% of carbon stock in tree biomass for dead wood and litter respectively.

4.3 Leakage

As it has been stated in PD document, the methodology requires the assessment of sources of leakage due to activity displacement (conversion from grazing land to forestry). Application of the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" led to the conclusion that this source can be neglected. The application of the "Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant", which is one of the applicability conditions of the tool, resulted in the conclusion that the project will not cause any displacement of the activity occurring before project implementation. The project accomplishes the following conditions:

(b) The total area expected to be displaced is more than 5% of the entire A/R CDM project activity or more than 50 ha, and the n – a ha (where "n" is the area in ha expected to be displaced and "a" is 5% of the total project area or 50 ha) are displaced to:

i. Areas of land that can be identified as degraded or degrading.

ii. Existing grasslands with the carrying capacity that allows for accommodation of the displaced animals during the entire period of displacement.

The total area to be displaced corresponds to the total area of the project 20.877 ha, meaning that the grazing area displaced is 100% and also more than 50 ha, then the value "n" – "a" is 20.877 – (5% of 20.877 = 1.043,9) = 19.833,1 ha. This area, used for grazing cattle, can be identified as degraded.

(i) The grazing cattle displaced by Guanaré project will be to neighbor areas. One of the main explanations are that the project areas are not located in only one farm but in 6 different areas (as seen in figure 1. It was already demonstrated that the project areas are degraded or degrading, and because the grazing animals are moved to neighbor zones (to control during on-site validation visit), the same conditions applies to this specific soil.

(ii) Moreover, the animals will be displaced only for 1 to 2 years and lately returned to the same site. The silvicultural management practice does not permit the animals to be grazing at the same time with the small trees, to avoid any physical damages. When the trees are big enough 1 or 2 years, the animals are reintroduced. During the period when the animals are displaced, the grasslands to where they go have the carrying capacity, as seen in table 4, the majority of farms in the project area (64%) are dedicated to beef cattle production. In Uruguay 80% of the land is dedicated to grazing animals.

(d) The total number of animals expected to be displaced is more than 40 LSU, and the n – 40 LSU (where "n" is the total number of animals, expressed in LSU, which are expected to be displaced) are displaced to:

i. Areas of land that can identify as degraded or degrading

ii. Existing grasslands with the carrying capacity that allows for accommodation of the displaced animals during the entire period of displacement

v. Slaughterhouses

Option (i) and (ii) were already demonstrated above. Option (v) is also valid for the case of Guanaré project. This is a common practice in the cattle beef production in Uruguay.

Most of the supporting evidence for the above paragraph demonstration can be obtained through the observation of the Uruguayan farms and it´s cattle production system during on-site visits.

Beyond all, we believe the application of the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" is not necessary. The application of the "Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant", which was superseded by the previously mentioned tool, resulted in the conclusion that the project will not cause any displacement of the activity occurring before project implementation.
Beef cattle breeding (cow-calf) was the dominant activity in the pre-project land (Eastern hilly areas of Uruguay). Cattle were based on a breeding herd where heifers are mostly placed with bulls at the age of 3 years. Sales include culling cows to be fattened, surplus heifers, and calves (at weaning). Average production is 33 kg per ha per year[3].

Considering the area subject to be afforested represents only 45-50% of the total area owned by the project participant (lowlands, biological corridors, roads, rocky areas, settlements, among others, complete the rest of the land use), the displacement of grazing activity can be considered neglected because:

- Uruguayan grazing activity is completely associated with forestry. A larger amount of cattle, more than what is usual, is put within the project area during some months to substantially reduce the amount of above ground biomass minimizing the use of glyphosate (herbicides for site preparation) during site preparation for the forest establishment

- During site preparation and for a maximum of two years after forest establishment, cattle is put apart in similar areas (commonly in neighbors farms) to prevent cattle from harming the small trees. During the period in which cattle loss the winger part of leather, it is very common the animal uses fences or trees to scratch. After these two years cattle is reintroduced and managed in a silvopastural system with trees (both activities complement each other). The impact of cattle displacement is reduced to two years over thirty year rotation.

