Project design document form (afforestation or reforestation)

(Version 11.0)

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

BASIC INFORMATION	
Title of the project activity	**CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia.**
Scale of the project activity	☒ Large-scale ☐ Small-scale
Version number of the PDD	04.0
Completion date of the PDD	01/10/2021
Project participants	Bosques de la Primavera S.A.
Host Party	Colombia
Applied methodologies and standardized baselines	Selected methodology: Reforestation or afforestation of land currently under agricultural use, ARAM0004, Version 04. The AR-ACM0003: Afforestation and reforestation of lands except wetlands - Version 2.0, Replace ARAM0004, Version 04. ***The current PDD includes the update to the methodology AR-ACM0003.***
Estimated amount of annual average net anthropogenic GHG removals	311,813 t CO2 year^{-1}.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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.

Primavera, Vichada is a remote region, far from the urban and productive centers of the country, with very poor transport infrastructure to connect with domestic or international markets. Illicit drug cultivation and rural violence have traditionally existed in the area. Financial revenues from carbon sequestration will help investors to offset the risks of investing in the area and the high costs of accessing distant markets for the future sale of timber and the development of products made of tropical woods. If the government fails to build highways and river transport infrastructure to the region, the transport costs of taking the lumber to market may outweigh its value, and the sale of certificates of emission reduction may end up being the primary source of income to the project.

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 reforestation and afforestation activities in the region. The President of Colombia and the Ministry of Agriculture created the program named *"The Rebirth of the High Orinoco Region of Colombia"* with a focus on CDM to attract investment and promote sustainable development. In 2005, through the CDM Feasibility study "CDM Implementation in the Megaproject: The Rebirth of the High Orinoco Region of Colombia[1]" the Ministry confirmed that the forest production options promoted by the research center CORPOICA[2] could become financially attractive in the area by adding the revenues generated by the CDM, given the high growth and carbon sequestration rates that have been documented in the area.

It is due to this initiative by the Presidency of Colombia and the Ministry of Agriculture that promoted the CDM as a principal new financial incentive for forestry in the High Orinoco that the Organización La Primavera S.A. and its associates decided to invest in this forestry project. Following the visits to the area by Dr. Roberto Camacho (Ministry of Agriculture and Rural Development) and Dr. Orland Piragauta (General Manager of the Regional Environmental Authority of the Orinoco Region CORPORINOQUIA), the planting process began on June 2nd, 2005 in properties owned by the Organización La Primavera S.A. The chronology of CDM activities carried out by the project from 2005 to the present is included in section B.6.

The project is a private initiative composed of 7 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 Cámbulos S.A.S and INCOMSER

[1] *Centro Andino para la Economía en el Medio Ambiente, Carbono y Bosques, 2005. CDM Implementation in the Megaproject: The Rebirth of the High Orinoquia of Colombia.*

[2] Corporación Colombiana de Investigación Agropecuaria

LTDA The estimated annual average GHG removals by sinks for the project is 311,813.43 tCO_2 and the total is 6,236,269 $tCO_2$for the first crediting period.

Vegetation cover and land-use in the baseline case

The total area of the project is 29,019 hectares. 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). This practice occurs with an average of 10 hectares per animal.

The combination of natural wildfires during periods of intense summer and regular anthropogenic grassland burning for cattle grazing degrade the soil, as minerals are lost and the physical conditions such as porosity, among others, are altered. Over–grazing and the lack of fertilization further deteriorate the soil. The degraded soils are washed out constantly by the heavy rains. The practice of grassland burning is carried out twice a year by cattle ranchers to obtain new grass re-sprouts which are palatable to the cattle and to the ranchers who seek to minimize their expenses. Gallery forests are also affected by the burning activities; uncontrolled flames often impact these forests causing the loss of forest density and reducing the area of forest cover. The regular burnings limit the ability of the native flora to naturally recover.

Land Use Changes in the Project Activity

The project activity eliminates the cattle/grassland burning model and replaces it with a) reforestation with commercial species in the open degraded grasslands, b) restoration of natural forests in biological corridors using assisted natural regeneration (ANR) with native species and c) protection of deforested areas adjacent to gallery forests[3] to allow protected natural regeneration (PNR) of forest cover.

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

These activities have been designed to optimize carbon sequestration and revenues from the sale of certificates of emission reduction.

This project includes a research component which is highly relevant to both sustainable development and adaptation in the High Orinoco. The objective of the research is identified and field test leading theoretical models of ANR in order to optimize carbon sequestration, biodiversity conservation and ecosystem services, with a view to employing the international carbon markets for financing the restoration and long term sustainability of natural forests in the High Orinoco region.

Three different ANR models will be evaluated in the field to develop a model for restoration of natural forests that complies with the national definition of a CDM forest, that includes native species with high carbon sequestration potential and preserves the exceptional biodiversity and environmental services. The ANR models introduce matrices of associated native tree species in various succession stages to favor the process of natural regeneration in CDM-eligible areas. The matrices will be set up within areas classified as eligible around commercial plantations, in soils appropriate to the establishment of the species, designed to expand forest cover an average of 100m from the gallery forests throughout the project, with a view to interconnection of biological corridors. These protected areas for natural regeneration (PNR) will be isolated and shielded from cattle grazing or other anthropogenic activities that impede the natural regeneration processes. The research proposals consider the involvement of nurse species, exclusion pioneers, initiation pioneers and other successional. Nurse species help prepare the degraded sites and provide shade and moisture for the establishment and proliferation of the other successional species.

The network of biological corridors will also interconnect with large productive corridors using commercial forest species identified by CORPOICA or CORPORINOQUIA as appropriate for the region. The project activity has adopted various timber species and stand models for the reforestation of degraded pastures. Timber species have been selected based on their adaptability, their carbon sequestration rates and their domestic and international marketing potential. Initial trials have demonstrated their rapid growth potential and high potential for carbon sequestration when suitable fertilization and management techniques are employed.

The project activity has had a positive impact on the existing vegetation cover, due to the cessation of cattle grazing activities and the elimination of grassland burnings. Gallery forest density and coverage are no longer threatened. Cattle are being moved to other areas in the same ranches, to be managed in a more intensive fashion.

Hunting of large fauna, which has long formed a part of the cattle ranching culture, has been eliminated in the project activity. This is a major benefit, given the presence of many endemic and endangered species in this area of rich aquatic and terrestrial biodiversity.

The following images (figures Aa- Af) display the dynamics of the burnings in the baseline case (1988 – 2002) and the recovery of the areas subsequent to implementation of the project activity (2009), for each of the project nuclei.

