Monitoring report form for CDM project activity

(Version 08.0)

Complete this form in accordance with the instructions attached at the end of this form.

MONITORING REPORT			
Title of the project activity	**CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia**		
UNFCCC reference number of the project activity	9199		
Version number of the PDD applicable to this monitoring report	Version 03.0		
Version number of this monitoring report	Version 01.0		
Completion date of this monitoring report	30/04/2021		
Monitoring period number	Second monitoring period		
Duration of this monitoring period	17/02/2016 – 01/10/2020		
Monitoring report number for this monitoring period	01		
Project participants	Bosques de la Primavera S.A.		
Host Party	Colombia		
Applied methodologies and standardized baselines	Reforestation or afforestation of land currently under agricultural use, ARAM0004, Version 04 Change to AR-ACM003.		
Sectoral scopes	Afforestation and Reforestation (14)		
Amount of GHG emission reductions or net anthropogenic GHG removals achieved by the project activity in this monitoring period	Amount achieved before 1 January 2013	Amount achieved from 1 January 2013 until 31 December 2020	Amount achieved from 1 January 2021
	0	**4,485,617 tCO2eq**	0
Amount of GHG emission reductions or net anthropogenic GHG removals estimated ex ante for this monitoring period in the PDD	**3,234,131 tCO2eq.**		

SECTION A. Description of project activity

A.1. General description of project activity

a) Purpose of the project activity and the measures taken for GHG emission reductions or net GHG removals by sinks;

The CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia has as its objective to employ the international carbon market as a key incentive for investments in new commercial forest plantations and restoration of natural forests in the remote High Orinoco region of Colombia.

The project is based on changing the use of land from extensive cattle ranching to sustainable forest production systems, restoring natural forest cover, and creating a landscape of biological and productive corridors that produce financial, social and environmental services for the region. These include the mitigation of climate change, regulation of water flows, expansion of habitat and conservation of the flora and fauna of the Orinoco region, among others.

Locally, the social benefits of the project include the direct and indirect creation of employment, the technification of manual labor, the development of social and productive infrastructure, and the demonstration of how the CDM and carbon markets may support the sustainable development of the region. The project is drawing labor force away from the illegal crops which have plagued the region.

The project was originated in 2005, when the Ministry of Agriculture and Rural Development began a program to promote the CDM as a means to financially bolster and promote reforestation and afforestation activity in the region.

The project is a private initiative composed of 6 groups: Organización La Primavera S.A., Bosques de la Orinoquía S.A., Bosques de La Primavera S.A., the María Padres Monfortianos Company, the Reforestadora Guacamayas S.A. the Reforestadora Los Cambulos S.A.S. and Incomser LTDA.

The total area of the project is 29,019hectares' eligibility. An extensive cattle ranching based on regular anthropogenic burning of grasslands has been the dominant model of land-use for over a century. As a result of the remoteness, lack of infrastructure and high transportation costs, this system has dominated land-use: 90% of the productive land of the Municipality of La Primavera is devoted to livestock grazing (Land Management Plan - EOT 2000).

At the present verification, only report 22,005.37 hectares established in the different stand models (commercial stand models and in natural regeneration systems) of the 29,019 hectares' eligibility.

The project achieved the replacement of activities that historically have been developed in the project area. Instead of those activities that used to lead soil degradation, today are covered by commercial forest systems and recovery of native forests with natural regeneration. These new systems have allowed the connectivity between gallery forests, plantations and area in recovery for the mobility of species of fauna and improving the flow gene between relicts of forests.

Among the aspects to be highlighted during the current period are the ability to recover degraded soils, due to the unsustainable use of land to livestock production and the continuous burnings to which they were subjected historically. Nowadays by the implementation of the project, soils have horizons with organic compounds that were not distinguishable at the beginning of the process. Therefore, the assessment of this additional sink is included to validation process to those already submitted, as a significant contribution in the soil recovery.

The organizational structure observed permits the implementation of monitoring actions on silvicultural, social and environmental activities (Diagram 1), and have a special emphasis on components related to the CDM (Diagram 2).

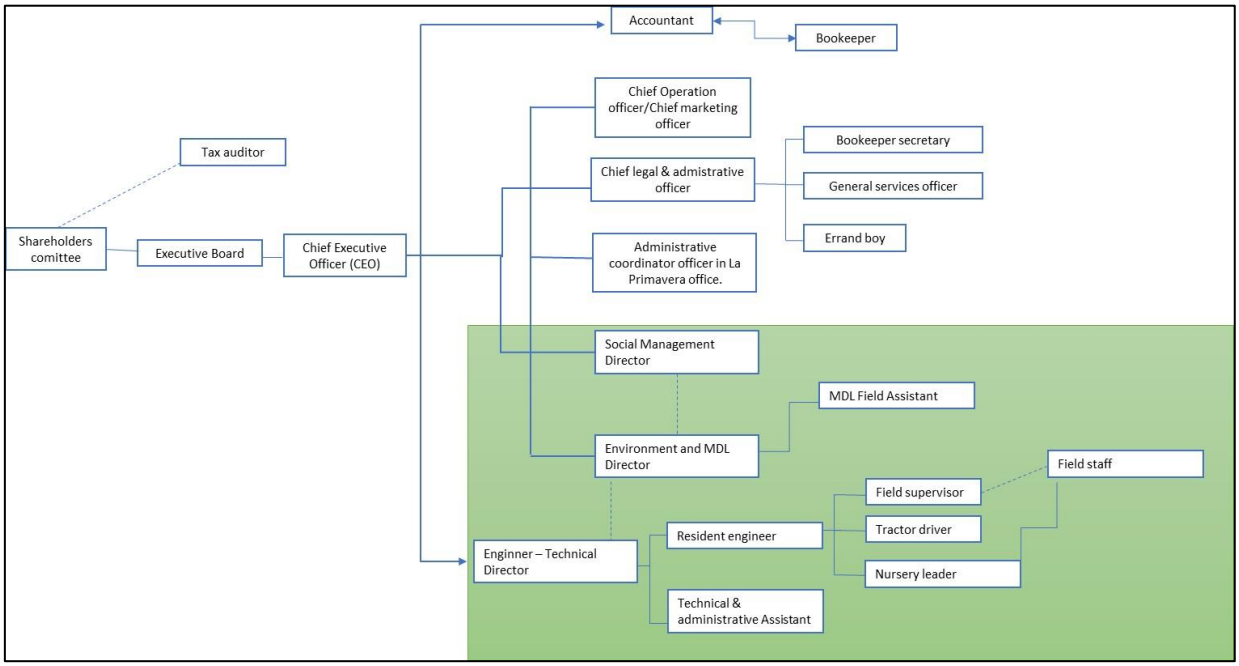


Diagram 1. Organization chart Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia.

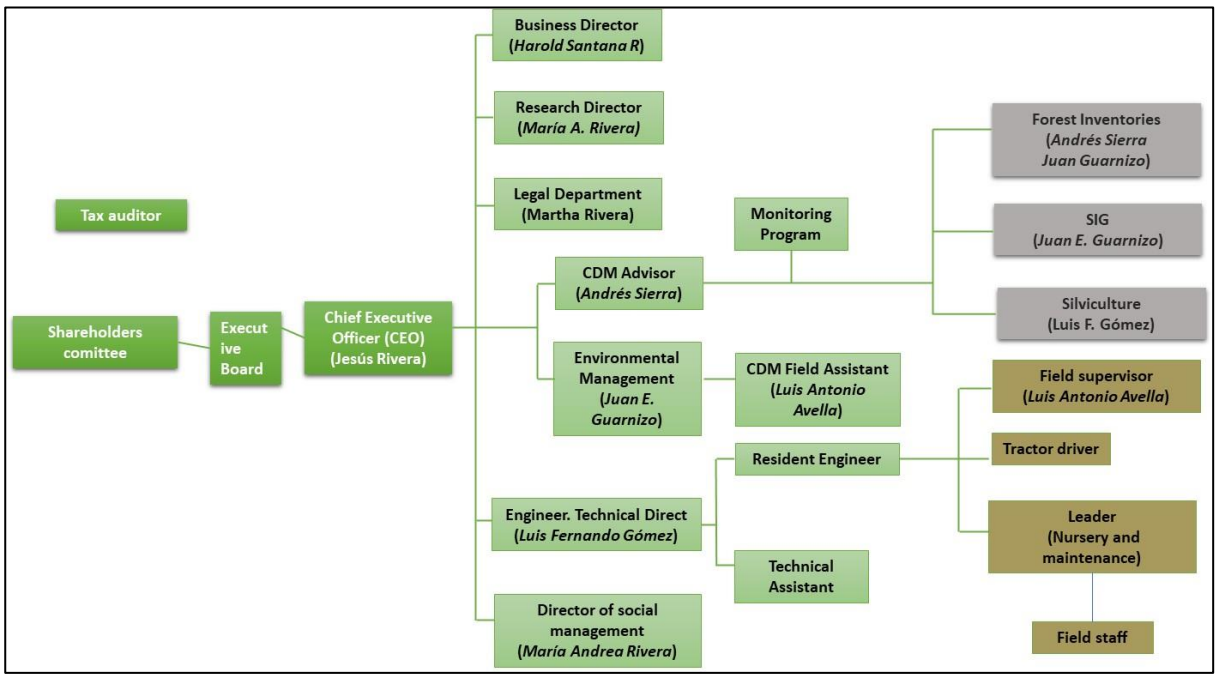


Diagram 2. Organization chart monitoring CDM.

Total removals estimations of atmospheric carbon by the project implementation are ***4,485,617.2*** tCO_2 eq. This includes contributions from aboveground, belowground, shrubs, litter, dead wood, and carbon organic soil sink

b) Installed technology and equipment.

In general, the project has developed to 01/10/2020 two models for stands: commercial and natural regeneration. The commercial model is based on the establishment of the species: *P. caribaea*, and a few tests with *P. oocarpa*; representing 88% of total area of the commercial stand. The rest of commercial areas were established with species such as *Tectona grandis*, *Acacia mangium* and *Eucalyptus pellita*. Total of the commercial stand consists of 19,181.1 ha that have been established since 2005.

For the development of natural regeneration, the project released the pressure that cattle used to make on the soil and eliminated the burning in that area by leaving a spontaneous recovery of the land covers. To 2020 have been identified land recovery in 2,824.3 ha, which are in early successional processes (**¡Error! No se encuentra el origen de la referencia.**).

A B

Photo 1. A y B, Early Development of Natural Regeneration.

The activities of establishment and forest management of the commercial stands began since 2005. In the same year, the actions started for encouraging the regeneration of the natural forest. The project has maintained and supported actions to enforce the care and positive contribution to the environment, for which it conforms to the regulations of the regional environmental entity CORPORINOQUIA. Commercially oriented stands keep the forest management activities, such as pruning, weed-release, and replanting among others. Areas with planting trials with native species strictly follow the technical recommendations of the environmental corporation, thus, only weed-release interventions are used for fertilization and replanting, but they are not pruned nor thinning or harvested foreseen, as they are areas of natural recovery. Natural regeneration in transition areas of gallery forests and plantations has been essential for structuring the biological corridors in the project.

Activities such as establishment of the areas to cultivate, planting, and weed control, fertilizing and pruning procedures are similar in the commercial plantations of the four species and in the model of assisted natural regeneration. However, the specific procedures for each of the species involved are detailed in the *Plan for Establishment and Forest Management*. A brief description of the activities is presented below.

Nursery: The seedlings are produced in a transitional nursery, which for this purpose was installed on each farm with a capacity of 500,000 to 1,000,000 seedlings. The best quality seeds will be used, and the seedlings are produced in tubular bags (bottomless) of 7 cm in diameter and 13 cm in height, with good resistance and root formation. Seeds for commercial species are available from certified suppliers; seeds for the ANR are gathered by hand from the local natural forests and seedlings are produced in a central nursery dedicated only to native species.

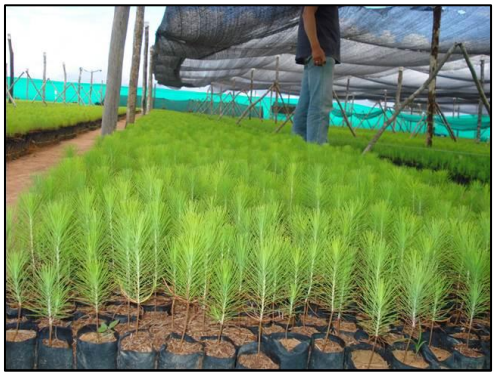


Photo 2. The tree nursery. *Pinus caribaea*

Establishing the plantation:

Planting will take place between the months of May, June, July and August, which are the months of most precipitation in the region.

***Planting density*:** planting density will be 1,001 trees per ha. Spaced at 3.16 x 3.16 m in a square.

Plantation layout: will be in stands according to the high land areas that do not flood. The low land areas that flood will not be planted.

Field preparation: Before the preparation of the terrain for planting, the team carries out basic activities including the elimination of minor vegetation, removal of rocks, and staking out the 50-meter buffer area to protect the adjacent natural forests. The preparation for planting is mechanized, with tractors.

Photo 3. Field preparation.

The chiseling of soils in the Orinoquia.
The solution to make more productive and sustainable soils was to develop an arable layer in them through vertical tillage (with chisels) to correct certain physical conditions. To add lime and fertilizers to amend their chemical conditions and sow in them, as components of the pasture, forage species, and improved cultivated species that adapt to soil conditions.
The use of the fertilizer and added amendments promote vigorous growth of the roots of the grasses in the pasture. Also, it allows increasing the fixation of atmospheric carbon (by 'sequestration') in the deep layers of the soil. Moreover, it reduces the nitrification and emission of nitrous oxides from the soil, boosts the biological activity of the soil, and stabilizes its physical structure.
Suppose farmers develop the idea of establishing topsoil and combine this soil management technology, either with cultivars of forage species and crops adapted to acidic soils in agropastoral systems or already with arboreal components in silvopastoral systems. In that case, they will have the instruments and technology to transform the Colombian savannas, increasing agricultural productivity and mitigating climate change.
Source: ***Sistemas agropastoriles: Un enfoque integrado para el manejo sostenible de Oxisoles de los Llanos Orientales de Colombia Amezquita et al (2013).***

***Planting*:** is carried out manually, by removing the bag without crumbling the loaf of soil and slightly pruning the root. The area around the tree should be pressed by the feet of the worker, preventing air pockets from remaining in the hole.

Photo 3. Hand-Planting the tree.

***Fertilization*:** 8 days before the seedlings are taken to the field, fertilizer is applied to the leaves in dosages of 100 grams per each 20 liters of water, to improve the resistance and the vigor of the plant for transplanting in the field and adaptation to the new habitat in which it is develop. In the field, fertilization will be carried out after 25 – 30 days after planting, by irrigation with a mix that includes *mycorhizae.* The project will carry out regular nutritional evaluation (visual observations and plant leaf tissue analysis) of the plantation and provide any additionally required nutrients.

***Plant sanitation*:** controls will be carried out when necessary (manual, chemical and cultural) to prevent infestations by Attar ants. These practices will be carried out within a program of integrated pest and disease management (IMP), which includes monitoring and timely reporting and an internal training plan for technicians and operators led by the Organization's head technician (Bosques de La Primavera S.A.).

Photo 4. Forest pest control in the project.

***Fire control and prevention**:* although firebreaks will be cleaned during the dry seasons, it will be necessary to train staff to monitor and control during periods of high risk with the equipment and instruments suitable for these tasks, such as beat-fire pumps, back-hoes, shovels, machinery and other alternatives. To this end a Control Pump was purchased for the project. In addition, it will emphasize the Prevention and Attention to Forest Fires Program, which includes training by Forest Brigadiers and preventive forestry techniques.

Photo 5. Fire control. Fire control equipped. Firebreaks. Bulldozers and special plows are used to clear fire lanes or firebreaks.

Forest management

Weed Control: During the first year after planting, the plate (80cm) surrounding the planted seedling is maintained completely free of weeds in order to permit the development of the plants and avoid attacks from pests and diseases. For the species, *Pinus caribaea* and *Eucalyptus pellita*, the plates are cleaned of weeds three times per year during the first three years in order to prevent the highly aggressive Gramineous species of the region from crowding out the planted tree.

Pruning: is done to the extent that the development of trees requires it, in order to obtain the best quality of wood. It is believed necessary to perform this activity from the second or third year. The basic criterion for pruning is to eliminate the side branches of trees up to 50% of their total height. This activity is done in order to prevent the formation of knots in the wood.

Photo 6. First tree pruning.

Thinning: all malformed trees (twisted, forked and defective) will be felled to avoid inefficient competition for space and nutrients with well-developed trees. This operation is done from the fifth year of the project. The procedure begins with the selection of individuals to be cut based on the intensity established.

For the *Pinus sp.* thinning, will be done in year 5, 9 and 12. One objective of the first thinning is to eliminate poorly formed individuals and branches, and those trees that present physiological deficiencies. The maximum allowed elimination is 30%, in order to leave 700 trees per hectare. The first thinning does not generate commercial products. The second thinning also focuses on eliminating poorly formed individuals and those that present physiological deficiencies. Again, the maximum allowed elimination is 30%, in order to leave 490 trees per hectare. The third thinning, in year 12, will again eliminate 30% of the stand.

Photo 8. Thinning.