- The total area under project activity was not afforested in the same year; the first year was dedicated only for site preparation, the second year 80 hectares were planted and 1.000 hectares during the third year. The following two years there were not any planting activity, finishing the sixth and seventh year with 387 and 71 hectares, respectively. The impact of this staggered plantation plan substantially reduces the eventual grazing displacement, cattle that has to be moved to other areas can be put in farms that were not afforested or in areas that has more than two years with forestry owned by Guanaré.

- Silvopastural production is conducted during twenty eight years of the thirty year rotation period. Silvopasture combines trees with forage and livestock production. The trees are managed for high-value sawlogs and, at the same time, provide shade and shelter for livestock and forage, reducing stress and increasing forage production

[3] INIA., 2001. Tecnologías forrajeras para sistemas ganaderos de Uruguay. Boletín de Divulgación 76.

Figure 10. Silvopastural system in Uruguay.

- During one and a half year –maximum two –cattle is put in existing grasslands with the carrying capacity that allows for accommodation of the displaced animals during this period of displacement. These are areas with no forest (80% of Uruguayan surface is pasture) meaning that deforestation never occurs when introducing cattle in farms. And these areas can be identified as degraded.

- Existing cattle in the pre-project situation may either stay within project boundaries or in an area controlled by project participant, or be sold to the market (calves and surplus heifers are normally sold in the market for fattening on other grazing areas, while cows, heifers and a reduced number of bulls are sold to slaughterhouses). It is Guanaré's policy that land owners can continue with their activities for a certain period after the purchase of the land, so that they have time to reduce the population of their cattle. In some cases, they may even stay in the land.

Furthermore, according to data gathered from governmental Livestock Controller Division (DICOSE) [4] there has been a smooth increase in the beef cattle number of heads at a national level (Figure 10).

On the other hand, according to data taken from National Forest Directorate (DGF) [5] forest plantations have also been increasing for the same period of time (Figure 11). In addition, native forest has been also increasing in terms of area in the last 43 years at the National level. According to National Forest Inventory (2010) [6] and to the forest maps based on aerial photographs of 1967[7] native forests have increased 21% in terms of area. The fact that total forest area and amount of livestock have been increasing is evidence that project activity does not result in displacement of the previous productive system. Therefore, leakage is assumed to be zero.

[4] http://www.mgap.gub.uy/DGSG/DICOSE/Informe2007/gravaccar2007.ppt
[5] http://www.mgap.gub.uy/portal/hgxpp001.aspx?7,20,442,O,S,0,,
[6] http://www.mgap.gub.uy/portal/hgxpp001.aspx?7,20,440,O,S,0,,
[7]URUGUAY MAP. Forest Directorate.- First Forest Chart. Montevideo: MAP, 1979 (http://www.mgap.gub.uy/portal/hgxpp001.aspx?7,20,410,O,S,0,MNU;E;2;15;125;1;MNU;,)