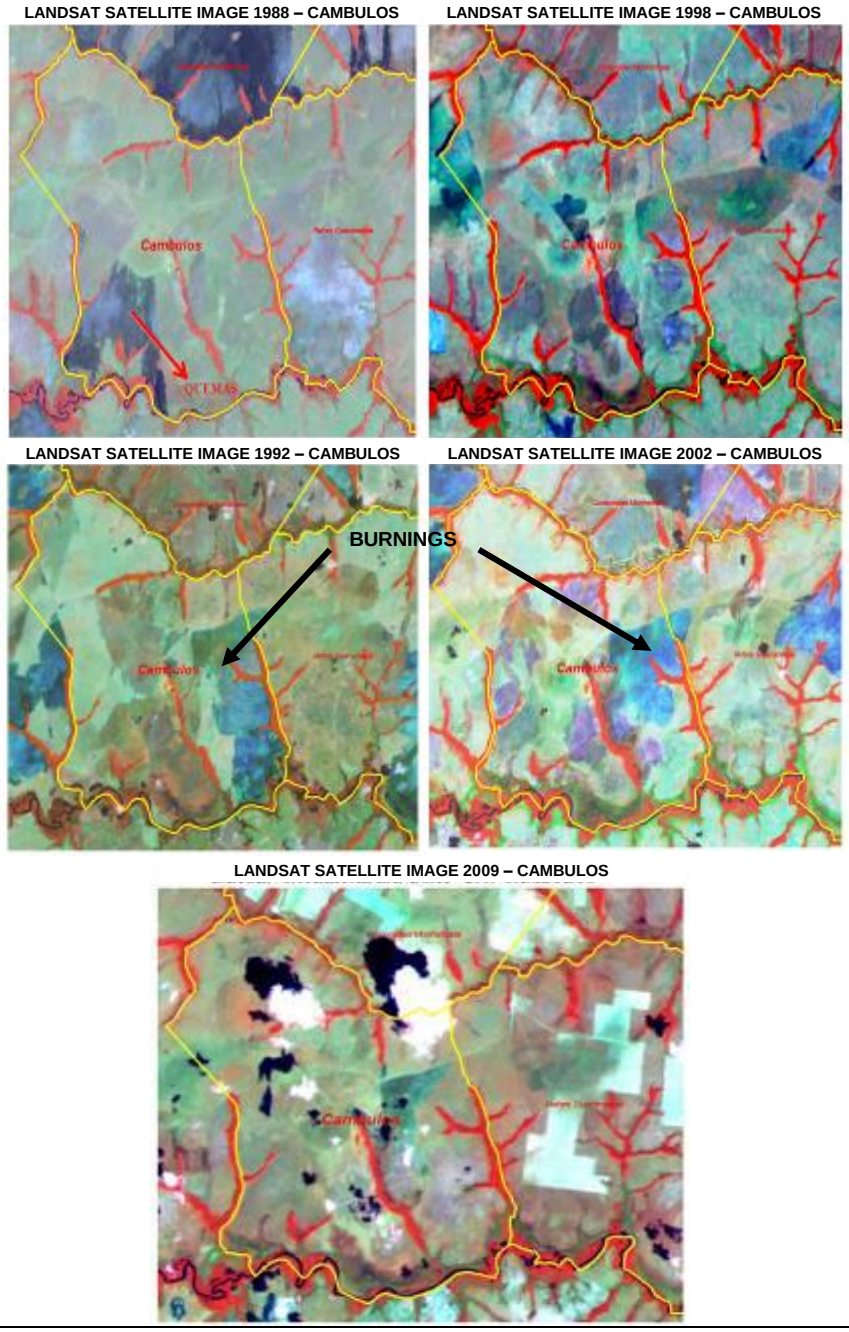

Figure Aa. Reforestadora Los Cámbulos S.A.S. These images from 1988, 1992 and 2002 exhibit large expansions of burned areas.