For the *A. mangium*, thinning will be done in year 5 (20%), and the last harvest will be done in year 10. For the *T. grandis*, the first thinning will be at 10 years, removing 20% of the volume at 15 and, 20, years, 30% of the total inventory at the time of the thinning to perform the final harvest at year 25, considering plantation turn. For the *E. pellita* a thinning is planned for year 5 to eliminate 30% of the stand, and another at year 9 that extracts 40%. A mortality rate of 5% is expected for every species.

To thin have been gradually developed for some of the lots, as a self-regulation of the stands has been identified with the initial mortality, so the lots are remaining in the expected densities for the final shift.

In order to maintain forest management monitoring activities, work contracts are carried out. These are recorded and located in physical papers at the main offices, and from there the information is taken for the balance of activities, an example of this monitoring is presented in the Table 1.

Table 1**.** Example of the monitoring exercise to record the activities of maintenance and forest management. The logs that feed the database are executed by Works contracts.

COMPANY	ACTIVITY	CONTRACTOR				
		2016	2017	2018	2019	2020
Organización La Primavera SA	**MAINTENANCE**	Jesus A. Fernandez	Jesus A. Fernandez	Jesus A. Fernandez	Jesus A. Fernandez	Jesus A. Fernandez
Bosques de la Orinoquia SA		Julio Garrido	Julio Garrido	Yeison Sánchez Miller Hernández Albert O. Rivas	Albert Olivo Rivas	
Bosques de la Primavera SA		Nelson Mora Galindo Libardo Castaño	Nelson Mora Galindo	Nelson Mora Galindo	Nelson Mora G.	
Compañía de María Padres Montfortianos		Héctor O. Coronado	Héctor O. Coronado	Héctor O. Coronado	Héctor O. Coronado	
Reforestadora Guacamayas SA		David Castaño	David Castaño	David Castaño	David Castaño	David Castaño
Reforestadora Los Cambulos SA.		Luis Albeiro Santa	Luis Albeiro Santa	Libardo Castaño Miller Hernández Aristóbulo Mosquera	Aristóbulo Mosquera	
Incomser		Alberto Rodríguez Kennedy Hernández	Luis Albeiro Santa Kennedy Hernández	Kennedy Hernández	Kennedy Hernández	

All the supports of the activities by nucleus are archived in physical and digital formats for their follow-up, accounting control and silvicultural execution.

Harvest plan

The harvests of the species are to be held in the year of the period established for each, as follows: *P. caribaea* 18 years, *A. mangium* 12 years, *T. grandis* 25 years and *E. pellita* 15 years, unless the wood market conditions are unfavorable. In that case, the owners may choose to leave the trees in the ground and continue to sequester carbon. This may occur if paved roads, bridges and related transport infrastructure are not built by the government. The harvesting activities have been displaced, due to low developed the commercial stand (Table 2)

Table 2. General thinning schedule for species, which make up the commercial stand model.

Species	Tree ha^{-1}	Thinning 1			Thinning 2			Thinning 3			Final turn	
		t (yrs)	% Ext.	% Mort.	t (yrs)	% Ext.	% Mort.	t (yrs)	% Ext.	% Mort.	t (yrs)	N_f
P. caribaea	1040	12	25	5	14	40	5	16	50	5	20	197
P. oocarpa	1040	12	25	5	14	40	5	16	50	5	20	197
A. mangium	1040	12	20	5	15	50	5	-	-	-	12	371
T. grandis	1040	10	20	5	15	30	5	20	30	5	35	153
E. pellita	1040	-	-	-	-	-	-	-	-	-	15	1040

Tree ha^{-1}: initial tree density.

% Ext.: thinning percentage (removal).

% Mort.: considered mortality percentage.

N_f: final tree density corresponds to the quantity of trees harvested during the turn of the species.

Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.).

Plantation began in June 2005 by gradually incorporating suitable areas for the establishment of commercial stands. These activities were most intense in the years 2009 to 2013 (**¡Error! No se encuentra el origen de la referencia.**). The plantations were completed in 2014 and the new activities have focused on maintenance and restoration. Maintenance activities have been carried out every year, according to the age of the lots and the stands in general. The records of these activities are supported by the work contracts developed by technicians and field workers[1].

Table 3. Distribution of commercial stand and natural regeneration areas (ha) over time.

t	*year*	*Area (ha)*	*Cumulated area (ha)*
0	2005	835.9	835.9
1	2006	489.9	1,325.8
2	2007	1,005.8	2,331.6
3	2008	2,582.0	4,913.6
4	2009	3,118.6	8,032.2
5	2010	3,571.0	11,603.2
6	2011	2,925.5	14,528.7
7	2012	2,420.0	16,948.6
8	2013	3,951.6	20,900.2
9	2014	1,105.2	22,005.4
10	2015	0.0	22,005.4
11	2016	0.0	22,005.4
12	2017	0.0	22,005.4
13	2018	0.0	22,005.4
14	2019	0.0	22,005.4
15	2020	0.0	22,005.4
	Total	**22,005.4**	***22,005.4***

The sowings were carried out in the months of May, June, July and August, which are the months of most precipitation in the region.

The forest inventory processes were carried out between September and October 2020.

c) **Total GHG emission reductions or net GHG removals by sinks achieved in this monitoring period.**

The vegetation covers in the project activity sites are pasture grasses mostly, burned grasses and scrublands in the base line. The predominant economic activity of the project area is based on extensive cattle ranching. This activity usually lacks appropriate technological packages, generating high pressure on the grasslands and the only food and energy sources available for livestock. The combination of natural wildfires during periods of intense summer and regular anthropogenic

[1] Records of these activities are in the logs of contracted and executed work. The records shall be made available in physical form to the auditor.

grassland burning for cattle grazing degrade the soil, as minerals are lost and the physical conditions such as porosity, among others, are altered.

According to the methodology applied and the validated PDD[2], carbon contents in base line are assumed to be zero C_{bsl} **= 0.**

Leakeage by activity displacement were shown to be zero. $L.K_{conversión}$ **= 0.**

The total values of reduced emissions are estimated to be 4,485,617.2 tCO2eq. These are distributed in six strata defined for the present verification period (Ratio of reduced emissions per stratum for the present verification period.Table 4).

Table 4. Ratio of reduced emissions per stratum for the present verification period.

Balance							
Estrata	**Area (ha)**	**%**	***Pools* (tCO2)**				
			Above and below biomass (tCO2)	**Biomass Shrubs (tCO2)**	**Litter and dead Wood (tCO2)**	**Carbon Organic Soil (tCO2)**	**Total (tCO2)**
Low	2,256.2	**10.3%**	54,292.6	63,063	11,944.4	626,125	
Steady	3,650.6	**16.6%**	272,591.4	102,038	59,970.1		
Middle	6,144.9	**27.9%**	797,589.0	171,755	175,469.6		
High	4,832.2	**22.0%**	915,534.8	135,062	201,417.6		
Upper	2,297.1	**10.4%**	619,357.3	64,207	136,258.6		
Natural Regeneration	2,824.3	**12.8%**	78,940.5	0	0.0		
	22,005.4	***100.0%***	***2,738,305.6***	***536,125.8***	***585,060.3***	***626,125.5***	***4,485,617.2***

Table 5. Final removals in tons CO2eq.

ΔCP,LB Sum of the changes in living biomass carbon stocks (above- and below-ground); t CO2-e	**CBSL Baseline net GHG removals by sinks (t CO2-e)**	**GHGE Emissions (t CO2-e)**	**LK Leakage (t CO2-e)**	***tCERs***
4,485,617.2	0	0	0	***4,485,617.2***

A.2. Location of project activity

a) Host Party

Colombia

b) Region/ State/ Province

Department of Vichada

c) City/ Town/ Community

La Primavera Municipality

d) Physical/ Geographical location

[2] See validated PDD.

The *CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia* is located in the Municipality of La Primavera in the Department of Vichada (6º19'34'' y º53'58'' N y 67º25'1'' y 71º7'10'' W) in the extreme eastern plains of the Colombian High Orinoquia region (CORPORINOQUIA, 2008 [3]). The Municipality of La Primavera is located approximately 400 km from Puerto Carreño, the capital of the department, and limits to the North with the Departments of Casanare and Arauca and the border of Venezuela. To the South, it limits with the Municipality of Cumaribo, to the East with the Municipality of Puerto Carreño and to the West with the Municipality of Santa Rosalía. The Municipality of La Primavera has an area of 21,420 km^2 which represents 22% of the total land area of Vichada (**¡Error! No se encuentra el origen de la referencia.**) (CORPOORINOQUIA 2008).

The Meta River is the main means of transportation during the rainy season, and dirt roads become more used in the dry seasons; municipal access from the project site is by unpaved roads. The Municipality has a large but untapped potential for tourism thanks to its scenic richness and unique, abundant biodiversity (CORPORINOQUIA, 2008).

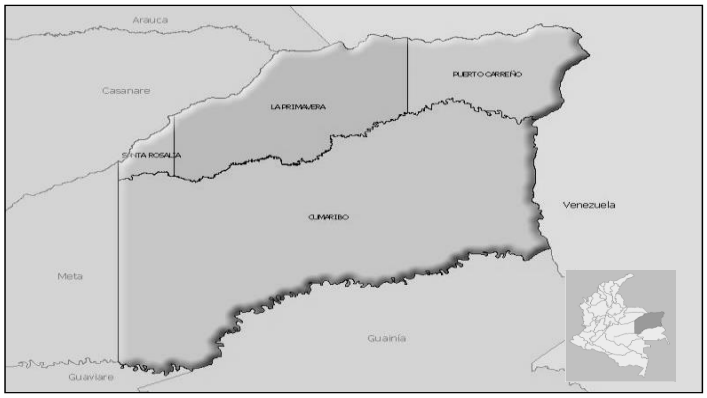


Figure 1. Location of the Municipality of La Primavera, department of Vichada.

Location of the forest project nuclei that make up the Project

The CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia is divided into six forest nuclei (**¡Error! No se encuentra el origen de la referencia.**). The main features of each are presented below.

Table 6. Location of each nucleus (center point).

	PLANAS		GEOGRÁFICAS	
Proyecto	**X**	**Y**	**N**	**E**
Bosques de la Orinoquia	1168687.28	1094402.53	5.447958	-69.555511
Monfortianos	1112002.19	1084663.39	5.360978	-70.067036
Guacamayas	1117826.19	1077782.06	5.298672	-70.014606
Bosques de la Primavera	1143404.47	1082147.28	5.337697	-69.783819
Organización La Primavera	1075832.32	1069974.15	5.228606	-70.393483

[3] Corporación autónoma regional de la Orinoquia - CORPORINOQUIA. 2008. Agenda Ambiental municipal de La Primavera, Departamento del Vichada.

Cambulos	1110748.51	1077895.95	5.299808	-70.078444
Incomser	1120319.27	1081091.63	5.328556	-69.992066

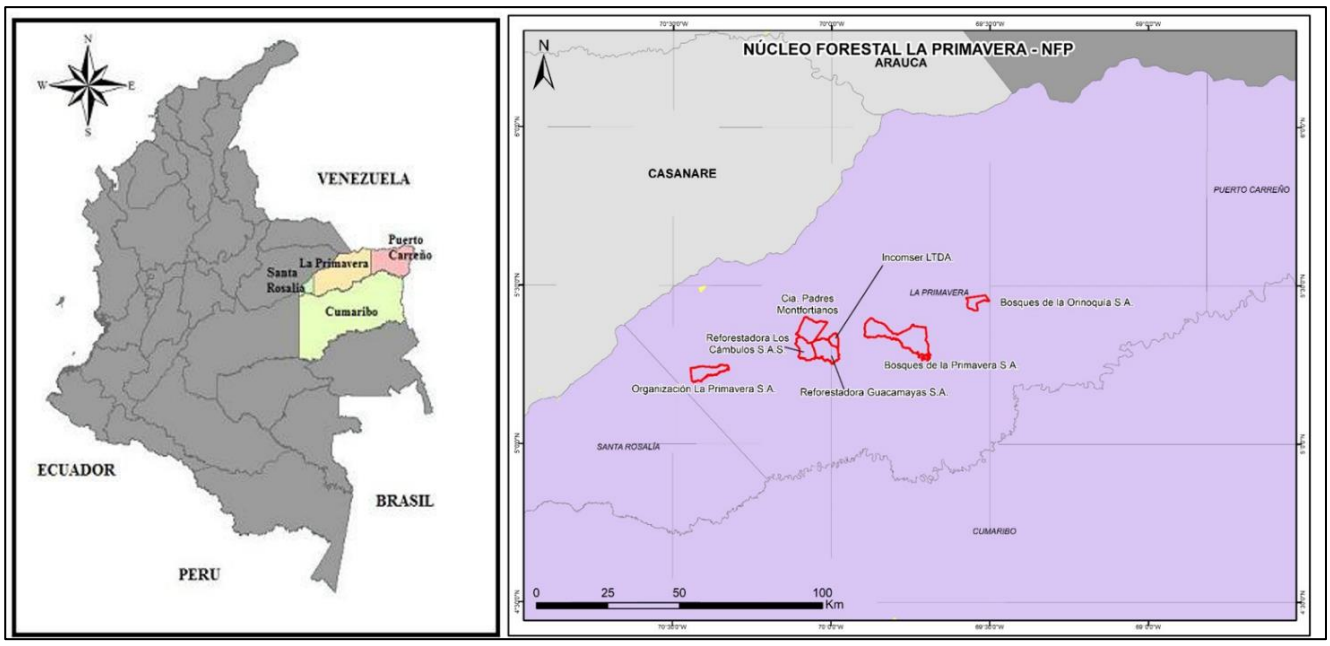
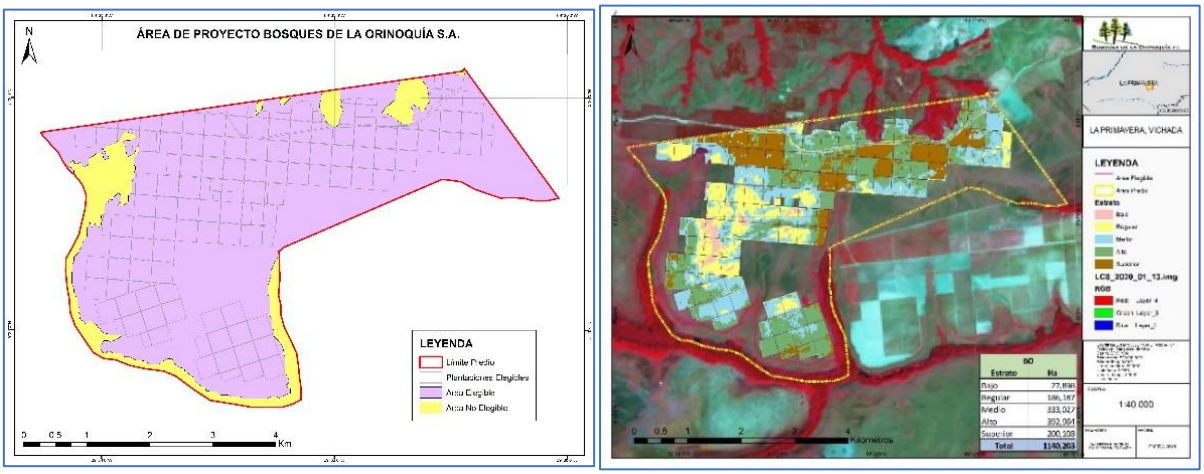


Figure 2. Location of the six forest nuclei in Municipality of La Primavera, Department of Vichada.

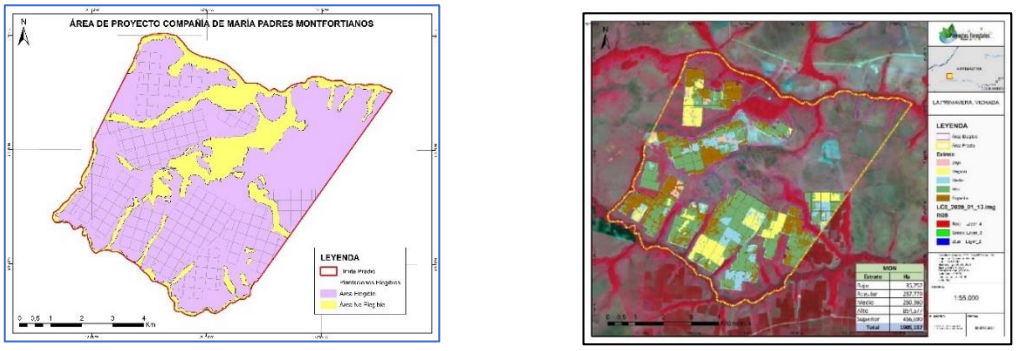
Bosques de la Orinoquia S.A.: This nucleus is located in the village of Soledad, 120 kilometers from the municipal capital on the road which leads towards Marandua between the Terecay Stream and the Bita River. It includes the properties of Tranquilandia and La Pista.



A B

Figure 3. Project boundary for Bosques de la Orinoquia. A, Project boundary; B, Planted area at 2020 year.