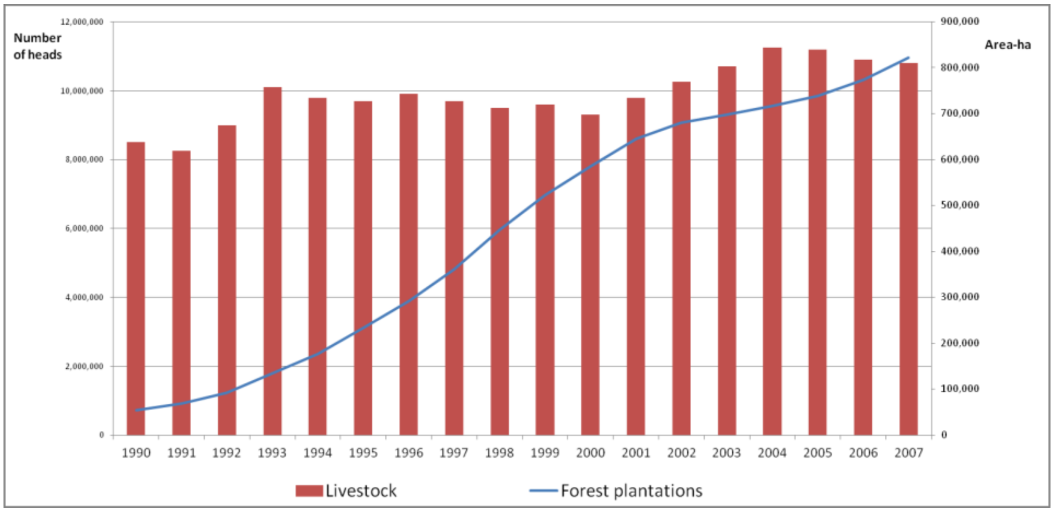

Figure 11 Blue curve shows the evolution of grassland area converted to forest plantations. Red bars show the number of cattle heads in each year. Statistics were taken from official sources at a national scale.

4.4 Net GHG Emission Reductions and Removals

The final results for carbon stock calculation are presented in the table below. Baseline net GHG removals and total GHG emissions due to leakage are zero, thus ex-post measurement of C AR−CDM equals ΔC ACTUAL:

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
2006	0	249,721	0	249,721
2007	0	1,359,224	0	1,359,224
2008	0	1,134,322	0	1,134,322
2009	0	309,067	0	309,067
2010	0	9,749	0	9,749
2011	0	6,220	0	6,220
Total	0	3,068,303	0	3,068,303

According to VCS version 3, AFOLU requirements, the amount of carbon credits must not exceed the long term GHG benefit of the project which is 7.644.973 t CO_2

Conservative approach

While applying this methodology, Guanaré ensures that “Guidelines on conservative choice and application of default data in estimation of the net anthropogenic GHG removals by sinks” is followed for addressing uncertainty.

The table below shows all variables used for estimation of the net anthropogenic GHG removals by sinks and how it is ensured that application of default data results in conservative, but not overly conservative estimates.

Table 9. Variables used for carbon stock calculation

Variable	Source of data	Conservativeness
BEF2 (Biomass Expansion Factor)	IPCC default values (table 3A.1.10 of IPCC GPG-LULUCF 2003)	When IPCC literature is used and data is available for conditions that are similar to the project (same vegetation genus, same ecological zone), then mean values of the data are considered as conservative
CF (Carbon Fraction)	The IPCC default value	When IPCC literature is used and data is available for conditions that are similar to the project (same vegetation genus, same ecological zone), then mean values of the data are considered as conservative
D (basic wood Density)	IPCC 2003. Table 3A.1.9-1 Basic wood densities of stem wood Technical Note N° 8 INIA-LATU	When IPCC literature is used and data is available for conditions that are similar to the project (same vegetation genus, same ecological zone), then mean values of the data are considered as conservative Local peer-reviewed studies under similar climate/soil conditions – provided the smaller datasets typical of local studies are considered sufficiently reliable
R (Root-shoot ratio)	Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs"	As per Guidelines quoted above: "If an approved A/R CDM methodology requires application of a default value and provides its numerical value then the value shall be considered as the conservative one"
f_{IN} (Relative stock change factor for baseline input regime)	A/R Methodological tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"	As per Guidelines quoted above: "If an approved A/R CDM methodology requires application of a default value and provides its numerical value then the value shall be considered as the conservative one"
f_{MG} (Relative stock change factor for baseline management regime)	A/R Methodological tool "Tool for estimation of change in soil organic	As per Guidelines quoted above: "If an approved A/R CDM methodology requires application of a default value