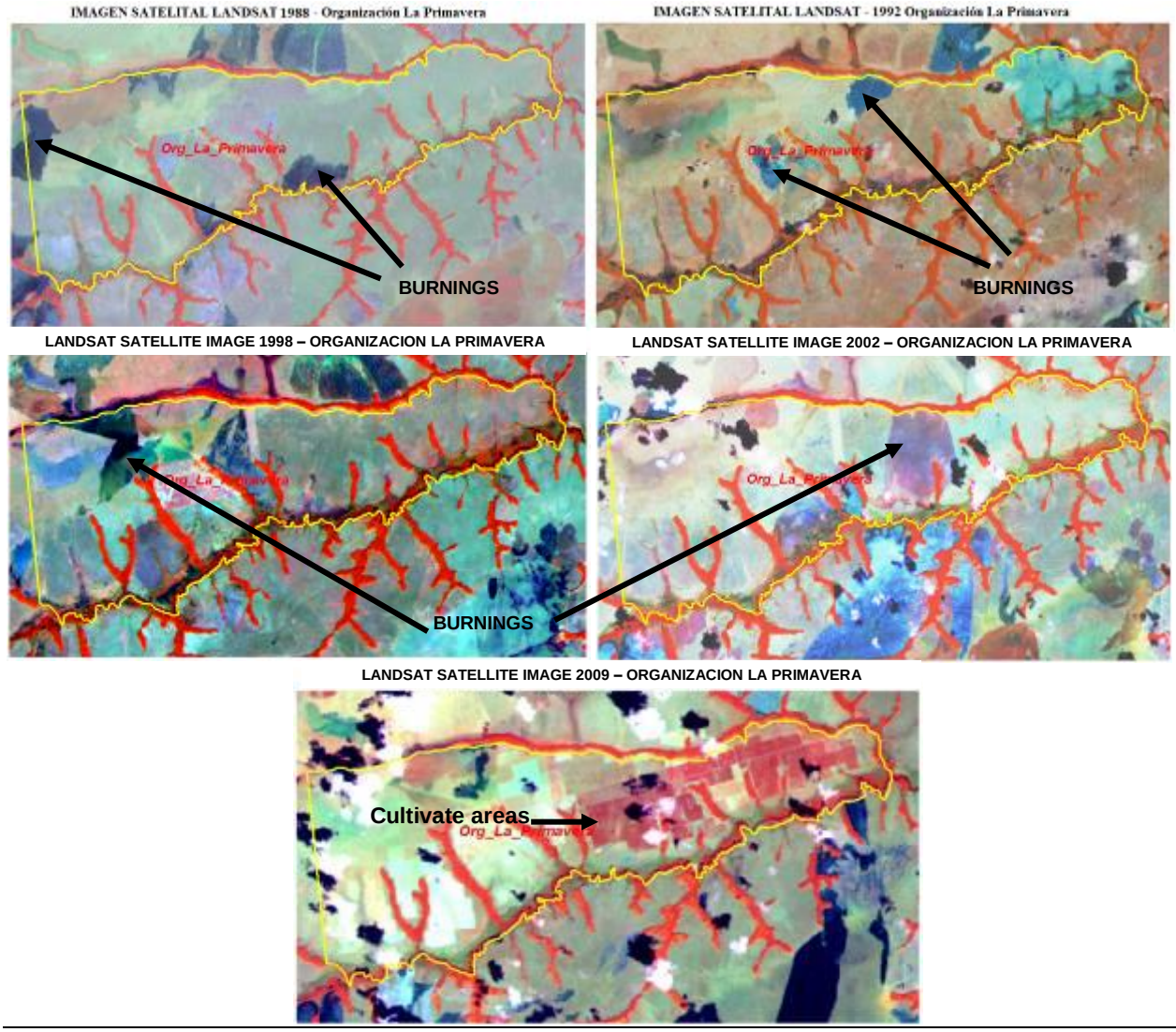

Figure Ab. Organización La Primavera S.A. Images from 1988, 1992, 1998 and 2002, exhibit large expansions of burned areas. In 2009, the burnings decreased as a result of the shift in land-use from grazing to reforestation.

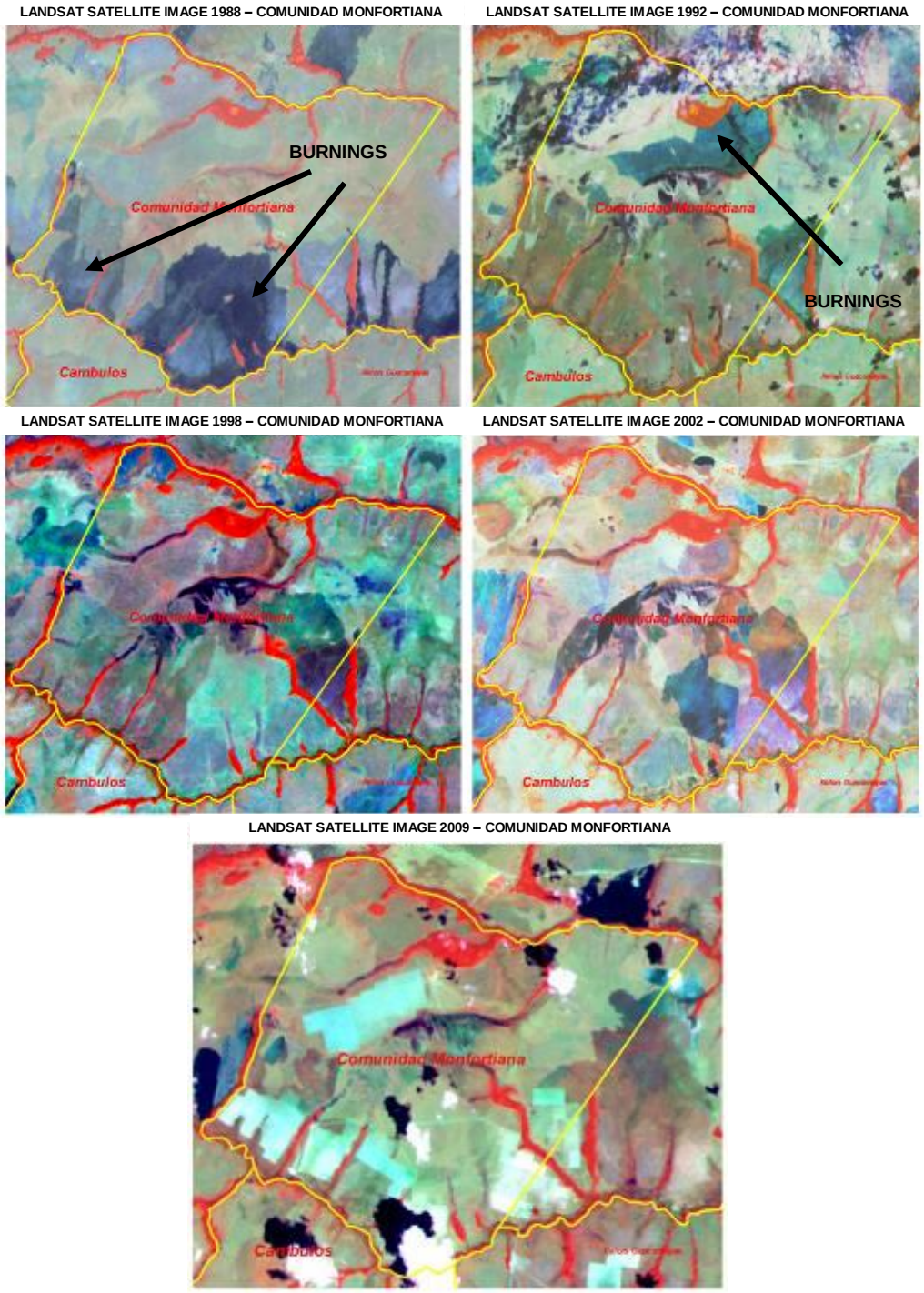

Figure Ac. Compañía de María, Padres Monfortianos. Images from 1988 and1992 exhibit large expansions of burned areas. In 2009, the burnings decreased as a result of the shift in land-use from grazing to reforestation.