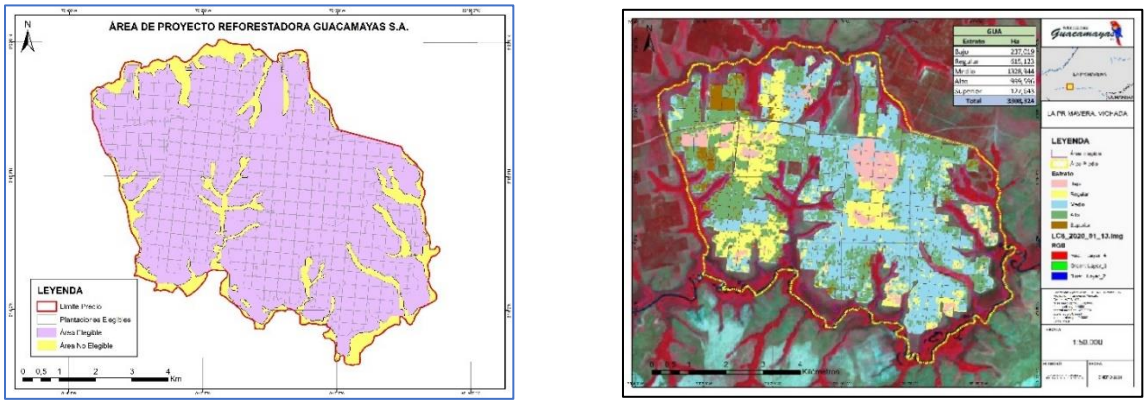
Compañía de María Padres Monfortianos*:* this nucleus includes the rural properties of Chaparrito and El Clavo. It is located in the hamlet of Matiyure, 50 km from the municipal capital.



A B

Figure 4. Project boundary for Compañia de María Padres Monfortinos. A, Project boundary; B, Planted area at 2020 year.

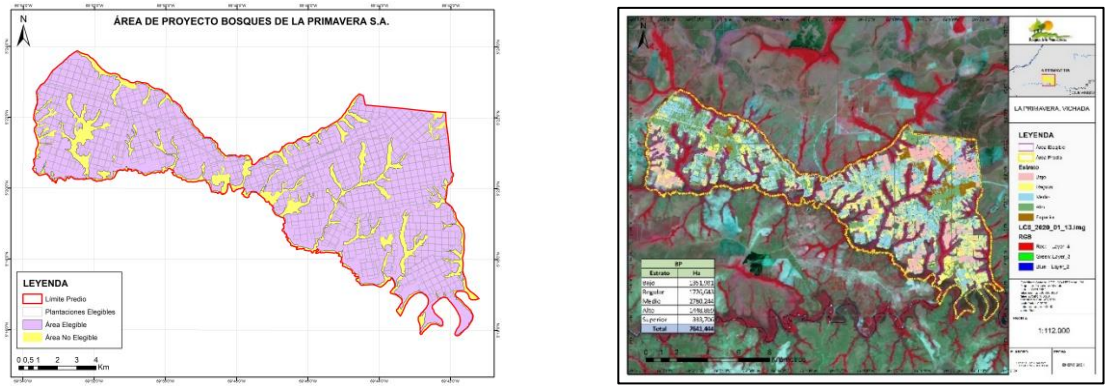
Reforestadora Guacamayas S.A*.:* the properties of Guacamayas, Los Leones and El Cafuche make up this nucleus, located near the hamlet of La Jaula.



A B

Figure 5. Project boundary for Reforestadora Guacamayas. A, Project boundary; B, Planted area at 2020 year.

Bosques de La Primavera S.A.: this nucleus is located near the hamlet of Matiyure. It includes the properties of Rincón Hondo, Caudimare, Araucaima, Araguaney, Paz Verde, Tibu, La Piraña, Manaos, Los Ponches and El Suevo.

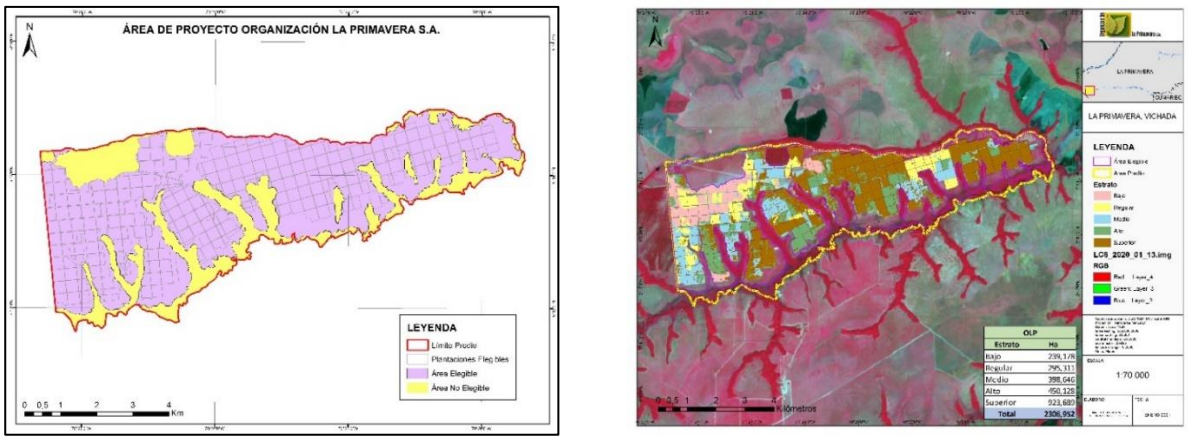


A B

Figure 6. Project boundary for Reforestadora Bosques de la Primavera. A, Project boundary; B, Planted area at 2020 year.

Organización La Primavera S.A*.:* this nucleus is located near the Altos de Meiva hamlet, 40 km from the municipal capital, bordering the El Lobo and Guacharacas streams and the junction with

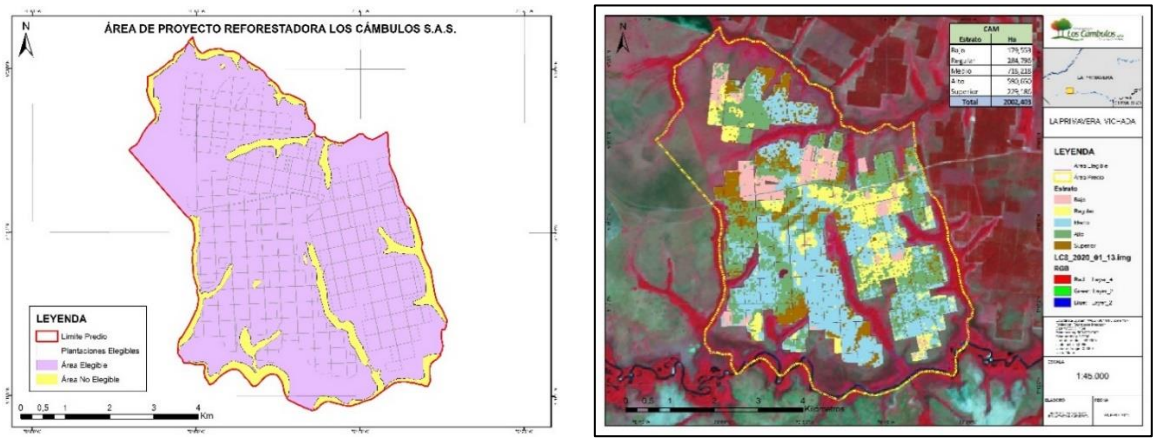
the La Evita River, a direct affluent of the Tomo River. It includes the properties of El Limonar, Mykonos II, Bosques de Vermont, Syros, Pasatiempo and El Deseo.



A B

Figure 7. Project boundary for Organización La Primavera. A, Project boundary; B, Planted area at 2020 year.

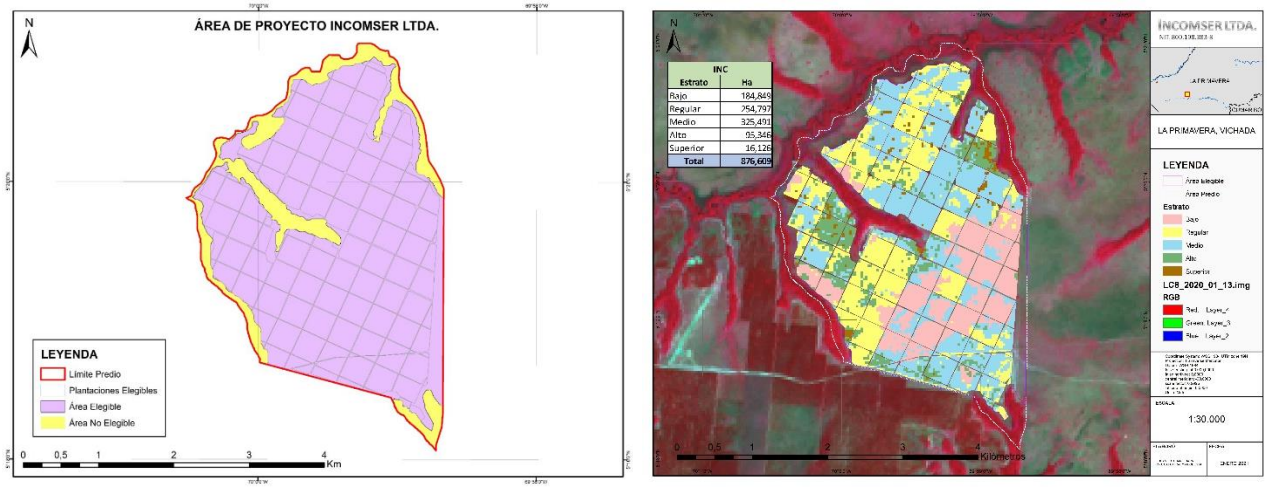
Reforestadora Los Cambulos S.A.S*:* This nucleus includes the properties Los Venados, Cámbulos and Chile. It is located on the road which leads from the Municipality of La Primavera to the city of Villavicencio (department of Meta) deviating at kilometer 19 and continuing 38 km East. The properties of this nucleus border to the North with the Veraditas stream, to the East with properties owned by the Reforestadora Guacamayas S.A, to the South with the Gavilán River.



A B

Figure 8. Project boundary Reforestadora Los Cambulos. A, Project boundary; B, Planted area at 2020 year.

Incomser LTDA: This nucleus is adjacent to the Guacamayas project, on the northeastern side. At present it is owned by INCOMSER LTDA, a company specialized in forestry and engineering services, the property is known as La Lapa.



A B

Figure 9. Project boundary Incomser. A, Project boundary; B, Planted area at 2020 year.

The *CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia* will consist of 29,019 ha, of which 20,573.1 will be devoted to commercial reforestation. The areas devoted to assisted natural regeneration (**ANR**) will total 390 ha, and the protection of deforested areas for natural regeneration (**PNR**) will comprise 8,056 ha. This distribution of areas was presented in the Table 7.

Table 7. Stand model distribution (ha)

Stand Model	Area (ha)
Commercial	20,573.1
Assisted natural regeneration	390
Natural regeneration (Passive)	8,056
Total	**29,019**

Some of the areas evaluated with a potential for a commercial forestry that were within the eligible area's lists were not established due to a weak soil quality conditions, such as periodic flooding that impede good seedling development. These areas have been left for natural regeneration, to increase the estimated areas for this component in the project.

A.3. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Colombia (host Party)	**Bosques de la Primavera S.A.**	No

A.4. References to applied methodologies and standardized baselines

Approved Methodology for Afforestation and Reforestation Activities AR-AM0004: ***"Reforestation or afforestation of land currently under agricultural use"- Version 04[4].***

According to the CLEAN DEVELOPMENT MECHANISM EXECUTIVE BOARD PROCEDURES, the AR-AM0004 methodology approved for a large-scale forestry project is NOT ACTIVE. Methodology AR-ACM0003: Afforestation and reforestation of lands except for wetlands replaced it. The applicability conditions of the current project meet the requirements set out by AR-ACM003 because soils, where the project is developed, are not organic soils. As seen in the PDD, soils in this area were historically used for extensive cattle ranching without management or sustainable improvement practices, high intensification of grazing, and ancestral practices of annual pasture burning (photo 9). These activities disrupted soils' physical and chemical properties and led them to be classified as soils in different states of degradation, poorly degraded, or absent organic matter. The impacts on carbon emissions due to the adequacy of the soils are minimal or null. Therefore it is feasible to adjust for the applicability conditions of AR-ACM003.

Photo 9. Land use, and land condition in base line.

Por tanto, para la presente verificación se hace un ajuste a la aplicación de la metodología AR-ACM003.

Photo 9. Soil condition in the project area pre project. Low or zero content of organic matter in the soil.

This verification will accept the AR-ACM003 methodology. Verification includes sinks that had restrictions in the AR-AM0004 methodology, but which are essential sinks for the project region with

[4] https://cdm.unfccc.int/methodologies/DB/S2OMSUTOWYOMLW75MPR0CG6SAKNG4Y

the implementation of afforestation, such as soil organic carbon, litter, shrubs inside plantations, and dead wood on the ground.

The following methodological tools are implemented in the current verification and validation processes.

The following methodological tools were used in the construction the PDD and the first verification:

- Guidance on the application of the definition of project boundary to A/R CDM project activities, Version 01. http://cdm.unfccc.int/Reference/Guidclarif/ar/methAR_guid22.pdf
- Guidance on accounting GHG Emissions in A/R CDM Project Activities (paragraph 35 in the report of the EB 42 meeting). http://cdm.unfccc.int/Reference/Guidclarif/ar/methAR_guid23.pdf
- Tool for the demonstration and assessment of additionality in A/R CDM project activities, Version 02. http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-01-v2.pdf
- Calculation of the number of sample plots for measurements within A/R CDM project activities, Version 02.1. http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf
- Anthropogenic GHG Removals by Sinks. Version 02 (EB 50, Annex 23). http://cdm.unfccc.int/EB/050/eb50_repan23.pdf
- Methodological tool. Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R. CDM project activities. AR-TOOL14. Version 04.2 https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v4.2.pdf
- Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities".

  https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-12-v3.1.pdf

  e) Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities.

  https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-16-v1.1.0.pdf
- Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in AR CDM project activities (version 01.0.1), Annex 24, EB67 http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-18-v1.0.1.pdf
- Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in AR CDM project activities (version 1.0.0), Annex 28, EB65 http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-17-v1.pdf
- Guidelines on accounting of specified types of changes in AR CDM project activities from the description in registered PDD (version 02.0), Annex 24, EB66 http://cdm.unfccc.int/Reference/Guidclarif/ar/methAR_guid32.pdf

A.5. Crediting period type and duration

Length of the crediting period: 20 years, 0 months, 0 days, from 2 June 2005 to 1 June 2025; with two equal renewal periods for a total crediting period of 60 year.

The actual monitoring period: **17 Feb 2016 – 01 October 2020.**

SECTION B. Implementation of project activity

B.1. Description of implemented project activity

B.1. Description of implemented registered project activity

The Project began on June 02, 2005. As shown in the registered PDD; retroactivity is recognized since this date.

At present, 22,005.37 hectares have been established in commercial stand and natural regeneration systems. Total area for the project eligible areas is 29,019 ha, of which most of the species is *Pinus caribaea*, a species with good development in acid, mineralized and degraded soils of the region.

The commercial model will be established in areas that are currently in pastures where extensive livestock activities have traditionally been carried out. The commercial plantations will include the following species:
- *Pinus caribaea*
- *Pinus oocarpa*
- *Acacia mangium*
- *Tectona grandis*
- *Eucalyptus pellita*

The commercial species were re-stratified according to their biomass content, as presented in Table 8. The re-stratification was developed following the PDD (see PDD Appendix 5 section 3), where strata were unified with similarity in biomass contents, and statistical analysis revealed the difference between strata (see section D.3 below).

Table 8. Distribution of commercial strata in the eligible area.

Strata	*Area (ha)*
Low	2,256.2
Steady	3,650.6
Middle	6,144.9
High	4,832.2
Upper	2,297.1
Natural Regeneration	2,824.3
Total	***22,005.4***

The actions of establishment, management and monitoring were followed according to the development plan for this purpose. These actions have been monitored within FINAGRO's audit scheme as part of the support received from the Forest Incentive Certificate (CIF). All the above projections for the forest management plan, including planting, maintenance, thinning, and harvesting among others, were modified during the period of implementation and growth of the project activity. The availability of resources, soil quality, the weather, and other factors, they affected the development of the stands and therefore the silvicultural activities.

At present, the project has established the next stands:

- Commercial
- Protection of deforested areas adjacent to gallery forests[5] to allow protected natural regeneration (PNR) of forest cover

[5] Gallery forests are remnants of natural forests that remain in place protecting waterways and .

The system of Protected Areas for Natural Regeneration (PNR), areas will be focused on deforested areas adjacent to the gallery forests, which until the beginning of the project were used to cattle ranching and anthropogenic burning. The PNR's main anthropogenic activities are the physical isolation for the protection of deforested areas and the elimination of livestock, fires and hunting.

The Table 9**¡Error! No se encuentra el origen de la referencia.** , present the area in the project by nucleus and strata (2005-2020).

Table 9. Distribution of forest establishments by nucleus and stratum.