	carbon stocks due to the implementation of A/R CDM project activities”	and provides its numerical value then the value shall be considered as the conservative one”
f_{LU} (Relative stock change factor for baseline land-use)	A/R Methodological tool “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”	As per Guidelines quoted above: “If an approved A/R CDM methodology requires application of a default value and provides its numerical value then the value shall be considered as the conservative one”
SOC_{REF} (Reference SOC stock corresponding to the reference condition in native lands)	A/R Methodological tool “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”	As per Guidelines quoted above: “If an approved A/R CDM methodology requires application of a default value and provides its numerical value then the value shall be considered as the conservative one”
Dead wood (Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass)	A/R Methodological tool “Estimation of carbon stocks in dead wood and litter in A/R CDM project activities”	As per Guidelines quoted above: “If an approved A/R CDM methodology requires application of a default value and provides its numerical value then the value shall be considered as the conservative one”
Litter (Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass)	A/R Methodological tool “Estimation of carbon stocks in dead wood and litter in A/R CDM project activities”	As per Guidelines quoted above: “If an approved A/R CDM methodology requires application of a default value and provides its numerical value then the value shall be considered as the conservative one”

Uncertainty of tree biomass per hectare

According to the instructions given in Version 03.0.0 of “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/RCDM project activity” tool, uncertainty of tree biomass per hectare within the project boundary was calculated, using the following formula:

$$u_{bTREE,t} = \frac{t_{VAL\ x}\ s_{bTREE,t}}{b_{TREE,t}}$$

Where:

$u_{bTREE,t}$ Uncertainty of tree biomass per hectare within the project boundary at a given point of time in year t, %.

t_{VAL} Two – sided Student´s t-value for: (i) Degrees of freedom equal to n-M, where n is total number of sample plots within the project boundary, and M is the total number of tree biomass estimation strata; and (ii) a confidence level of 90%.

$S_{bTREE,t}$ Square root of the variance of mean tree biomass per hectare within project boundary at a given point of time in year t (i.e. the standard error of the mean); t d.m.ha-1.

$b_{TREE,t}$ Mean tree biomass per hectare within the project boundary at a given point of time in year t; t d.m.ha-1.

In order to assure the reliability of the obtained results, a statistical analysis was done, including three items:

- Calculate the uncertainty of the mean tree biomass per hectare within the project boundary, by applying the formula stated above.
- In order to follow the QA/QC standards it was decided to compare the results of the plots included in the project with the other plots measured in the Continuous Forest Inventory (IFC) in order to demonstrate that the carbon project plots were not treated differently.

Regarding the uncertainty of the mean tree biomass per hectare within the project boundary, the obtained value resulted in 4.5 % which means that the value of GHG Emission Reductions and Removals (tCO_2) calculated is reliable. Calculations were based on α value of 0.1.

Given that the uncertainty of the mean tree carbon per hectare within the project boundary is lower than 10%, it was no necessary to install additional sample plots or accept a deduction in the estimated change in carbon stocks. In other words, there was no correction for large maximum allowable relative error.

Emission Reduction by Year (vintage)

A carbon credit's "vintage" refers to the year that the emissions reduction took place.

With the growth increments values there were calculated the Current Annual Increment (CAI- It is the increment, which a tree puts on in a single year) for each specie/genus.

After obtaining the CAI, it was calculated the annual growth by year (m^3/year) and the percentage of GHG Emissions Reductions and Removals by year on the forests within the project boundaries.

Table 10. Year that the emissions reduction took place (Vintage).

	Total GHG Emission Reductions and Removals by year and by forest age (t CO2)							
Planted Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	
Age	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**TOTAL**
Planted 2006	251	754	29.378	20.356	58.316	38.532	102.134	**249.721**
Planted 2007	0	4.852	14.556	164.972	165.038	845.359	164.447	**1.359.224**
Planted 2008	0	0	4.611	13.833	156.776	156.776	802.326	**1.134.322**
Planted 2009	0	0	0	4.000	12.000	149.362	143.705	**309.067**
Planted 2010	0	0	0	0	0	0	9.749	**9.749**
Planted 2011	0	0	0	0	0	1.555	4.665	**6.220**
Planted 2012	0	0	0	0	0	0	0	**0**
								3.068.303
TOTAL (t CO2)	**251**	**5.606**	**48.545**	**203.161**	**392.130**	**1.191.584**	**1.227.026**	**3.068.303**
	0,0%	**0,2%**	**1,6%**	**6,6%**	**12,8%**	**38,8%**	**40,0%**	**100,0%**