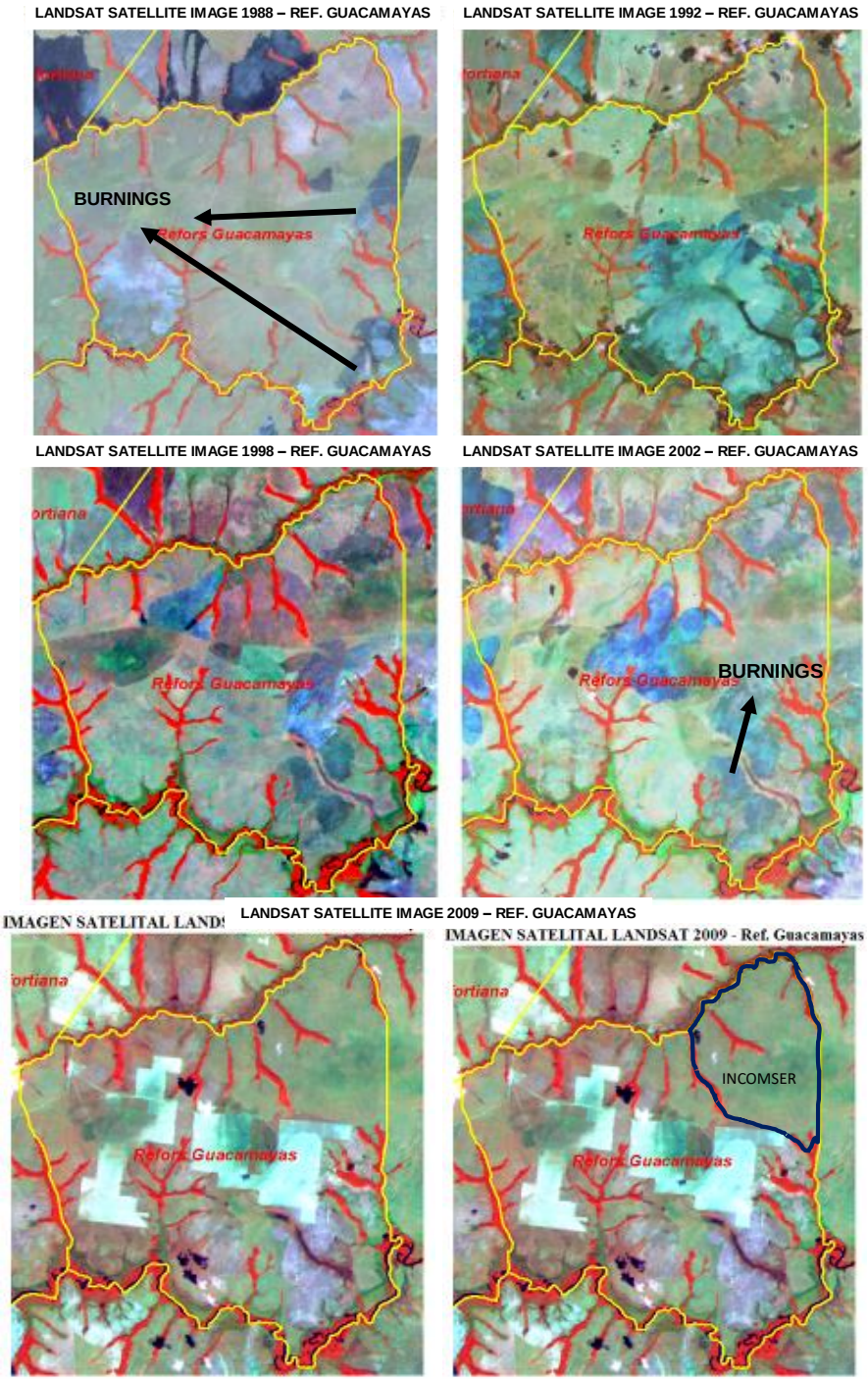

Figure Ad. Reforestadora Guacamayas S.A. Images from 1988 and 2002 exhibit large expansions of burned areas. In 2009, the burnings decreased because of the shift in land-use from grazing to reforestation. The INCOMSER Project, to part of the Guacamayas polygon, therefore its analysis is integrated into this property, and the eligibility map is updated. see sections later.

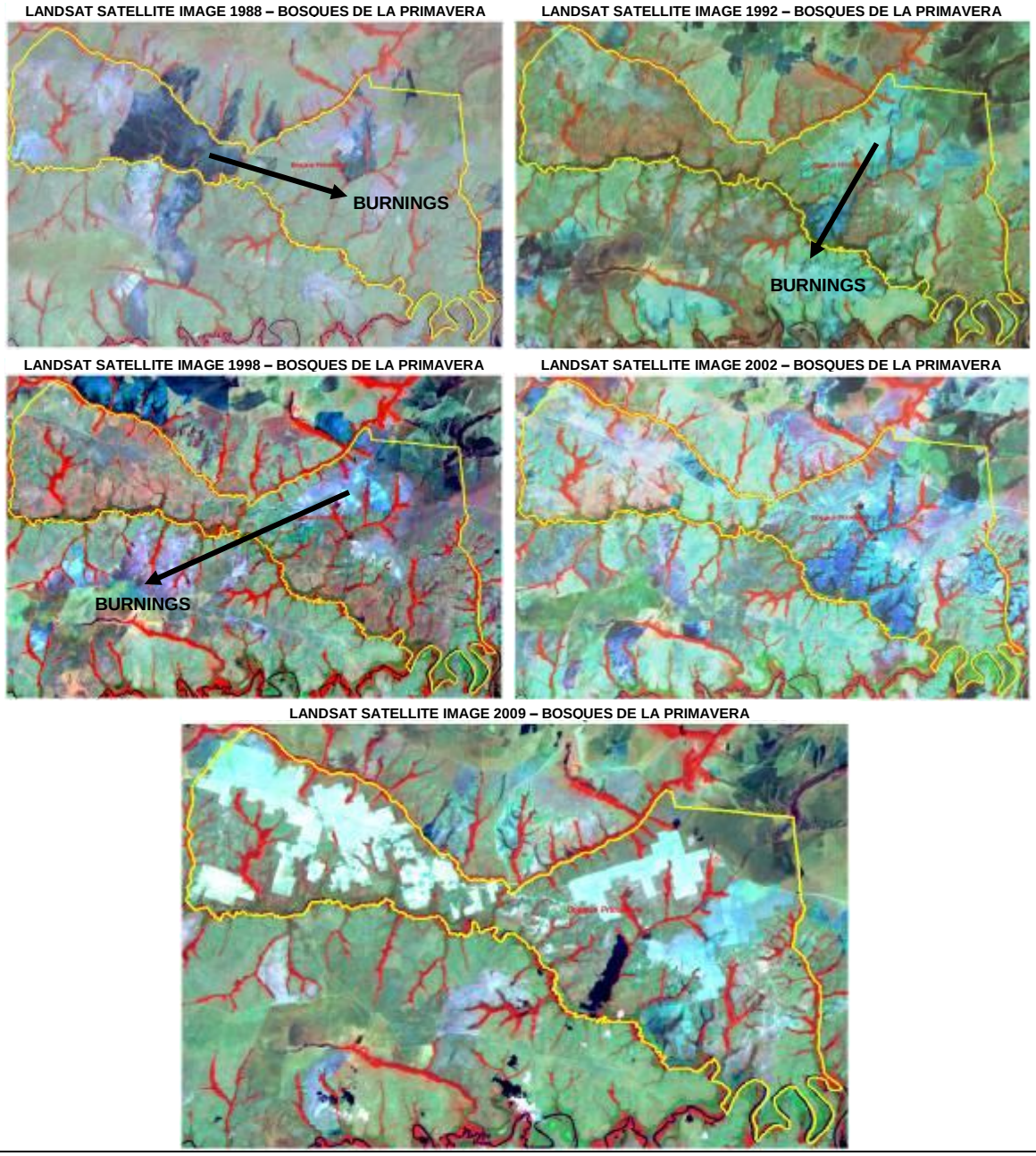

Figure Ae. Bosques de La Primavera S.A. The images from 1988, 1992 and 1998 exhibit large expansions of burned areas. In 2009, the burnings decreased as a result of the shift in land-use from grazing to reforestation.