Stratum	Bosques de la Orinoquia (ha)	Bosques de la Primavera (ha)	R. Cambulos (ha)	Guacamayas (ha)	P. Monfortianos (ha)	Organización La Primavera. (ha)	Incomser (ha)	TOTAL (ha)
Low growth	27.898	1,351.98	179.553	237.019	35.752	239.178	184.849	***2,256.2***
Steady growth	186.187	1,726.64	284.796	615.123	287.779	295.311	254.797	***3,650.64***
Middle growth	333.027	2,780.24	718.218	1,328.944	260.360	398.646	325.491	***6,144.93***
High growth	392.984	1,448.87	590.650	999.596	854.577	450.128	95.346	***4,832.15***
Upper	200.108	333.71	229.186	127.643	466.690	923.689	16.126	***2,297.14***
Protected Natural regeneration	551.656	212.072	501.479	391.66	667.209	484.994	15.203	***2,824.27***
Sub-totals	***1,691.860***	***7,853.516***	***2,503.882***	***3,699.985***	***2,572.366***	***2,791.946***	***891.812***	**22,005.37**

The records of the activities developed in the period of the present monitoring session are kept in physical documents in the installations of the project. **¡Error! No se encuentra el origen de la referencia.**, shows the structure for the development of establishment and implementation of forestry and environmental technology.

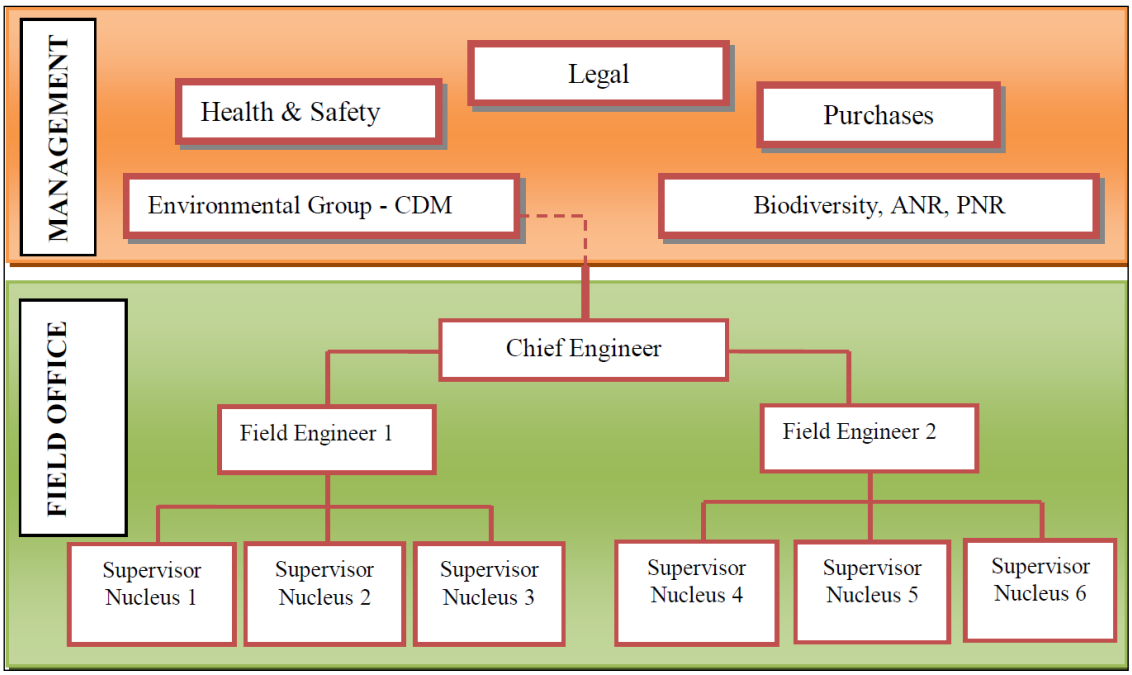


Figure 10. Operational and Management Structure of the Project Activity

The central operational and management structure of the project is organized under the Office of the General Manager. This office runs operations and oversees the offices of Legal, Purchases, Health and Safety, the Environmental Group which coordinates CDM, biodiversity and the Biodiversity team which coordinates Assisted Natural Regeneration of Natural Forests.

The Field office manages forestry operations and technical direction, which is composed of the supervisors, resident forestry engineers and the chief forestry engineer. These operatives manage all the silvicultural activities of the project activity. Each one of the six nucleus that conform the project activity is under the direction of a field supervisor, who report to the chief forestry engineer. The chief forestry engineer is responsible for gathering and recording all the relevant information on the management of the project activity in each of the six nuclei. Each nucleus has a resident forestry engineer that files regular reports to the chief engineer, who then reports to and interfaces with the general manager of the project.

Monitoring of the CDM related parameters and data is the responsibility of the Environmental Group Director. The archives shall include:

• Registers and logbooks of activities, including soil preparation, planting, application of soil correctives, fertilizers, weeding, pruning, thinning, and harvests among others.

• Copies of all original field measurement data, data analyses and spreadsheets.

• Estimates of the carbon stock changes in all aboveground and belowground biomass and corresponding calculation spreadsheets.

• GIS products.

• Copies of the measuring and monitoring reports.

For the development of the actions and fulfillment of the objectives of the project, about 942 trainings have been developed since 2011, in which 8,674 people have participated (Table 9). In this way, the project contributes to the development of the region and the country, by forming skilled labor for the forestry activities in the territory.

Table 10. List of trainings and number of participants of the activities developed from 2011 to 2020.

Training	Total, Training	PERSONAL Trained
Occupational accident and illnesses	72	409
Ophidian accidents	66	400
Check list application	1	2
Personal and camp cleanliness	4	75
Self-care	35	163
Project benefits	5	66
Climate Change	39	367
Waste classification	9	151
Basic concepts of Biodiversity	12	72
Conservation	12	72
Fire controls	4	22
Control of Entrance/Exit of Personnel Staff	1	9
Care of flora and fauna	39	367
Care of environment	3	56
Waste disposal	39	415
Ecology	9	47
Hunting effects in natural ecosystem and the project	9	129
EPP	53	425
Establishment of forest plantations	3	41
Management strategies for biodiversity in the project	3	25
Geographical information structure	2	6
Identification of hazards and prevention of risk at work	3	60
Environmental Impacts	19	247
Environmental impacts on the project	20	120
Biodiversity importance	12	72
Instruction in change of pins	1	2

Water management	41	415
Use of extinguishers	12	160
Use of safety MSDS	53	430
Forest plantation maintenance	3	41
CMD	39	367
Basic safety and coexistence Standards	51	490
Safety Standards for maintenance of agriculture machinery	1	2
Safety Standards for operation of agricultural machinery	1	2
Standards for handling and storage of crop protection products	50	483
Standards for tool handling	30	363
Standards for transfers	42	380
Reforestation objectives	4	56
Workplace hazards	50	393
Environmental management plan	1	6
Prevention of forest fires	23	270
Project processes	39	367
Environmental management program	20	120
Trophic networks (concepts, composition, levels, importance)	9	129
Responsibilities in matters of SO	1	2
Occupational health	28	250
Social security	34	258
Signaling	1	14
Waste management system	8	103
Field techniques for wildlife inventory and monitoring	1	1
Transportation of personnel	1	9
Use of first aid kit	17	120
Tree nursery	1	7
Total	**1036**	**9058**

Photo 7. Personal capacitation.

Nearly 400 thousand labor wages have been generated (Table 10) and a total of 1,740 jobs during the current monitoring period. This is highlighted in a region where job opportunities are scarce.

Table 11. Days wage and employment generated (2005-2019).

Year	Day's wage year	Workforce
2005	6278	26.16
2006	2123	8.85

2007	14447	60.2
2008	32079	133.66
2009	83832	349.3
2010	54036	225
2011	50335	210
2012	44222	184
2013	57979	242
2014	35395	147
2015	19160	80
2016	5910	25
2017	5910	25
2018	3134	13
2019	2574	11
Total	**417413**	**1740**

Most of the jobs and labor works were performed between 2009 and 2014, where the largest establishments were presented and coincided with the maintenance of the plantations established in previous years.

Finally, there has not been any request for prior approval.

B.2. Post-registration changes

B.2.1. Temporary deviations from the registered monitoring plan, applied methodologies, standardized baselines or other methodological regulatory documents

N.A

B.2.2. Corrections

N.A.

B.2.3. Changes to the start date of the crediting period

Not apply

B.2.4. Inclusion of monitoring plan

N.A

B.2.5. Permanent changes to the registered monitoring plan, or permanent deviation of monitoring from the applied methodologies, standardized baselines, or other methodological regulatory documents.

It supported the application of the AR-ACM003 methodology, which replaces the AR-AM0004.

The change refers explicitly to the adoption of carbon sink accounting. For this and subsequent verification, and because AR-ACM003 replaced the AR-AM0004 methodology, all the carbon sinks provided by AR-ACM003 are adopted. Litter, deadwood on the ground, and soil organic carbon are included in the carbon balances for the component shrubs within the plantations.

These sinks, in contrast to the baseline where they are grasslands subjected to annual burns, this sink is considered to be zero (this condition is based on the assumptions established in the methodological tool Estimation of carbon stocks and change in carbon stocks of trees and shrubs in

A / R CDM project activities, as they are degraded soils with the presence of saline and acid soils, and especially as described in point 5, line 12: "Changes in carbon stocks in trees and shrubs in the baseline may be accounted as zero for those lands for which the project participants can demonstrate, through documentary evidence or participatory rural appraisal (PRA), that one or more of the following indicators apply: (f) Land is subjected to periodic cycles (eg slash-and-burn, or clearing -regrowing cycles) so that the biomass oscillates between a minimum and a maximum value in the baseline."

Therefore, the aboveground biomass is considered zero, and it is additional to the accumulation made by trees, shrubs, litter, and deadwood present in the stand models.

Also, soil conditions according to the study of Vichada soils and land zoning elaborated by the Agustín Codazzi Geographical Institute, 36% of the department (3.6 million hectares) has areas suitable for agricultural, livestock, and forestry production. It is possible to take advantage of this potential if appropriate agronomic practices are carried out. Those practices must improve soil conditions and restore them from the damage of severe chemicals derived from continuous burning in the region for more than 50 years. Because of these historical processes, soils present low organic matter content, high acidity, and in some sectors, aluminum toxicities (National University of Colombia, Orinoquía headquarters, 2018).

Considering the characteristics described before, soil organic carbon component is fundamental in the accounting for the project. This sink was not considered in AR-AM0004, and it is incorporated in the current verification and the following.

The changes related in this monitoring period are in accordance with option c (Section B.2.5) of the instructions of the monitoring report template:

"Changes that are being submitted with this monitoring report as part of the request for issuance (post-registration change - issuance track) as applicable from this monitoring period".

f) The company Incomser LTD is included in the project because it is the owner of the La Lapa plot. It is an area that had the eligibility and applicability conditions, and it was attached to the Guacamayas property.

The maps and areas of the properties were readjusted. Also, under Act No. February 11, 2020, the board of directors of the CDM project participation account contract "Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia" accepted to include the company Incomser LTDA to the project as an owner of a portion of the areas eligible and registered for the project. (See certificate of tradition and freedom Incomser real estate registration 540-908 office of public records of Puerto Carreño Vichada).

The above changes do not affect:

- **Not affect the aditionality:** They remain the same stand models and project proposal registered.

- **Not affect the scale project.** The annual net removals remain high, so it does not change the scale of the project.

With reference to the Root-shoot ratio values, they are adjusted appropriately to the values reported by the guideline of the IPCC 2003, since this guide discriminates by species and range of tons accumulated in the biomass area.

The value related in the PDD and the monitoring report of the first verification assumed an R: S value of 0.27 for all species and refers to the IPCC 2003 table 3A.1.8. However, the IPCC value corresponds to:

Table 12. Root-Shoot Ratio

ROOT-SHOOT RATIO	Date	Source
Pino sp	0.46 (<50 t/ha Above biomass) 0.32 (50-150 t/ha Above biomass) 0.23 (>150 t/ha Above biomass)	IPCC 2003 Table 3A.1.8
Eucalipto sp	0.45 (<50 t/ha Above biomass) 0.34 (50-150 t/ha Above biomass) 0.2 (50-150 t/ha Above biomass)	IPCC 2003 Table 3A.1.8
A. mangium	0.24 (NE t/ha Above biomass)	IPCC 2003 Table 3A.1.8

B.2.6. Changes to project design

The changes related in this monitoring period are in accordance with option *c (Section* B.2.6) of the instructions of the monitoring report template:

"Changes that are being submitted with this monitoring report as part of the request for issuance (post-registration change - issuance track) as applicable from this monitoring period".

- **Distribution area**.

The changes in the Project Design are related to the distribution of the areas of each company that is part of the Project. This last part refers to when Incomser joined as part of the CDM project participation account contract. The same approved, valid and registered area is as follows:

Table 13. Empresas vinculadas al proyecto CDM.

Predio	AREA (ha)	%
Incomser	1,021	4%
Organización La Primavera	3,279	11%
Comunidad Monfortiana	4,236	15%
Cambulos	3,265	11%
Bosques de la Primavera	10,750	37%
Bosques de la Orinoquia	1,921	7%
Guacamayas	4,548	16%
TOTAL	***29,019***	***100%***

- **Changes in stratification.**

In the present verification was a re-stratification, modifying the strata proposed in the registered project. The procedure was developed in line with the proposed in section B.7.2. *Sampling plan* of the PDD. The re-stratification was developed because of the differences identified in the developed pre-sampling process assessments with information systems and geographic. In these lots with the same species, age, and handling, showed important differences in its development, due to the difference in quality of site, causing wide in its developments and hence variations in the content of biomass.

This re-stratification makes precision on the phases of development and established conservative biomass assessments, differentiate within the same plot, areas with variations in their growth and therefore on contents of biomass. The new stratum of the project is presented below.

Table 14**. Stand** model **Re-estratification.**

Strata	Sub-strata	Area (ha)
Commercial	***LOW***	20,573.1
	STEADY	
	MIDDLE	
	HIGH	
	Upper	
Assisted Natural regeneration		390
Protected Natural regeneration		8,056
Total		**29,019**

This in line with the procedures proposed in the PDD register.

a. Not affect the applicability condition the methodology and Base line
b. The re stratification is consistent with the registered PDD, see B.8.2 section.
c. Maintains the accuracy requirements in the estimates and reduces uncertainty.
d. Not affect the additionally.
e. Not affect the scale project. Since the project area is not reduced and the annual average removals remain high.

A list of changes developed according to Annex 24, EB 66, is presented below

Types of changes from the description in the registered PDD as outlined in the guidelines (Annex 24, EB66) and their applicability to the implemented project.		
No.	***Types of changes from the project description in the PDD of an A/R CDM project activity***	***Applicability to the project***
a)	Changes in year-wise areas planted, possibly resulting in a part of the project area not being planted;	No
b)	Changes in species composition, if the changes are demonstrated at verification to be consistent with the baseline identification and additionality demonstration made at the validation stage;	No
c)	Changes in stocking density, if the changes are demonstrated at verification to be consistent with the baseline identification and additionality demonstration made at the validation stage	Yes. By incorporating new sinks to the Project, the estimates are higher to estimates calculated in formulation and adjustment previous to PDD This do not affect the contents achieved until the first verification, conversely have a positive effect reflected on carbon build up by project activities -Not affect the applicability condition the methodology and Base line - Not affect the adtionality. - Not affect the scale project. Since the project area is not reduced and the annual average removals remain high. The baseline remains unaffected, because the assumptions indicate a value of zero in the carbon content in the baseline
d)	Changes in timing and choice of silvicultural operations;	No, there are no changes in the timing of harvest anticipated prior to third verification.
e)	Changes in timing of harvest occurring before the third verification;	No
f)	Changes related to collection of non-timber forest products;	No
g)	Changes in tree/shrubs propagation method;	No
h)	Changes in post-harvest replanting/regeneration methods;	No
i)	Changes in technology employed;	No
j)	Changes in inputs (e.g. fertilizers, certified seeds, watering);	No

K)	Changes in stratification for sampling;	Yes, ex post stratification has been implemented taking into account site conditions that influence the development of stands. This in line with the procedures proposed in the PDD register. -Not affect the applicability condition the methodology and Base line -The re stratification is consistent with the registered PDD, see B.8.2 section. - Maintains the accuracy requirements in the estimates and reduces uncertainty. - Not affect the adtionality. - Not affect the scale project. Since the project area is not reduced and the annual average removals remain high.
l)	Changes in type of sample plots (e.g. temporary, permanent, point sampling);	No
m)	Changes in number of sample plots and their allocation to strata;	Yes. The strata are modified (see above) and of sample plots and their allocation to strata is developed as described in the PDD, (see B.8.2 section). The number plots change commensurate development of the plantation.
n)	Changes in the project boundary (limited to reduction in project area), if the changes are demonstrated at verification to be consistent with the baseline identification and additionally demonstration made at the validation stage;	No, changes in project boundary have not occurred. The project boundary at the verification is consistent with that at the baseline identification and additionality demonstration at the validation stage.
o)	Changes in quality assurance/quality control (QA/QC) procedures, where it can be demonstrated that the changed QA/QC procedures are used by the National Forest Inventory or were applied in another registered A/R CDM project activity;	No.
p)	Changes in parameters, equations, or methods used in tree biomass estimation, if the applicability of the changed parameters, equations, or methods is demonstrated at verification using the *"Tool for demonstration of applicability of allometric equations and volume equations in A/R CDM project activities"* when available, or if the changed parameters, equations, or methods do not result in a decrease in precision of the estimate of tree biomass.	No
q)	Changes from provisions regarding shifting of pre-project activities, if the related emissions are estimated at verification using the tool "Estimation of the increase in greenhouse gas (GHG) emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity". and are accounted for as leakage	Not Applicable.

r)	Changes in use of fire in site preparation, if the related emissions are estimated at verification using the tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" and are accounted for as project emissions;	Not Applicable.
s)	Changes in extent of soil disturbance in site preparation, if the related emissions are estimated at verification using Equation (2) of the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" and are accounted for as project emissions;	No
t)	Changes in methods of estimation of changes in any carbon pool, if the method applied at verification uses the latest version of the relevant approved tool and the applicability conditions of the methodology applied are consistent with the applicability conditions of the tool.	Yes, *The estimation of the carbon contents for the Shrub sinks within the plantations, litter, dead Wood and Carbon Organic Soils (COS), is incorporated.* The R: S ratio values are adjusted according to those reported by the IPCC 2003 Table 3A.1.18, for the species of *Pino sp* and *E. pellita*. According to the accumulation of aerial biomass obtained from the forest monitoring.

The adjustments and changes proposed, are described in the updated PDD.

B.2.7. Changes specific to afforestation or reforestation project activity

No Apply

SECTION C. Description of monitoring system

The structure for the monitoring process in the CDM project is presented in **¡Error! No se encuentra el origen de la referencia.**. This diagram is slightly different from that presented in the PDD, but it is in line with what was developed in the project until the present verification. The changes are in line, with the processes of continuous improvement in QA/QC.

Total coordination was developed by the entity *Proyectos Forestales* and was supported by a team of forestry, administrative, social and CDM experts.

The project activity applies the monitoring system as prescribed in the approved methodology AR-AM0004/Version 04, which is consistent with methodology AR-ACM003 that replaces the previous one.

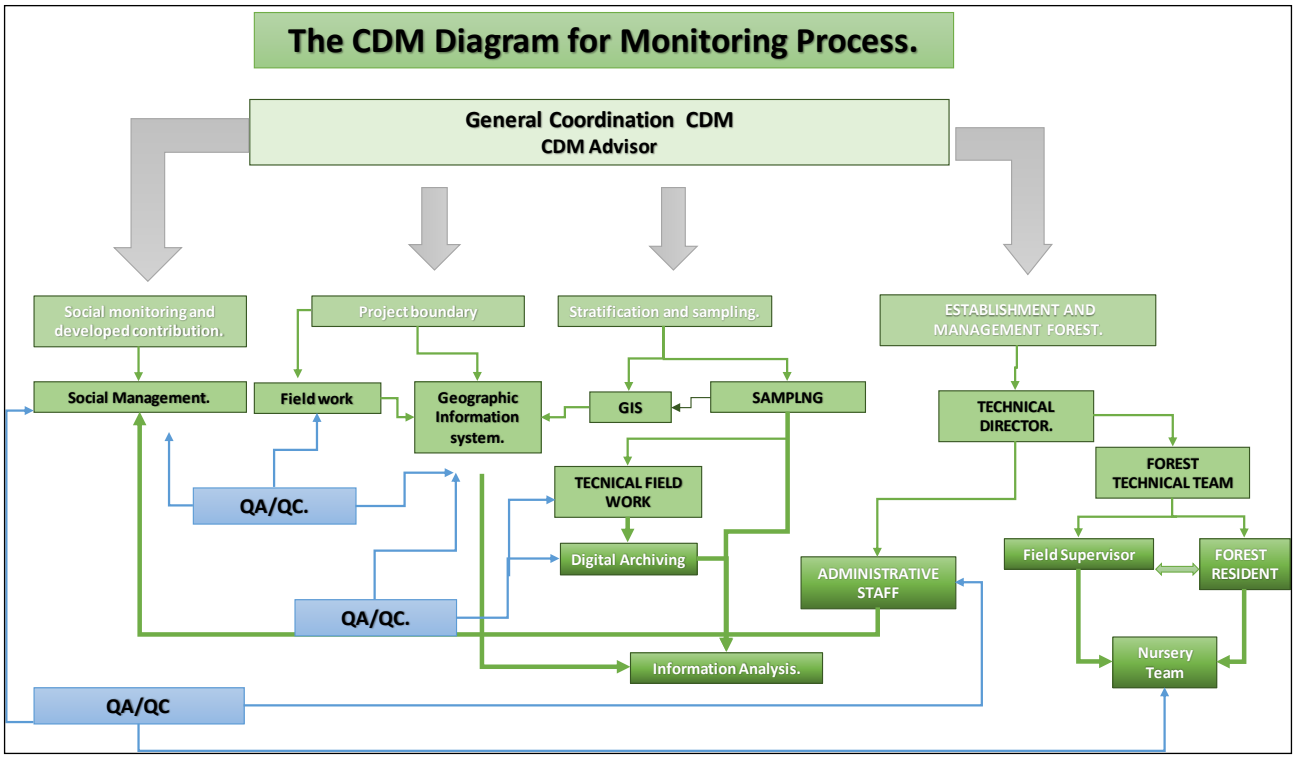


Figure 11. Monitoring structure for A/R CDM project. The structure is continuously adjusted to improve the quality and control information.

The project monitoring system was based on the following aspects:

a) Monitoring project boundary and project implementation:

Each lot was measured with the help of GPS during the execution of the Project, through field trips. The lots were drawn following its contour and were related in the database of activities tracking with the date of planting and other silvicultural management activities developed.

Through geographic information processes, and with the help of satellite images *Landsat 8* date January 13/2020, an effort was made to determine areas effectively established, and areas included in the eligible areas and described in the PDD. The project has digital files of the contours of each lot collected with GPS; and Annex I[6], shows the verification process of the areas established within the eligible areas also by using GIS.

The areas under natural regeneration were identified with satellite image information; and, by means of spectral responses was possible to describe developed areas (with early successions of secondary forest) and biomass contents greater than those identified in the baseline (pastures), qualifying therefore those areas which have been in recovery processes.

Re-stratification was developed due to the different degrees of development between and within each lot, due to the clear differences in site quality, mortalities, and re-plantings. This re-evaluation was made based on the biomass contents obtained through satellite imagery processes. Therefore, plots with similar dates of planting, species and management had to be unified in strata of similar biomass conditions. This process is in line with the stratification proposed in the PDD, sect B.8.2 and Appendix 5.

b) Monitoring of forest management.

[6] They are not annexed to the monitoring report, supports delivered only to the DOE.

- *Forest management practices are important drivers of the GHG balance of the project, and thus must be monitored. The activities monitored included.*
- *Cleaning and site preparation measures: date, location, area, biomass removed and other measures undertaken.*
- *Planting: date, location, area, tree species (establishment of the stand models);*
- *Thinning: date, location, area, tree species, thinning intensity, volumes or biomass removed;*
- *Harvesting: date, location, area, tree species, volumes or biomass removed;*
- *Coppicing: date, location, area, tree species, volumes or biomass removed;*
- *Checking and confirming that harvested lands are re-planted, re-sowed or coppiced as planned and/or as required by forest law.*
- *Checking and ensuring that good conditions exist for natural regeneration if harvested lands can regenerate naturally.*
- *Monitoring of disturbances: date, location, area (GPS coordinates and remote sensing, as applicable), tree species, type of disturbance, biomass lost, implemented corrective measures, change in the boundary of strata, and stands.*

Monitoring of these activities is related to work contracts executed by the contractors and reports are archived in digital format at the project headquarters in Bogota.

Monitoring of GHG removals have been performed by sampling procedures based on ex-post stratification (see PDD). Baseline net GHG removals by sinks, GHG emissions and leakage have not been monitored following section B.7 of the PDD.

Measurement of carbon pools

Monitoring of GHG removals have been performed by sampling procedures based on ex-post stratification (see previous paragraphs) The Baseline net GHG removals by sinks, GHG emissions and leakage have not been monitored, following what is defined in the PDD.

Sampling for ex post calculations.

For the present verification period, five strata were defined to be monitored, and on which inventories were implemented to determine net removals of anthropogenic carbon. The statistical results for each stratum are presented in Table 15.

Table 15. Areas of each identified stratum in the Project area.

Stratum	Area (ha)	% Project	Plots	Mean Biomass
LOW	2,256.230	10.3%	49	9,61878
STEADY	3,650.636	16.6%	51	29,1421
MIDDLE	6,144.931	27.9%	84	52,7077
HIGH	4,832.150	22.0%	26	79,8901
UPPER	2,297.147	10.4%	21	113,687
P_N_R **(Protected_Natural Regenerations)**	2,824.274	12.8%	N.A	11.585
Total	**22,005.367**	**100.0%**	***231***	

The natural regeneration in the current verification, was not provided with arboreal species on which there could be implemented processes of measurement of diameters and heights in permanent plots,

given to that are still in a process successional early, characterized mostly by shrubs of average and high size, which crown cover the totality of the areas that corresponds to natural regeneration. For the previous thing, the biomass in was calculated accord to AR-Tool 14, section 11 (only shrubs). Its estimation way does not imply any plots assembly in land:

$$C_{SHRUB,t} = \frac{44}{12} \times CF_s \times (1 + R_s) \times \sum_i A_{SHURUB,i} \times b_{SHRUB,i}$$

Where:

$C_{SHRUB,t}$ = Carbon stock in shrubs within the project boundary at a given point of time in year *t*; tCO2-e

CF_s = Carbon fraction of shrub biomass; t C (t.d.m.)$^{-1}$

A default value of ***0.47*** is used unless transparent and verifiable information can be provided to justify a different value.

R_s = Root-shoot ratio for shrubs; dimensionless.

The default value of 0.40 is used unless transparent and verifiable information can be provided to justify a different value.

$A_{SHRUB,I}$ = Area of shrub biomass estimation stratum *i*; ha

$B_{SHRUB,\ i}$ = Shrub biomass per hectare in shrub biomass estimation stratum *i*; t d.m. ha^{-1}

BDR_{sf} = Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e. 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located; dimensionless. A default value of 0.10 should be used unless transparent and verifiable information can be provided to justify a different value.

b_{FOREST} = Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located; t d.m. ha^{-1}.

$CC_{SHRUB,I}$ = Crown cover of shrubs in shrub biomass estimation stratum i at the time of estimation, expressed as a fraction (e.g. 10 per cent crown cover implies $CC_{SHRUB,i}$ = 0.5; dimensionless.

Quality assurance/ quality control.

Verification of methods used to collect field data: to verify the correct measurements of sample plots 10% of them, randomly selected, have been re-measured. Three parameters have been re-measured (plot location, DBH and height of each tree).

The audited actions for quality control were:

- Training of personnel and expertise in the inventory processes: Training was held on the implementation of sampling, and how field activities are developed. The training was in line with the monitoring plan developed and presented in the PDD. The team featured: forestry engineers, crew leaders, and field staff support.

- Equipment: Verification of the proper functioning of the equipment used and its calibration. Diameters were taken with Lufkin W606PM diametric tape, and for diameters smaller than 5 cm, calibrator was used (Image 1A and B).

For measurement process, totally new equipment was acquired, guaranteeing its good function and calibration. The equipment was presented to the audit team and the purchase record are presented in annexe _7.

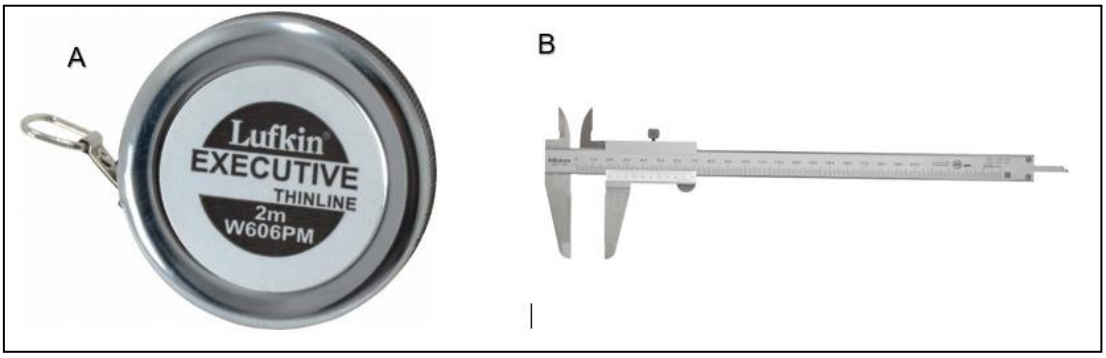


Image 1. DBH measurement equipment (cm): A, diametric tape, B. calibrator.

For measure the height to those trees that exceeded 4 m, indirect measurement was held with the use of TRUPULSE ™ 200 / 200B instrument (Figure 2-3). In all other cases, it was performed with a rod and a metric tape.

Image 2. Indirect Height Measurement Unit TRUPULSE™ 200 / 200B.

The equipment was purchased before the sampling started with factory calibration.

Image 3. Verification of equipment prior to the start of field sampling

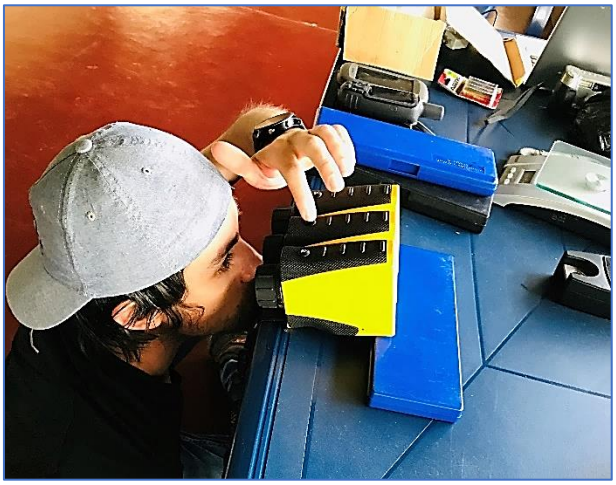


Image 4. Identification of errors in the calibration of digital hypsometers. The process is carried out by placing the instruments at different angles and in a flat area, checking each time the equipment to be used marks the same measurements with respect to the reference instrument or base equipment.

Image 5. Verification in the measurement of geographic coordinates from the two equipment to be used in the field. A new GPS is used as a reference.

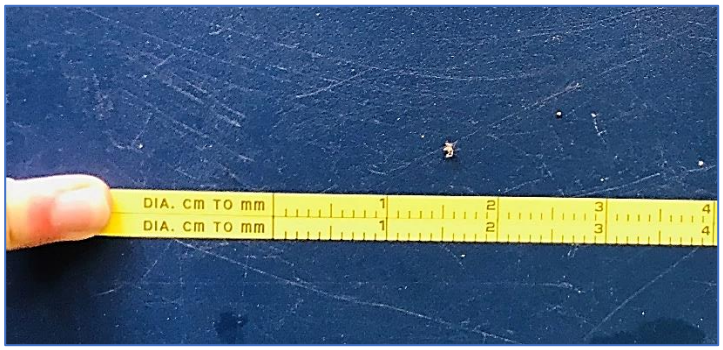


Image 6. New diameter tapes (cm values) are used in each field monitoring process, and both are verified to have equal calibration and no measurement-altering defects.

- Verification of methods used to collect field data: to verify the correct measurements of sample plots 10% of them, randomly selected, have been re-measured. Three parameters have been re-measured (plot location, DBH and height of each tree).

Due to the adjustments developed within the quality control processes, and to the improvement of the equipment use, the measurement errors were not significant. Variations in the diameters (greater

in the audit) were identified because of the normal growth of the trees and normal detachment of barks in the species of *Pinus sp*.

During the sampling, all tree heights were taken in each plot, reducing the associated uncertainty when heights are estimated with allometric equations.

- **Verification of data entry and analysis techniques**: All field data collected have been reviewed by an expert. Some necessary corrections, based basically on the transcript of data form field forms to the spreadsheet, have been done in coordination between the field team and the expert. Typing errors were associated to decimals entered. These, within the analyzed database did not exceed 0.25% error (15 data found and corrected).

- Custody of the information collected in the field and digitized: Archiving performance was verified of the information generated in field; all the forms were collected and ordered in books that rest in the central offices in Bogota. As a backup of the information obtained, all forms were recorded into digital media by scanning. The digital field survey files with GPS and GIS processes are digitally backed by the CDM coordinating computer at the headquarters of *Proyectos Forestales* Company, and have digital backups in the cloud (Dropbox, google drive) and in hard disks. All project information is available to DOE in its original formats and in digital media.

In subsequent monitoring processes to ensure accuracy in measuring equipment, an evaluation of the status and assessment of the level of accuracy will be carried out with equipment of the same references that have been properly safeguarded, to make comparisons quality control for accuracy, this applies especially to those of mechanical operation (Example: metric and diametric tape, calibrator). Digital equipment, such as GPS or digital hypsometer, will be taken to laboratories recommended by the manufacturers for their verification.

To ensure the quality of the information taken in field, when an equipment presents problems strictly will be replaced by a new one with factory certification or purchase invoice.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante

The parameters measured and monitored were aligned with those settled in the monitoring plan. The constant values suggested by the IPCC 2003 as presented in the PDD were maintained and some equations for determining biomass contents were adjusted to the requirements of the methodological tools, especially using information that is used in official national reports for determination of emission factors for Land Use Change and Forestry sector.