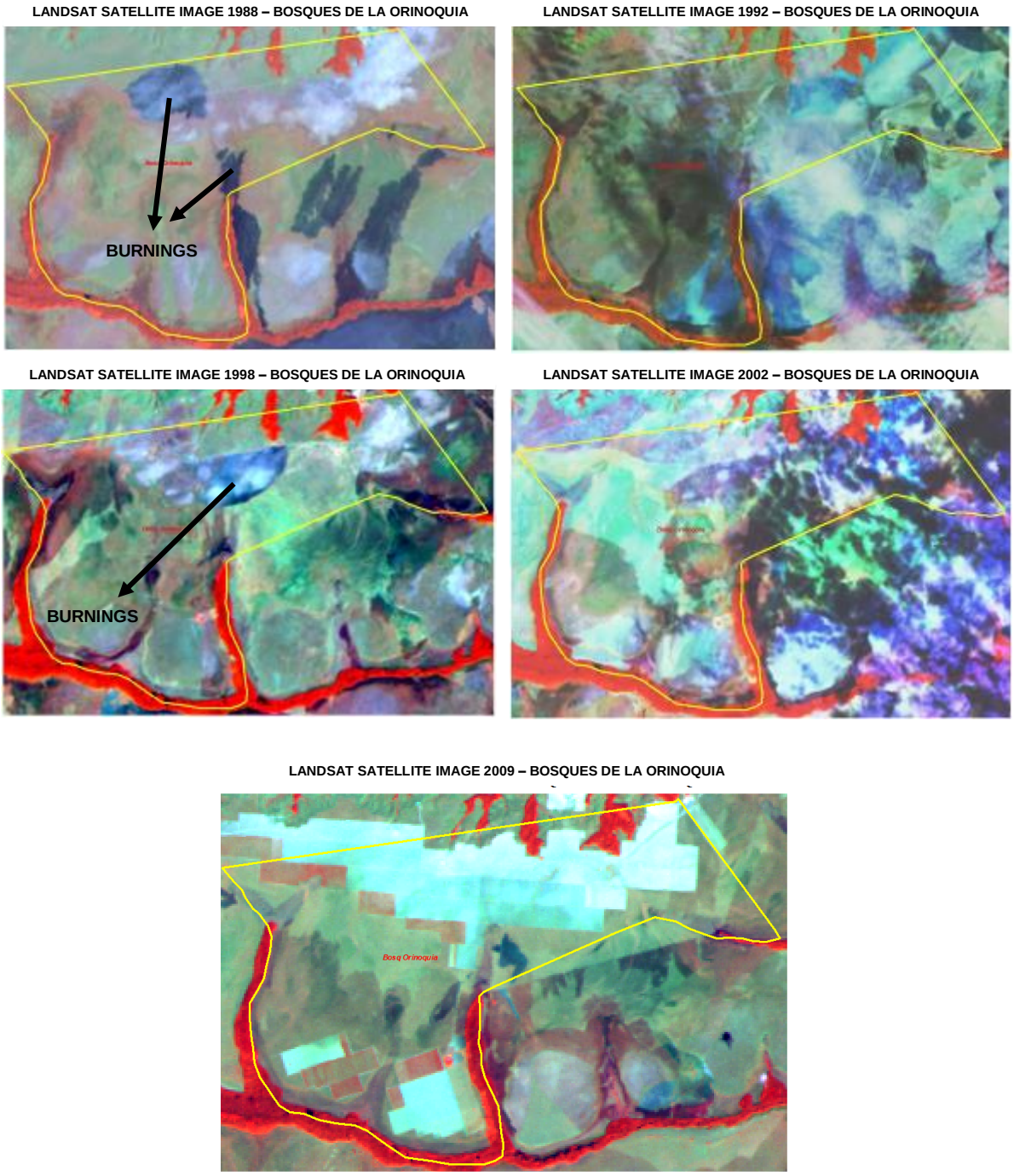

Figure Af. Bosques de la Orinoquía S.A. Images from 1988 and 1998 display large expansions of burned areas. In 2009, the burnings decreased as a result of the shift in land-use from grazing to reforestation.

A.2. Project boundary

A.2.1. Host Party

Colombia

A.2.2. Region/State/Province etc.

Department of Vichada.

A.2.3. City/Town/Community etc.

Municipality of La Primavera.

A.2.4. Physical/Geographical location

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). The Municipality of La Primavera is located approximately 400km 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 Rosalia. The Municipality of La Primavera has an area of 21.420 km^2 which represents 22% of the total land area of Vichada (Figure A.1) (CORPOORINOQUIA 2008[4]).

According to the census carried out by the DANE in 2005, the population in the municipal capital was 4,826. The rural area of the municipality has around 5,443 inhabitants of which 15.2% (1,560) is indigenous population. 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).