Data/parameter:	BEF_{2j}
Unit	Dimensionless
Description	Biomass expansion factor for conversion of stem biomass to above-ground tree biomass for tree species j
Source of data	Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC, 2003. Table 3A.1.10
Value(s) applied)	*Pinus sp:* *1.3*
Choice of data or measurement methods and procedures	Default value

Purpose of data	Calculation of actual net GHG removals by sinks Applied in the eq. 67 of the methodology AR-AM0004 v.04.
Additional comments	The equations used in *pinus sp* (except DAP<0.6cm) relate the DBH to the stem volume, and the *BEF 2* should be applied for branches, leaf biomass, etc. For other species Allometric equation method has been used.

Data/parameter:	**Carbon fraction, *CFj***
Unit	Dimensionless
Description	Carbon fraction content in the biomass
Source of data	IPCC (2003), PDD REF 9199. AR-Tool 14 Version 04.2
Value(s) applied)	*A. mangium*: 0.49; *T. grandis*: 0.49 *E. pellita*: 0.49; *Pinus sp.*: 0.49; Several species (ANR and PNR stand models): 0.49 For early successional states ANR and PNR. 0.47
Choice of data or measurement methods and procedures	default value
Purpose of data	Actual net GHG removals by each species in the project activity. Applied in the eq. 68 of the methodology AR-AM0004 v.04 and AR-Tool 0014 V.04.2 in the section 11 for the biomass and carbon shrubs.
Additional comments	It was applied to each stand model.

Data/parameter:	**Carbon fraction, *CFs***
Unit	t C
Description	Carbon fraction of shrub biomass
Source of data	PDD REF 9199. AR-Tool 14 Version 04.2
Value(s) applied)	0.47
Choice of data or measurement methods and procedures	Default value
Purpose of data	Actual net GHG removals by each species in the project activity. Applied in the eq. 68 of the methodology AR-AM0004 v.04 and AR-Tool 14 V 04.2, in the section 11 for the biomass and carbon shrubs.
Additional comments	It was applied to ANR and PNR models

Data/parameter:	*Dj*
Unit	t d.m. m-3
Description	Basic wood density for species *P. caribaea and P. oocarpa*
Source of data	USDA 2006a Trujillo N. 2013. Guía de Reforestación. 3º edición. Bogotá 254 p
Value(s) applied)	0.55
Choice of data or measurement methods and procedures	Data from national reference.
Purpose of data	Actual net GHG removals by *P. caribaea and P oocarpa* in the project activity. Applied in the eq. 67 of the methodology AR-AM0004 v.04
Additional comments	Data from national reference. Is applied only with volume equations to lead to biomass. For *A. mangium, T grandis* and *E. pellita*, biomass eq uations were used, and Basic wood density for this specie it was not necessary.

Data/parameter:	***Root-shoot ratio, R_j***
Unit	Dimensionless
Description	Root-shoot ratio for species *j.*
Source of data	Good Practice Guidance for Land Use, Land-Use Change and Forestry. IPCC, 2003. Table 3A.1.8
Value(s) applied)	*Pino sp*: 0.46 (<50 t.ha de biomasa aérea); 0.32 (50-150 t.ha de biomasa aérea); 0.23 (>150 t.ha de biomasa aérea) *Eucalipto sp*: 0.45 (<50 t.ha de biomasa aérea); 0.34 (50-150 t.ha de biomasa aérea) 0.2 (50-150 t.ha de biomasa aérea) *A. mangium*: 0.20 (<125 t.ha de biomasa aérea *Several species (ANR and PNR stand models): 0.27*
Choice of data or measurement methods and procedures	Default value
Purpose of data	Actual net GHG removals by each species in the project activity. Applied in the eq. 68 of the methodology AR-AM0004 v.04.
Additional comments	It was applied to *Pinus sp,* commercial stand model. *Pinus* tropical/sub-tropical moist forest.

Data/parameter:	**Root-shoot ratio, *Rs***
Unit	dimensionless
Description	Root-shoot ratio for shrubs
Source of data	UNFCCC AR Tool 14.
Value(s) applied)	0.4
Choice of data or measurement methods and procedures	N.A
Purpose of data	Actual net GHG removals in the early successional states ANR and PNR.
Additional comments	This process is applied for the early successional states in the natural regeneration.

Data/parameter:	***DLP***
Unit	%
Description	Desired level of precision.
Source of data	Value suggested by the methodology applied (AR-AM0004 v.04)
Value(s) applied)	10 %
Choice of data or measurement methods and procedures	N.A
Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comments	Applied for adjustment of the statistical sampling. Applied in the eq. 57 of the methodology AR-AM0004 v.04

Data/parameter:	$Z_{\alpha/2}$
Unit	Dimensionless
Description	Value of the statistic z (normal probability density function), for α = 0.1 (Implying a 90% confidence level).
Source of data	*Excel program*
Value(s) applied)	1.97
Choice of data or measurement methods and procedures	

Purpose of data	Calculation of project emissions or actual net GHG removals by sinks
Additional comments	To develop an accurate inventory of timber volume and carbon and applied for adjustment of the statistical sampling. See eq. 59 of the methodology AR-AM0004 v.04.

Data/parameter:	BDR_{sf}
Unit	Dimensionless
Description	Ratio of shrub biomass per hectare in land having a shrub crown cover
Source of data	AR Tool 14 V 04.2
Value(s) applied)	0.10
Choice of data or measurement methods and procedures	Default value
Purpose of data	Actual net GHG removals in the early successional states ANR and PNR
Additional comments	This process is applied for the early successional states in the natural regeneration and PNR.

Data/parameter:	bFOREST
Unit	t d.m. ha-1
Description	Default above-ground biomass content in forest in the region where the A/R CDM project activity is located
Source of data	National source, national forest inventory.
Value(s) applied)	231.7 t d.m. ha-1
Choice of data or measurement methods and procedures	N.A
Purpose of data:	Applied in the biomass and carbon shrubs in the regeneration stratum.
Additional comments	Applied for the tropical humid forest in Colombia. Phillips, et al, IDEAM 2014.

Data/parameter:	$\boldsymbol{DF_{DW}}$
Unit	Per cent (%)
Description	Conservative default factor expressing carbon stock in dead wood as a percentage of carbon stock in tree biomass
Source of data	National source, national forest inventory, IPCC or UNFCCC.

Value(s) applied)	10%
Choice of data or measurement methods and procedures.	The values recommended by AR-Tool 12 tropical biome with elevation below 2000m and precipitation >1600 mm yr^{-1}.
Purpose of data:	Applied in the carbon dead wood
Additional comments	AR-Tool 12

Data/parameter:	$CC_{SHRUBS.i}$
Unit	Dimensionless
Description	Crown cover of shrubs in shrub biomass stratum i
Source of data	National source, national forest inventory, IPCC, UNFCCC OR Field measurement
Value(s) applied)	0.5
Choice of data or measurement methods and procedures.	Considering that the biomass in shrubs is smaller than the biomass in trees, a simplified method of measurement may be used for estimating shrub crown cover. Ocular estimation of crown cover may be carried out or any other method such as the line transect method or the relascope method may be applied
Purpose of data:	Applied in the carbon shrub biomass stratum *i*
Additional comments	AR-Tool 14. When land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the shrub crown cover oscillates between a minimum and maximum values in the baseline, an average shrub crown cover equal to ***0.5*** is used unless transparent and verifiable information can be provided to justify a different value.

Data/parameter:	DF_{li}
Unit	Per cent (%)
Description	Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass.
Source of data	National source, national forest inventory, IPCC or UNFCCC.
Value(s) applied)	16%
Choice of data or measurement methods and procedures.	The values recommended by AR-Tool 12 tropical biome with elevation below 2000m and precipitation >1600 mm yr^{-1}.
Purpose of data:	Applied in the carbon dead wood

Additional comments	AR-Tool 12. Value of the conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass (DF_{LI}) is selected according to the guidance provided in the relevant table in Section 8 unless transparent and verifiable information can be provided to justify a different value. *For the present Project, litter biomass studies were analyzed for Pinus sp plantations under similar conditions to that project area. From this analysis (see attached analysis delivered to auditor team) was demonstrated that an average value of 16% is adequate for tropical forest plantations and is import highlight that tool recommended values is for natural forest not to plantations. This value is not appropriate to applied to these AR project conditions*. A literature analysis was developed to identify the reported values of litter biomass in *Pinus sp* plantations, which is presented to the auditor as an annex to this report.

Data/parameter:	f_{MG}
Unit	Dimensionless
Description	Relative stock change factor for baseline land-use in stratum *i* of the areas of Land.
Source of data	IPCC 2003. Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities.
Value(s) applied)	0.7
Choice of data or measurement methods and procedures.	The values recommended by Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities. The baseline identifies grassland as land use.
Purpose of data:	Applied for estimation of change in soil organic carbon stocks
Additional comments	

Data/parameter:	$f_{lu,i}$
Unit	Dimensionless
Description	Relative stock change factor for baseline land-use in stratum *i* of the areas of land
Source of data	IPCC 2003. Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities.
Value(s) applied)	1
Choice of data or measurement methods and procedures.	The values recommended by Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities. For Grassland in *Tropical, wet.*
Purpose of data:	Applied for estimation of change in soil organic carbon stocks

Additional comments	

Data/parameter:	$F_{IN,i}$
Unit	Dimensionless
Description	Relative stock change factor for baseline management regime in stratum *i* of the areas of land
Source of data	IPCC 2003. Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities.
Value(s) applied)	1
Choice of data or measurement methods and procedures.	The values recommended by Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities. For Severely degraded soil.
Purpose of data:	Applied for estimation of change in soil organic carbon stocks
Additional comments	

Data/parameter:	B_{Forest}
Unit	t.d.m ha^{-1}
Description	Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located
Source of data	IPCC 2003 and Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.
Value(s) applied)	231.7
Choice of data or measurement methods and procedures.	For tropical rainforest in Colombia. Phillips et al, IDEAM, 2014[7].
Purpose of data:	Applied for estimation of change in Shrubs carbon stocks
Additional comments	

D.2. Data and parameters monitored

This list considering only data and parameters obtained from field measurement in accordance with monitoring plan (see PDD).

[7] Phillips, J.F., Duque, A.J., Scott, C., Peña, M.A., Franco, C.A., Galindo, G., Cabrera, E., Álvarez, E. & Cárdenas, D. 2014. Aportes técnicos del Sistema de Monitoreo de Bosques y Carbono a la propuesta de preparación de Colombia para REDD+: datos de actividad y factores de emisión. Memoria técnica. Instituto de Hidrología, Meteorología, y Estudios Ambientales (IDEAM). Bogotá D.C., Colombia. 45 pp.

Data/parameter:	***A***
Unit	ha
Description	Total project area
Measured/calculated/default	Measured
Source of data	Measured and verified with GIS.
Value(s) of monitored parameter	29,019 ha
Monitoring equipment	GIS (Geographic Information System) and remote sensing.
Measuring/reading/recording frequency:	Annual
Calculation method (if applicable):	NA
QA/QC procedures:	As a control of the actual presence of the established stands, verification is done with satellite images and geographic information processes. This work is developed by an expert in image processing. The areas of natural regeneration are measured according to the image processing identification development of the areas under control and released for their natural forest development.
Purpose of data:	Calculation of project emissions or actual net GHG removals by Sinks.
Additional comments:	

Data/parameter:	A_{ikt}
Unit	ha
Description	All area under control that have been established up to 2015 in the stratum *i.*
Measured/calculated/default	Measured
Source of data	Measured in field with GPS and verified with GIS.
Value(s) of monitored parameter	**Stratum** / **Area (ha)** **LOW** 2,256.230 **STEADY** 3,650.636 **MIDDLE** 6,144.931 **HIGH** 4,832.150 **UPPER** 2,297.147 **P_N_R (Protected_Natural Regenerations)** 2,824.274 **Total** ***22,005.367***

Monitoring equipment	Global Position System (GPS). Remote sensing.
Measuring/reading/recording frequency:	Yearly and verified for the monitoring period.
Calculation method (if applicable):	N.A
QA/QC procedures:	Areas/lots/plots are measured with GPS, before establishment, and re-measured after plantation. This is required for payment procedures to contractors who carry out the activities and is subjected to a second verification by national entities that promote the development of the forestry sector (FINAGRO[8]). The whole process of area measuring in the field is carried out by professionals of the forestry and the environmental sector in charge of the project. These staff have been trained to use and manage GPS. As a control of the actual presence of the established stands, verification is done with satellite images and geographic information processes. This work is developed by an expert in image processing. The areas of natural regeneration are measured according to the image processing identification development of the areas under control and released for their natural forest development. The equipment's GPS (GLOBAL POSITIONING SYSTEMS) with which measurements are made of the areas of the strata, will be checked in his calibration before the fieldwork.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comments:	The total project area is calculated as de the sum of areas of the biomass estimation strata: $A_{i,k,t}=\sum A_i$

Data/parameter:	$A_{SHRUB,i}$
Unit	ha
Description	Area of shrub biomass estimation stratum i; ha
Measured/calculated/default	Measured
Source of data	Measured in field with GPS and verified with GIS.
Value(s) of monitored parameter	N_R (Natural Regenerations) 3,222.50 ha

[8] https://www.finagro.com.co/productos-y-servicios/CIF

Monitoring equipment	Remote sensing and geographic information system (GIS). The land verification with Global Position System (GPS). GARMIN ETREX 30.
Measuring/reading/recording frequency:	Yearly and verified for the monitoring period.
Calculation method (if applicable):	*N.A*
QA/QC procedures:	As a control of the actual presence of the established stands, verification is done with satellite images and geographic information processes. This work is developed by an expert in image processing. The areas of natural regeneration are measured according to the image processing identification development of the areas under control and released for their natural forest development. The equipment's GPS (GLOBAL POSITIONING SYSTEMS) with which measurements are made of the areas of the strata, will be checked in his calibration before the fieldwork.
Purpose of data:	Calculation of project emissions or actual net GHG removals by sinks
Additional comments:	It is also valued for areas (ha) in the commercial stand model, which allow carbon estimation by shrubs within the plantation.

Data/parameter:	***AP***
Unit	m^2
Description	Sample plot area
Measured/calculated/default	Measured
Source of data	Field measurement
Value(s) of monitored parameter	0.05 ha for the commercial stand and 0.001 ha in the sample for natural regeneration.
Monitoring equipment	Metric tape of 30 m. Precision of 2 mm.
Measuring/reading/recording frequency:	5 years
Calculation method (if applicable):	NA
QA/QC procedures:	The sampling protocol was applied, the training of field staff was developed. Then the developed procedure and the obtained information are evaluated. Development of error control according to PDD. In each verification process, new metric tapes will be available to ensure proper operation and accuracy of measurements.
Purpose of data:	Calculation of the changes in carbon stocks.

Additional comments:	The field-team received additional training for the correct establishment of the plots, this included team management, reading and care. To evaluate the biomass in the natural regeneration, a specific protocol was developed with defined steps, which was socialized to the field team. Given rectangular plots developed in commercial models, the right angles in the corners had to be verified with metallic stakes that have right angles in their upper part. See startup report. To verify that the parcels presented the correct areas, 10% of the established parcels were re-measured.

Data/parameter:	$B_{TREE,l,jp,i}$
Unit	kg tree^{-1}
Description	Biomass of tree *l* of species *j* in sample plot *p* of stratum *i*; It refers to trees with DAP lower than those applicable in the proposed alometric or volume equations. *For this monitoring applies only to Pinus sp.* with DBH < 0.6 cm or does not present height to measure DBH *(height <1.3m).* The other values of individual biomass per tree are estimated with the proposed equations and within the ranges established by these for each species.
Measured/calculated/default	Measured
Source of data	Field measurement
Value(s) of monitored parameter	*0,113* kg tree^{-1}
Monitoring equipment	Weighing scale
Measuring/reading/recording frequency:	Five years
Calculation method (if applicable):	NA
QA/QC procedures:	The sample size should be sufficient (min 30 samples) to reduce the statistical variability of sampling. The samples are harvested and properly weighed in weighing scale. The Weighing scale, it is recommended to use new scales in each verification to reduce precision errors. In the present certification, a new scale with a precision of 0.001 gr was used.
Purpose of data:	Applied in the biomass by tree, where the number of saplings with diameter below the range of diameter applicable to the allometric equation is high.

Additional comments:	This procedure is recommended for each verification, for trees that do not meet the minimum ranges of the equations are applied in the sampling for each species. The field-team received additional training for the correct establishment of the process, this included team management, reading and care. With the results of the average biomass per tree, and the count of the number of trees smaller than the DBH defined in each plot, its contribution in the biomass per plot is estimated. This procedure conforms to the recommendation of AR Tool 0014 V.04.2. Appendix 1.

Data/parameter:	***DBH***
Unit	cm
Description	Diameter at breast height
Measured/calculated/default	Measured
Source of data	Field measurement in sample plots
Value(s) of monitored parameter	All trees within simple plots.
Monitoring equipment	Diametric tape and Caliper. Precision of 1 mm.
Measuring/reading/recording frequency:	Each monitoring
Calculation method (if applicable):	*NA*
QA/QC procedures:	Data cross checking is done in the sample plots. New diametric tapes were used during the inventory development. Staff was trained in the correct way to measure and make use of the equipment. An audit process was held, and under cross-checking verification was corroborated data in a sample greater than 10% of the established plots. This process was realized with metallic diametrical Tapes, which show less variations in precision. The monitoring staff, keeps a tape in perfect condition, to calibrate the tapes used in the field. This tape is not used in field measurements and is stored in the central offices. Tapes that have problems of calibration, are replaced with new tapes of the same conditions (metallic tape).
Purpose of data:	Applied in the allometric or volume equations, for each species.