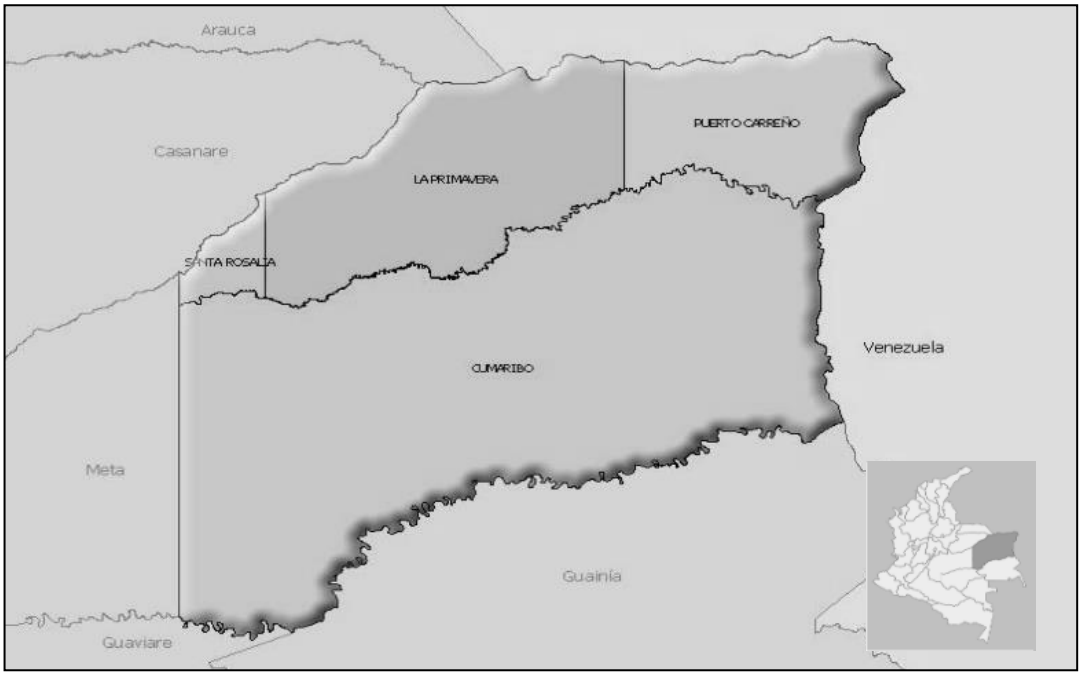

Figure A.1. Location of the Municipality of La Primavera, department of Vichada.

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 seven forest nuclei (Figure A.2). The main features of each are presented below (Figure A.3).

[4] CORPORACIÓN AUTÓNOMA REGIONAL DE LA ORINOQUIA - CORPORINOQUIA. 2008. Agenda Ambiental municipal de La Primavera, Departamento del Vichada.

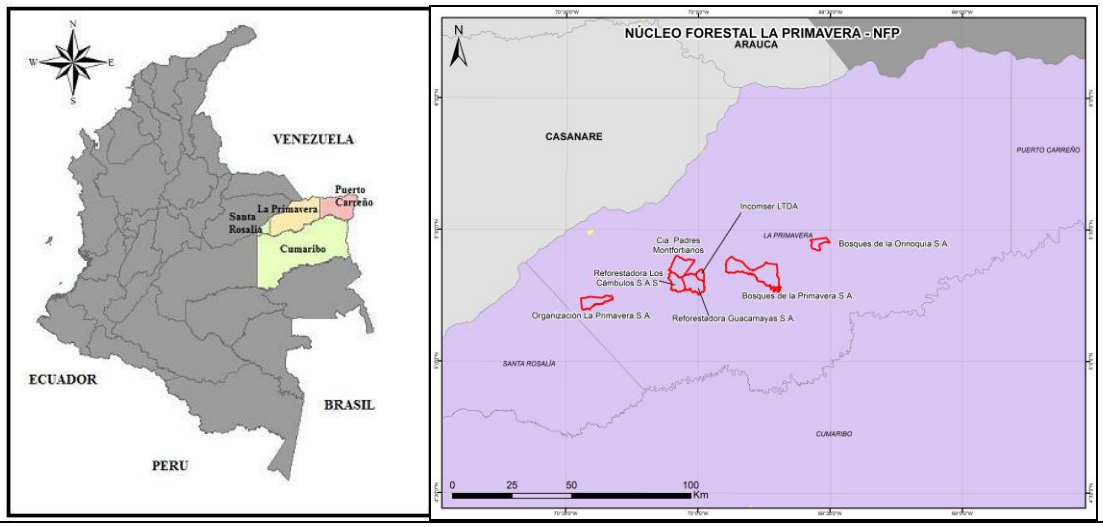

Figure A.2.- Location of the seven forest nuclei in Municipality of La Primavera, Department of Vichada.

Bosques de la Orinoquia S.A.: this nucleus is located in the hamlet of La 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 (Figure A.3). The center point of this nucleus is 69º33'19,84'' W 5º26'52,65'' N, and plane coordinates 836.177, 17 X y 1'094.386,64 Y.

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. The center point of this nucleus is 70º4'1,33'' W 5º21'39,52'' N, and plane coordinates 779.425,36 X y 1'084.935,22 Y.

Reforestadora Guacamayas S.A*.:* the properties of Guacamayas, Los Leones and El Cafuche make up this nucleus, located near the hamlet of La Jaula. The center point of this nucleus is 70º0'52,58'' W 5º17'55,22'' N, and plane coordinates 785.215,93 X y 1'078.011,80 Y.

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 and El Suevo. The center point of this nucleus is 69º47'1,75'' W 5º20'15,71'' N, and plane coordinates 810.816,12 X y 1'082.266,35 Y.

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. The center point of this nucleus is 70º23'36,54'' W 5º13'42,98'' N, and plane coordinates 743.164,61 X y 1'070.409,16 Y.

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, and to the East with the lands of Mr. Víctor Porto. The center point of this nucleus is, and plane coordinates. The center point of this nucleus is 70º4'42,40'' W 5º17'59,31'' N, and plane coordinates 778.135,26 X y 1'078.171,20 Y.

INCOMSER LTDA: This nucleus towards part of macaws, passes under the name of the INCOMSER company maintaining the same principles for the CDM project. It is located in the northeastern corner, neighboring the Guacamaya property. The property is known as La Lapa, but

in its public deeds it is defined as La Papa II. The center point of this nucleus is 69° 59' 31,446" W 5° 19' 42,781" N.

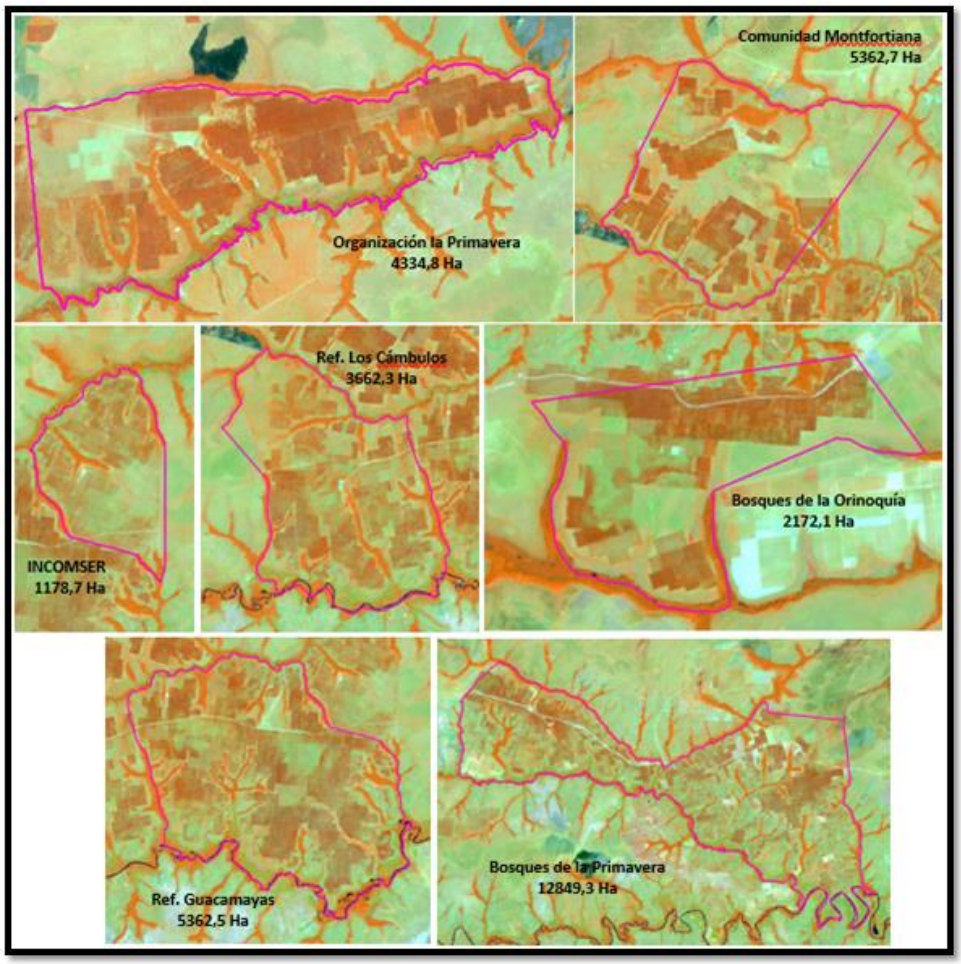

Figure A.3. Maps of the Seven Forest Nuclei included in the project activity.

A.2.5. Geographical boundaries

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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 19,181.09 will be used to commercial reforestation, and the other areas be made up of models of assisted natural regeneration and protection for natural regeneration. The areas devoted to assisted natural regeneration (ANR) will total 390 ha, and the protection of deforested areas for protected natural regeneration (PNR) will comprise 9,447.78 ha. The boundaries for each project nucleus are presented in figures A.4, A.5, A.6, A.7, A.8 and A.9. Table A.1 details the areas of each forest nucleus.

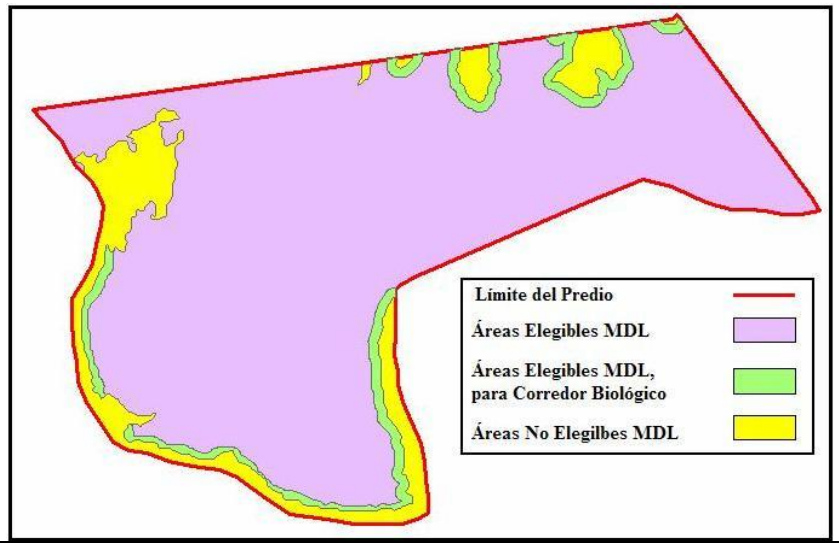

Figure A.4. Project boundary for the La Orinoquia S.A. Forest Nucleus

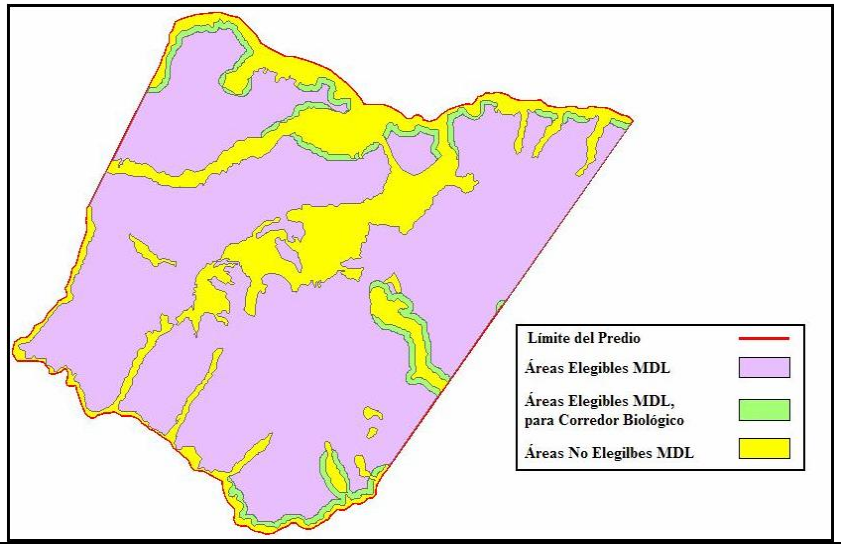

Figure A.5. Project boundary for Compañía de María – Padres Monfortianos Forest Nucleus.

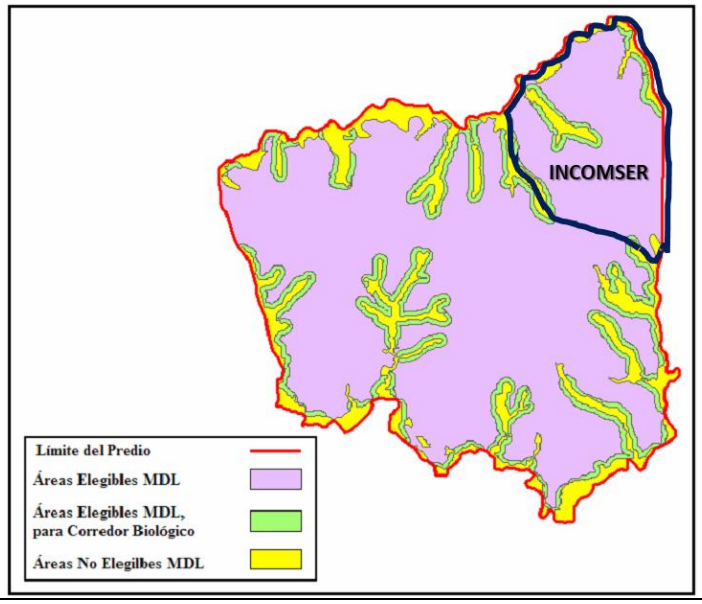

Figure A.6. Project boundary for the Reforestadora Guacamayas S.A. Forest Nucleus. The **INCOMSER** Project, to part of the Guacamayas polygon, therefore its analysis is integrated into this property, and the eligibility map is updated. see sections later.