Additional comments:	The field-team received additional training for the correct establishment of the plots, this included team management, reading and care. To evaluate the biomass in the natural regeneration, a specific protocol was developed with defined steps, which was socialized to the field team. In order to verify that the parcels presented the correct areas, 10% of the established parcels were re-measured.

Data/parameter:	***H***
Unit	m
Description	Tree height
Measured/calculated/default	Measured
Source of data	Field measurement
Value(s) of monitored parameter	NA
Monitoring equipment	TRUPULSE™ 200 / 200B. And metric tape.
Measuring/reading/recording frequency:	Each monitoring
Calculation method (if applicable):	N.A
QA/QC procedures:	-Protocol for taking dendrometric measurement variables. A random sampling was developed in more than 10% of the established plots. With the same equipment and processes were used to corroborate the proper height measurement. The trees with heights less than 5 meters, can be taken with the help of tape measure. The staff keeps a tape in perfect condition, to calibrate the tapes used in the field. This tape is not used in field measurements and is stored in the central offices. Tapes that have problems of calibration, are replaced with new tapes of the same conditions (metallic tape). Trees with heights greater than 5 meters, they will be measured with digital hypsometers. The equipment's with which measurements, will be checked in his calibration before the fieldwork. These checks develop in laboratory specialized recognized by the manufacturers. When an equipment present problem demonstrated by the calibration laboratory and verified by monitoring staff, will be strictly replaced by new one.
Purpose of data:	Applied in the allometric or volume equations, for each species.

Additional comments:	Height measurements were taken in all plots of commercial stands, and in all trees into the plots. This process was adjusted to the recommended in the monitoring plan and in the PDD, since it was suggested only to sample a portion and to develop allometric equations for estimates the heights of the unmeasured trees. The field-team received additional training for the correct establishment of the plots, this included team management, reading and care. To evaluate the biomass in the natural regeneration, a specific protocol was developed with defined steps, which was socialized to the field team. To verify that the parcels presented the correct areas, 10% of the established parcels were re-measured.

Data/parameter:	$CC_{SHRUB,I}$
Unit	dimensionless
Description	Crown cover of shrubs in shrub biomass stratum *i*
Measured/calculated/default	Calculated
Source of data	Field measurement
Value(s) of monitored parameter	***0.5***
Monitoring equipment	N.A
Measuring/reading/recording frequency:	At every verification
Calculation method (if applicable):	Considering that the biomass in shrubs is smaller than the biomass in trees, a simplified method of measurement may be used for estimating shrub crown cover. Ocular estimation of crown cover may be carried out.
QA/QC procedures:	A default value of 0.5 should be used unless transparent and verifiable information can be provided to justify a different value. Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied.
Purpose of data:	Applied in the biomass and carbon shrubs in the regeneration stratum (ANR and PNR) and shrubs commercial stand.
Additional comments:	When land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the shrub crown cover oscillates between a minimum and maximum values in the baseline, an average shrub crown cover equal to **0.5** is used unless transparent and verifiable information can be provided to justify a different value. This process was appearing in the natural regeneration and to the shrubs present within the commercial stand.

D.3. Implementation of sampling plan

To implement the sampling plan, a re-stratification was held according to the definition in the PDD in section B.8.2. This was based on the biomass contents identified through image processing and field work (see Annex).

The samples were randomly distributed within the strata by following the sampling plan.

The sample size was calculated following the methodological tool "Calculation of the number of sample plots for measurements within A / R CDM project activities" V.02.1.0. And, the Winrock's CDM A / R Sample Plot Calculator Spreadsheet Tool version 2014 tool was applied to estimate the sample size from the field survey.

Equations to determine aerial biomass

The plots randomly distributed were located in the five strata defined in the re-stratification. These included species *Acacia mangium*, *Pinus caribaea, P. oocarpa*, *Eucalipto pellita and Tectona grandis*. The species *P. caribea* dominates more than 70% of the commercial crop in the project.

The equations used in general were allometric that related a dasometric variable with the total biomass of the tree; in cases where this equation was not available, volume equations were applied, and the basic density method of the wood was taken to total biomass.

To select the equations, we followed the recommendations of the tools *"Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A / R CDM project activities*" and "*Demonstrating appropriateness of allometric equations for estimation of aboveground biomass in A / R CDM project Activities*". It should be noted that for the region there are no equations for the project species, but there are equations from official national sources. For pine species, equations developed in regions with similarity of conditions and management were sought as the tools request. The sources of information of the equations used are provided to the auditor in annex[9].

Equations per species and their application according to the tools are in Table 16:

Table 16. Equations of volume and biomass applied for included species in work-field survey.

Specie	Equations	*Observation /applied*	Source
P. caribaea	$\mathrm{Ln(Vol)}=-9.66+1.834*\ln(\mathrm{DAP})+1.007\mathrm{Ln}(h_t)$	**Edafo climatic conditions:** Temperature: 21.7 °C Soils: Ultisols, red clay soils and acidic. Very humid, tropical premotane forest **Statistics:** ✓ ***R^2= 0.97*** ✓ ***N=45*** **Application range:** DAP≥ 10-28 cm	Salazar, 1985[10].

[9] They are not annexed to the monitoring report, supports delivered only to the DOE.

[10] Salazar, R. 1985. Productividad del *Pinus caribaea var*. *hondurensis Barr.* Y Golf. En Turrialba, COSTA RICA. IPEF. N.29 p.19-24

	$BA = 0.887 + \left(\frac{10486 * DAP^{2.84}}{(DAP^{2.84}) + 376907}\right)$	**Edafo climatic conditions:** Pines of temperate and tropical zones **Statistics:** R^2= 0,98 N= 137 **Application range:** DAP 0,6 - 56 cm.	IPCC 2003[11].
P. oocarpa	$V(m^3) = \left((0.442123) \times \left(\frac{DAP}{100}\right)^2 \times H_t\right) + 0.000178$	**Edafo climatic conditions:** Temperature: 18-24 °C. Very humid, tropical premotane forest **Statistics:** R^2: 0.991 N: 105 **Application range:** Not defined.	INDERENA, 1989[12] OIMT-CONIF-MINAMBIENTE, 1999[13].
A. mangium	$BA = 0.204 * DAP^{2.2801}$	**Edafo climatic conditions:** Humid tropical forest Temperatura: 26 °C – 28 °C Alluvial plane. Acid soils, low fertility Slope 0-3% **Statistics:** N=52 R^2= 0.94 **Application range:** *DAP> 5cm*	Recommended in the national carbon protocol of Colombia, Yepes et al, IDEAM, 2011[14].

[11] IPCC 2003. Good Practice Guidance for Land Use, Land-Use Change and Forestry. Penman, J. Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe K., and Wagner F Editors. Intergovernmental Panel on Climate Change.

[12] Posada F, 1989. Compilación de tablas de volumen para árboles en pie. Instituto Nacional de los Recursos Naturales Renovables y del Ambiente -INDERENA. 128 pg.

[13] Vélez, F., Ortiz R. 1999. Estimador del crecimiento Forestal V.1. Organización Internacional de las Maderas Tropicales –OIMT, Corporación Nacional de Investigación y Fomento Forestal –CONIF, Ministerio del Medio Ambiente de Colombia –MINAMBIENTE. 70 pg.

[14] Yepes A.P., Navarrete D.A., Duque A.J., Phillips J.F., Cabrera K.R., Álvarez, E., García, M.C., Ordoñez, M.F. 2011. Protocolo para la estimación nacional y subnacional de biomasa - carbono en Colombia. Instituto de Hidrología, Meteorología, y Estudios Ambientales-IDEAM-. Bogotá D.C., Colombia. 162 p.

E. pellita	$BA = 1.22 * DAP^2 * h_t * 0.01$	**Edafo climatic conditions:** *Subtropical zone*. Temperature: 17.3 °C. **Statistics:** R^2= 0.97. N= 130. **Application range:** *DBH:1-31 cm*	*Recommended in the national carbon protocol of Colombia, Yepes et al, IDEAM, 2011, Surce IPCC 2003.*
T. grandis	$BA = 0.131748 * D^{2.406413}$	**Edafo Climatic conditios:** Humid tropical forest Temperatura: 27 °C Precipitation: 2478,8 mm Alluvial plane. **Statistics:** R^2= 0.97. N= 102 **Application range:** *DBH:1.75-31.1 cm*	*Torres, D.A. 2004*[15].

Below ground biomass.

This was estimated from the aerial biomass, applying the conversion factor of aerial biomass to underground *Root:Shoot ratio* (IPCC, 2003). This process is considered a good practice within the IPCC guidelines for land use change.

Statistic for the six strata identified is presented in Table 17.

Table 17. Statistics for strata sampled in the project within the current monitoring period.

Stratum	Area (ha)	% Project	Plots	Mean Biomass
LOW	2,256.230	10.3%	49	9,61878
STEADY	3,650.636	16.6%	51	29,1421
MIDDLE	6,144.931	27.9%	84	52,7077
HIGH	4,832.150	22.0%	26	79,8901
UPPER	2,297.147	10.4%	21	113,687
***P_N_R* (Protected_Natural Regenerations)**	2,824.274	12.8%	*N.A*	11.585
Total	**22,005.367**	**100.0%**	***231***	

To determine if the sampling was sufficient and that fulfils the 10% error level criteria and 90% of reliability level, the *Winrock's CDM A/R Sample Plot Calculator Spreadsheet Tool Version 2014*[16]

[15] Torres, D.A 2004. Modelación del crecimiento y producción en volumen y biomasa de la teca. Trabajo de Grado de Ingeniería Forestal, Departamento de Ciencias Forestales, Facultad de Ciencias Agropecuarias, Universidad Nacional de Colombia, Medellín. 48 p.

[16] http://www.winrock.org/resources/winrock-sample-plot-calculator

tool was used. This tool applies the methodological tool AR_AM_03_v2.1 (*Calculation of the number of sample plots for measurements within A/R CDM project Activities*[17]).

For the sampling process in each stratum, the steps described in the applied methodology and in the methodological tools for determination of sample size were followed.

After stratifying the project, the equation for the calculation of the sample per stratum was applied

Equation 1 $$n = \frac{N * t_{val}^2 * (\sum_i w_i * s_i)}{N * E^2 + t_{val}^2 * \sum_i w_i * s_i^2}$$

Where:

n: Number of required plots:

N: Total number of possible plots in the area of the project.

t_{val}: Students t (two-tailed) value for infinite degrees of freedom, and according to the defined reliability level.

w_i: Relative weight of stratum area i (divides the stratum size by the total size of the project).

s_i: Estimated standard deviation for biomass content (t dry matter ha-1).

E: Acceptable error margin defined for biomass estimation.

i: *1,2,3,…* Project stratum.

In total for commercial stands, 213 plots were established (see: anexx_ analisis_estadisticos_muestreo).

Statistical analysis applied to the results for the plots in each stratum determines significant differences between commercial strata (see Table 14 and **¡Error! No se encuentra el origen de la referencia.**). The natural regeneration stratum was not included in this analysis due to its clear differences in management, thus, it does not apply a comparison with commercially managed stands.

Table 18. Results of multiple ranges for the values of the commercial strata sampled.

Contrast	***Significance***	***Difference***	***+/- Limits***
Low - Steady	*	-19,5233	3,43584
Low - Middle	*	-43,0889	3,08748
Low - High	*	-70,2713	4,16737
Low -Upper	*	-104,068	4,47978
Steady - Middle	*	-23,5656	3,049
Steady - High	*	-50,7481	4,13894
Steady - Upper	*	-84,5451	4,45335
Middle - High	*	-27,1824	3,85466
Middle – Upper	*	-60,9795	4,19045
High - Upper	*	**-33,797**	**5,03928**

* Shows a significant difference.

[17] http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf

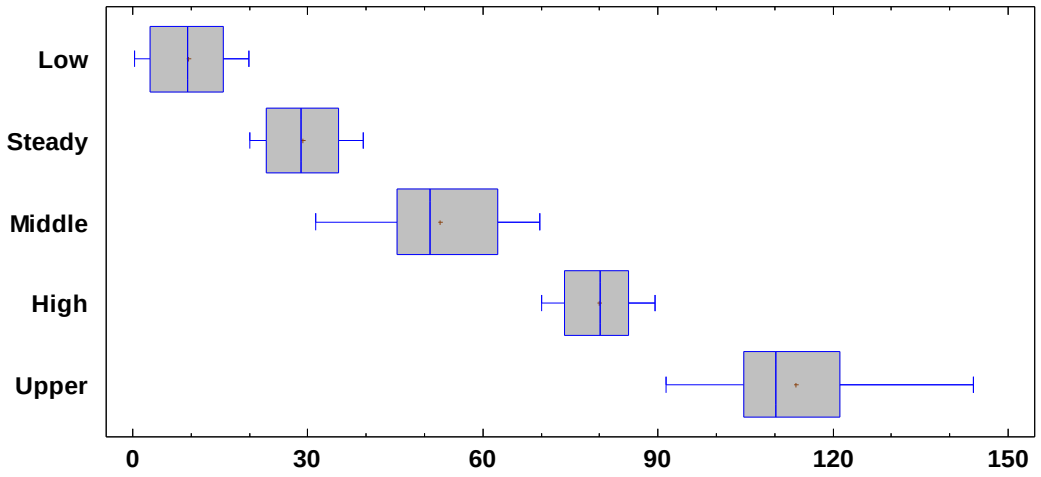


Figure 12. Analysis of statistical differences of the total biomass (t / ha) between strata of commercial species from the monitoring developed.

Estimation of simple size.

To determine whether sampling was sufficient and meets the 10% error level criteria and 90% confidentiality level, we followed the *Winrock's CDM A / R Sample Plot Calculator Tool Spreadsheet Tool Version 2014*[18] *(Annex 5).* This format is adjusted by the methodological tool *AR_AM_03_v2 (Calculation of the number of sample plots for measurements within A / R CDM project Activities*[19]*).*

The results of the calculation tool for the sample size are presented in **¡Error! No se encuentra el origen de la referencia.**. This shows that the number of established plots compared to the required plots was exceeded, so it is assumed that the sampling was sufficient and complies with the Statistical adjustments of error of 10% and level of confidence of 90%.

Table 19. Sample plot in the present monitoring period.

Stratum	*Plot calculated*	*Sample Plot*
Low	1	49
Steady	1	51
Middle	2	84
High	1	26
Upper	1	21

Shrubs

According with AR_Tool 14 tool, Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, this sink is considering positive when the biomass shrubs values are above those identified values in the baseline.Hence, they are accounted for in the anthropogenic net carbon balance.

[18] http://www.winrock.org/resources/winrock-sample-plot-calculator

[19] http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-03-v2.1.0.pdf

On the other hand, this component in AR activities within the definition of forest, considers shrubs as an integral part in the Colombian context. Therefore, as they have significant changes compared to the baseline values, they are accounted for in the anthropogenic net carbon balance.

As indicated in previous paragraphs, due to frequent burn activities, the eligible zones just consider clean grasslands without tree presence or shrubs, this zones to be influenced by periodic burns, restrict the presence of this component in the baseline conditions. Therefore, his value is assumed as zero.

Now the estimation of this component for project conditions is carried out, following recommendations from literal 11 of AR-Tool 14 tool. Its application is made in strata where the dominance in the coverage of the tops of the shrubs is above 5%.

- $\Delta C_{SHRUB,t} = \frac{44}{12} \times CF_s \times (1 + R_s) \times \sum_i A_{SHRUBS,i} \times b_{SHRUBS,i}$ Equation 26 Tool.
- $b_{SHRUBS,i} = BDR_{SF} \times b_{FOREST} \times CC_{SHRUBS,I}$ Equation 27 Tool.

Where:

$\Delta C_{SHRUB,t}$	=	Change in carbon stock in shrubs within the project boundary in year t between times t_1 and t_2 . *tCO₂-e*
CF_s	=	Carbon fraction of shrub biomass C (t.d.m.)$^{-1}$. default value of 0.47
R_s	=	Root-shoot ratio for shrubs; dimensionless. Default value of 0.40
$A_{SHRUB,t}$	=	Area of shrub biomass estimation stratum *i*; ha
$b_{SHRUB,t}$	=	Shrub biomass per hectare in shrub biomass estimation stratum *i, td.m.ha^{-1}*
BDR_{SF}		Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e. 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located; dimensionless. A default value of 0.10
b_{FOREST}	=	Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located *td.m.ha^{-1}*
$CC_{SHRUBS,i}$	=	Crown cover of shrubs in shrub biomass estimation stratum i at the time of estimation, expressed as a fraction.

Carbon stock in dead wood and Litter.

To estimation of this component follows the methodological tool, AR-TOOL12 "Estimation of carbon stocks and change in carbon stocks in and litter in A / R CDM project activities."

The baseline is based on the same concept: the absence or accumulation of litter due to the periodic burning processes. Instead, project activities promote the formation of a litter layer that remains for long periods on the ground. Some studies have shown contributions of up to 29% of the biomass in the general balance of carbon sinks. Compared with the accumulation of zero in the baseline, this value shows the importance of this deposit in the general carbon balances for the Project.

The methodological tool recommends two ways for estimating the carbon content in the litter and deadwood components. For the current calculation, the conservative method of default factors will be used for the current calculation.

This methodological process assumes that deadwood is not removed and remains on the plantation soil. This assumption is what happens in the project activities; the organic matter derived by pruning

or self-pruning (eucalyptus) and by natural mortality of some individuals is not removed. This matter is left inside the plantations during the rotation cycle. Your way of calculating for dead wood is defined by:

$\Delta C_{DW,i,t} = C_{TREE,i,t} \times DF_{DW}$ Equiation 9 Tool.

Where:

$C_{DW,t}$	=	Carbon stock in dead wood within the project boundary at a given point of time in year t, t CO_2-e
$C_{TREE,i,t}$	=	Carbon stock in trees biomass in stratum i at a point of time in year t, as calculated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities. tCO_2-e
DF_{DW}	=	Conservative default factor expressing carbon stock in dead Wood as a percentage of carbon stock in tree biomass, %.
i	=	1,2,3,… biomass estimation strata within the project boundary
t	=	1,2,3,… years elapsed since the start of the A/R CDM project activity

Carbon Litter.

It is conservatively estimated with default factors for estimating carbon content of this pool.

- $C_{LI,i,t} = C_{TREE,i,t} \times DF_{LI}$ Equation 15 of tool.

Where:

$C_{LI,i,t}$	=	Carbon stock in litter in stratum i at a given point of time in year, *t* CO_2-e
$C_{TREE,i,t}$	=	Carbon stock in trees biomass in stratum i at a point of time in year t, as calculated in tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities". *t*CO_2-e
DF_{LI}	=	Conservative default factor expressing carbon stock in litter as a percentage of carbon stock in tree biomass; percent, %.
i	=	1,2,3,… biomass estimation strata within the project boundary
t	=	1,2,3,… years elapsed since the start of the A/R CDM project activity

Soil Organic Carbon stocks

Under baseline conditions (see paragraphs of generalities), because of the characteristics of the soils and their management, they have led to significantly low organic carbon content of the soil.

To develop carbon balances and their changes in the soil component, the methodological tool will be applied *"Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities".*

Changes in organic carbon content are defined by:

$\Delta SOC_{AL,i}$ Change in SOC stock in areas of land meeting the above applicability conditions, in year t tCO_2-*e*

$$SOC_{INITIAL,i} = SOC_{REF,i} \times f_{LU,i} \times f_{MG,i} \times f_{IN,i}$$ Equation 1 of tool.

Where:

$SOC_{INITIAL,i}$	=	SOC stock at the beginning of the A/R CDM project activity in stratum i of the areas of land, *t*C ha^{-1}
$SOC_{REF,i}$	=	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 *t*C ha^{-1}
$f_{LU,i}$	=	Relative stock change factor for baseline land-use in stratum i of the areas of land; dimensionless.
$f_{MG,i}$	=	Relative stock change factor for baseline management regime in stratum i of the areas of land; dimensionless.
$f_{IN,i}$	=	Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum i of the areas of land; dimensionless
i	=	*1, 2, 3, …..* strata of areas of land; dimensionless.

For the estimation of this component, making use of default factors and following methodological recommendations of conservative values and maintaining transparency of the results, the tool is used ARWG SOC tool Multizone format *Excel "The approved spreadsheet to facilitate the calculation of changes in soil organic carbon stocks"*[20].

Results of CO_2e contents by sink and for all strata.

In order to estimate the final emission reduction values generated by the project during the analysis period, the uncertainty associated to estimations was evaluated in order to make discounts according to their level.

The equations applied was (equation 6, Tool AR_AM00014):

Equation 2

$$u_{\Delta C} = \frac{t_{val} \times \sqrt{\sum_{i=1}^{M} w_i^2 \times \frac{S_{\Delta i}^2}{n_i}}}{|\Delta b_{TREE}|}$$

Where:

ΔC_{TREE} = Change in carbon stock in trees between two successive measurements; t CO_2e.

$u_{\Delta C}$ = Uncertainty in $\Delta C_{TREE.}$

Δb_{TREE} = Mean change in tree biomass per hectare within the biomass estimation strata; t d.m. h^{-1}.

t_{val} = Two-sided Student's t-value for a confidence level of 90 per cent and degrees of freedom equal to n – M, where n is total number of sample plots within the tree biomass estimation strata, and M is the total number of tree biomass estimation strata

[20] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-16-v1.1.0.pdf/history_view

w_i = Ratio of the area of stratum i to the sum of areas of biomass estimation strata (i.e.A_i/A); dimensionless.

$S^2_{\Delta,i}$ =*Variance of mean change in tree biomass per hectare in stratum i;* (t d.m. $ha^{-1})^2$

n_i = Number of sample plots, in stratum *i*, in which tree biomass was re-measured.

The accumulated uncertainty was less than 5% and by strata less than 10% as shown in Table 20. Since the uncertainty associated with the total estimates was <10%, no adjustments are required to the final estimates.

Table 20. Results of the assessment of the uncertainty (only commercial area above and below carbon biomass) of the reduced carbon estimations in the project area by the implementation of the CDM.

Strata	Area of Stratum (ha)	Mean carbon of Stratum (t/ha)	Ratio of stratum *i* area to project area (wi)	wi* Mean carbon of Stratum	Number of sample plots	Variance of mean change in carbon per ha	t-value 10%, sample plots *i* - 4 strata	Error	Margin of Error (%)
Low	2,256.2	24.1	0.12	2.8	49.0	0.1	1.68	0.5	16.88%
Steady	3,650.6	74.7	0.19	14.2	51.0	0.2	1.68	0.8	5.30%
Middle	6,144.9	129.8	0.32	41.6	84.0	0.4	1.66	1.1	2.63%
Higth	4,832.1	189.5	0.25	47.7	26.0	0.5	1.71	1.2	2.61%
Upper	2,297.1	269.6	0.12	32.3	21.0	0.9	1.72	1.6	5.08%
Total	***19,181.1***			***138.6***	***231.0***	***2.2***	***1.65***	***2.4***	***1.75%***

According to previous analyzes and in line with the assumptions explained in the PDD that explains no emissions generated by implementation of the project activities, and there are no leaks, the anthropogenic net removals for the 17_02_2016 – 01_10_2020 analysis periods are:

Table 21. Results of carbon removals for each stratum within the Project.

Estrata	*Average CO_2 stock tree biomass*	***Pools***						**Total *($tCO_2e.$)***
		Area (ha)	***CO_2 total tree biomass***	***Shrubs***	**Cli,t**	**CDW**	**COS**	
Low	*24.06*	*2,256.2*	*54,293*	*63,063*	*3,258*	*8,687*	626,125.49	
Steady	*74.67*	*3,650.6*	*272,591*	*102,038*	*16,355*	*43,615*		
Middle	*129.80*	*6,144.9*	*797,589*	*171,755*	*47,855*	*127,614*		
Higth	*189.47*	*4,832.1*	*915,535*	*135,062*	*54,932*	*146,486*		
Upper	*269.62*	*2,297.1*	*619,357*	*64,207*	*37,161*	*99,097*		
RN	*27.95*	*2,824.3*	*78,941*	*0*	*0*	*0*		
		22,005.37	*2,738,306*	*536,126*	*159,562*	*425,498*	*626,125*	***4,485,617***

For more details see Annex_4_Carbon_Balance_AR_V01_25_04AS

The databases, analyzes and statistical processes are presented to the DOE confidentially for its verification.

SECTION E. Calculation of emission reductions or net anthropogenic removals

E.1. Calculation of baseline emissions or baseline net removals

N/A

The baseline is determined ex ante and remains fixed during the first crediting period. Thus, the baseline is not monitored. (See section B.7. of the PDD) Following equation in section B.7. of the PDD, ex ante baseline net greenhouse gas removals by sinks are zero.

$$CBSL = 0 \text{ for all } t^* \leq tcp \qquad \text{(Equation number 2 of the PDD)}$$

CBSL = baseline net greenhouse gas removals by sinks; t CO_2-e

ΔCB,LB = baseline sum of the changes in living biomass carbon stocks (above- and below-ground); t CO_2-e.

*t** = Number of years elapsed since the start of the A/R project activity; yr

tcp = Year at which the first crediting period ends; yr.

E.2. Calculation of project emissions or actual net removals

The net GHG removals by carbon sinks (actual net GHG removals) represents the sum of the changes in the carbon content in the project activity scenario, after deducting non-woody biomass removed to establish the models (*Ebiomassloss*), minus the increase in GHG emissions due to project implementation (GHG emissions) in accordance with Section 7.1 of the AR-AM0004/Version 04 Methodology.

The actual net GHG removals by sinks within the project scope (C_{ACTUAL}) were determined using Equation 3 and Equation 4 of methodology AR-AM0004/Version 04.

Equation 3 $C_{Actual} = \Delta C_{P,LBt} - GHG_e$

$\Delta CP_{,LB}$ = changes in carbon stored in the living tree biomass compartments in the project activity scenario; $tCO_{2\text{-}e}$

GHG_E = sum of the increments in GHG emissions within the project scope attributable to the project implementation; t CO_2-e

Equation 4 $\Delta C_{P,LB} = \Delta C_{P,LB_T} - E_{biomassloss}$

Equation 5 $\Delta C_{P,LB_T} = \sum_{t=1}^{t} \sum_{i=1}^{m_{BL}} \sum_{k=1}^{K_p} \Delta C_{P,LB,ikt}$

Where.

$\Delta C_{P,LBt}$. = sum of changes in the carbon stock of the project scenario

$\Delta C_{LB,ikt}$ = change in the annual carbon stock for stratum i, tree stand model *k*, time *t*

i = 1, 2, 3,…m_{BL}

k = 1, 2, 3,…*K* tree stand model in the project scenario

t = 1, 2, 3,…*t** years from the start of the project.

$E_{biomasslos}$ = Decrease in the carbon stock of the living biomass

According to the AR-ACM0003 that replaces the AR-AM004 its applicability conditions, only emissions from burning of biomass activities are considered. In the proposed A/R CDM project activity there will be no biomass burning for site preparation or for forest management. Therefore, emissions within the project boundary are not considered; GHG = 0.

Changes in biomass content in the project activity models ($\Delta C_{P,LBikt}$)

The procedure and implemented equations to estimate the aboveground and belowground biomass is described in section D.3 (see above).

Removed biomass ($E_{biomassloss}$)

The biomass removed as part of site preparation before planting corresponds to herbaceous vegetation. Following the methodology AR-AM0004/Version 04 and guidance contained in paragraph 35 in the report of the EB 42 meeting, the living biomass does not contain the biomass of herbaceous vegetation; therefore, loss of living biomass ($E_{biomassloss}$) is *0*.

Burning for the preparation of soils has not been developed nor is it expected to develop in the project proposal, on the other hand this is an activity that is controlled by the environmental corporation (CORPORINOQUIA) and that it conforms to resolution 0187 the 2007 year, of the ministries of Agriculture and environment of Colombia regarding the prohibition of burning for soil adequacy in Colombian territory (CORPORINOQUIA[21]).

The above mentioned, is in line with what was proposed in the PDD section B.6.1.

Increase in GHG emissions of the project activity ($GHG_{Emissions}$)

According to the AR-ACM0003 that replaces the AR-AM004, its applicability conditions its applicability conditions, only emissions from burning of biomass activities are considered. During the current monitoring period, no burns were developed for soil preparation. This is in line with the proposed in the PDD. Therefore, emissions within the project boundary are $GHG_E = 0$.

According to this, in the proposed project the net GHG removals by carbon sinks (actual net GHG removals) is equal to the sum of changes in the carbon stock of the project scenario.

$$C_{Actual} = \Delta C_{P,LB_T}$$

21 http://www.corporinoquia.gov.co/files/Normas_sobre_aprovechamiento_forestal/resolucin_187_de_2007.pdf

E.3. Calculation of leakage emissions

According to the PDD, leakages are not considered due to displacement of activities as a product of project implementation. See section B.7.3 of the PDD.

Therefore, *Lk= 0*

Therefore, it does not require quantification within the current analysis period.

E.4. Calculation of emission reductions or net anthropogenic removals

	Baseline GHG emissions or baseline net GHG removals ($t CO_2e$)	Project GHG emissions or actual net GHG removals ($t CO_2e$)	Leakage GHG emissions ($t CO_2e$)	GHG emission reductions or net anthropogenic GHG removals ($t CO_2e$)			
				Before 01/01/ 2013	From 01/01/ 2013 until 31/12/ 2020	From 01/01/ 2021	Total amount
Total	0	**4,485,617**	0	0	**4,485,617**	0	**4,485,617**

E.5. Comparison of emission reductions or net anthropogenic removals achieved with estimates in the registered PDD

Amount achieved during this monitoring period ($t CO_2e$)	Amount estimated ex ante for this monitoring period in the PDD ($t CO_2e$)
4,485,617	**3,234,131**

E.5.1. Explanation of calculation of "amount estimated ex ante for this monitoring period in the PDD"

As per CDM registered PDD, the net remotion is 3,234,131 tCO2e this value is smaller with monitoring present, because in the PDD document, based on the AR-AM0004 methodology, soil organic carbon (SOC), litter, shrubs within the plantations, and deadwood above the ground were not considered as accounting elements in net removals.

For the current monitoring, arguing that the AR-AM0004 methodology is inactive and the AR-ACM0003 methodology replaces it, these sinks are included in the Project's accounting, adding them to the carbon present aboveground and underground biomass already registered and monitored in the current period. Therefore, the balances of the current verification are higher than those estimated in the ex-ante phase.

E.6. Remarks on increase in achieved emission reductions

The PDD document and its technical support have been developing since 2010. By that time, the methodology that fits best for the Project's conditions was AR-AM0004 according to the UNFCCC CDM platform. The PDD was completed on 12/30/2012 and submitted for validation and registration on the same date. The Project is registered on March 1, 2013, with a PDD document based on the AR-AM0004 methodology.

However, the AR-AM0004 methodology lost its validity on November 12, 2012, and AR-ACM0003 replaced it. Despite the change, projects based on the AR-AM0004 methodology could be submitted for registration until January 18, 2013. Following this alternative, the process continued under the AR-AM0004 methodology, and the Project didn't make adjustments to change to the new one.

https://cdm.unfccc.int/methodologies/DB/S2OMSUTOWYOMLW75MPR0CG6SAKNG4Y

Once the Project is registered, The Project Technical Unit analyzes the applicability and additionality of AR-ACM0003 methodology conditions. After conducting the analysis, the technical unit identified that the Project complies with the same conditions defined by AR-AM0004. Moreover, the technical unit concluded that AR-ACM0003 methodology adjusts much better to the conditions of the projects related to carbon sinks. This characteristic is important due to the positive impact on the accumulation of carbon in the soil, shrubs, litter, and wood dead on the ground, compared to the baseline. The previous AR-AM0004 methodology did not consider these sinks, so they could never be linked to the balance of net removals in the ex-ante phase despite their high positive value as CO_2 sinks.

In 2018 the Colombia national government defined Carbon Deposits as the compartments where the carbon of continental ecosystems and their products is stored. These are aboveground and underground biomass, dead organic matter including debris and deadwood, the organic carbon in the soil, and harvested wood products. This definition was made for the national accounting of GHG emissions reduced or avoided, and it can be found in Resolution 1447 "By which the monitoring, reporting, and verification system of mitigation actions at the national level referred to in article 175 of Law 1753 of 2015, and other provisions are issued". The resolution is part of the climate change policies of the country.

https://www.minambiente.gov.co/images/normativa/app/resoluciones/98-RES%201447%20DE%202018.pdf

Considering Resolution 1447, the replacement of AR-AM0004 methodology by AR-ACM0003, which includes all these sinks, the project "CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia" accepted the sinks of the AR-ACM0003 methodology since they are additional compared to the baseline. R-ACM0003 methodology adds the aerial and underground biomass sinks, the Soil Organic Carbon sinks, Leaf litter, Shrubs within the plantations, and deadwood on the ground. This acceptance explains the higher values for the current monitoring report than those expected and projected in the ex-ante PDD.

E.7. Remarks on scale of small-scale project activity

Not Apply

Document information

Version	*Date*	*Description*
08.0	6 April 2021	Revision to: • Reflect the “Clarification: Regulatory requirements under temporary measures for post-2020 cases” (CDM-EB109-A01-CLAR).
07.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Add a section on remarks on the observance of the scale limit of small-scale project activity during the crediting period; • Add "changes specific to afforestation or reforestation project activity" as a possible post-registration changes; • Clarify the reporting of net anthropogenic GHG removals for A/R project activities between two commitment periods; • Make editorial improvements.
06.0	7 June 2017	Revision to: • Ensure consistency with version 01.0 of the “CDM project standard for project activities” (CDM-EB93-A04-STAN); • Make editorial improvements.
05.1	4 May 2015	Editorial revision to correct version numbering.
05.0	1 April 2015	Revisions to: • Include provisions related to delayed submission of a monitoring plan; • Provisions related to the Host Party; • Remove reference to programme of activities; • Overall editorial improvement.
04.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the monitoring report form (these instructions supersede the "Guideline: Completing the monitoring report form" (Version 04.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for completing the CDM-MR-FORM in A.6 and Appendix 1; • Change the reference number from *F-CDM-MR* to *CDM-MR-FORM*; • Editorial improvement.
03.2	5 November 2013	Editorial revision to correct table in page 1.

Version	*Date*	*Description*
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB 70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
01.0	28 May 2010	EB 54, Annex 34. Initial adoption.

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