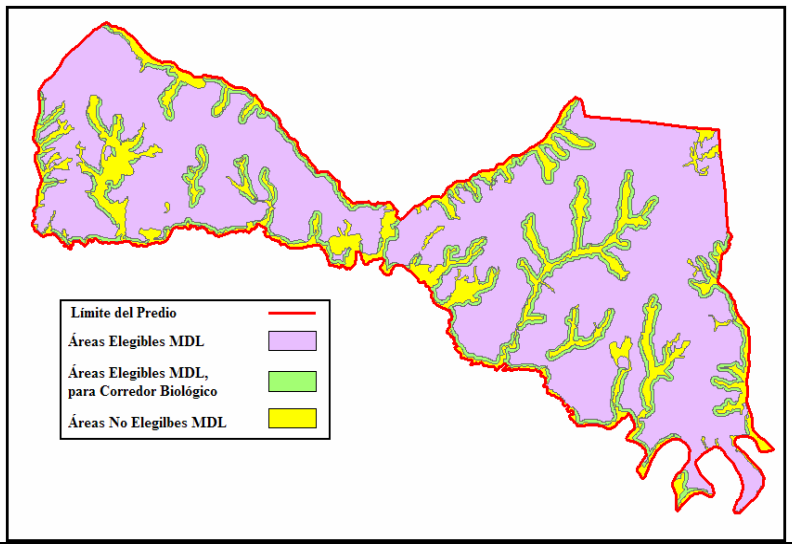

Figure A.7. Project boundary for Bosques de La Primavera S.A. Forest Nucleus

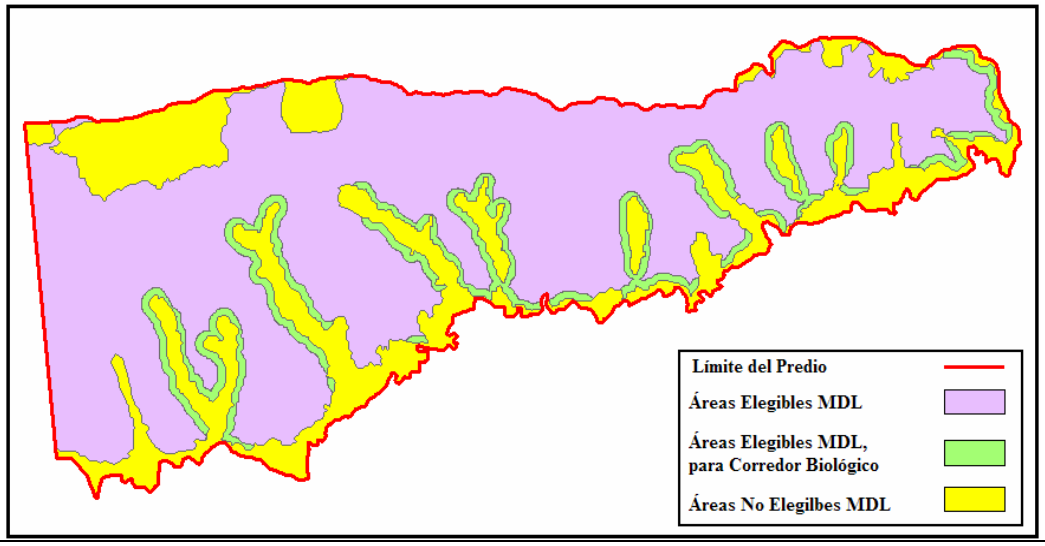

Figure A.8. Project boundary for the Organización La Primavera S.A. Forest Nucleus

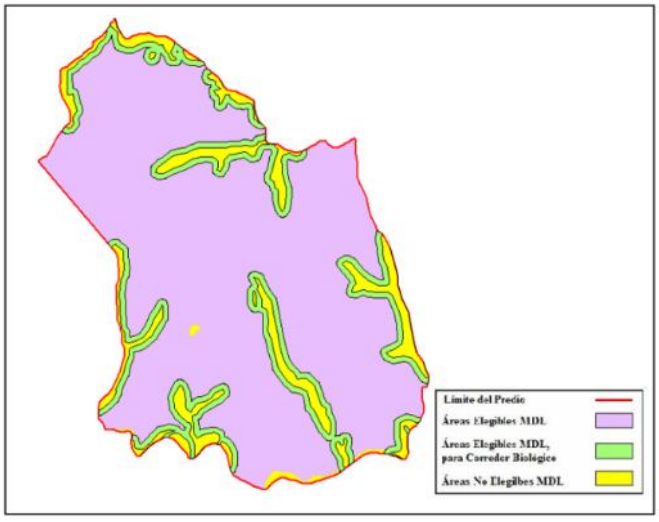

Figure A.9. Project boundary for the Reforestadora Los Cámbulos S.A.S. Forest Nucleus

Table A.1. *CDM Project for the Forest Restoration in Productive and Biological Corridors in the Llanos Orientales (Eastern Plains)* Areas.

Property	Areas Evaluated per nucleus	*Eligible CDM areas per nucleus*			
		Commercial stand model	ANR stand model	PNR stand model	Total Eligible Areas
Bosques de la Orinoquía S.A.	2,172.19	1140.2	30.0	750.9	1,921
Compañía de María, Padres Monfortianos	5,362.75	1905.2	90.0	2240.7	4,236
Reforestadora Guacamayas S.A.	5,362.52	3308.3	60.0	1179.3	4,548
Bosques de La Primavera S.A.	12,849.32	7641.4	30.0	3078.5	10,750
Organización La Primavera S.A.	4,334.84	2307.0	60.0	912.0	3,279
Reforestadora Los Cámbulos S.A.S.	3,662.36	2002.4	90.0	1172.4	3,265
INCOMSER	1,178.75	876.6	30.0	114.1	1,021
Total per stand model	***34,922.73***	***19,181.09***	***390.00***	***9,447.78***	***29,018.87***

A.3. Legal title to land

All the properties included in *The CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia* belong to their owners, which have clear title: Organización La Primavera S.A., Bosques de la Orinoquia S.A., Bosques de La Primavera S.A., la Compañía de María - Padres Montfortianos, la Reforestadora Guacamayas S.A., Reforestadora Los Cámbulos S.A.S and INCOMSER LTDA Similarly, the rights to the tCERs will belong to the project owners, in direct proportion to the accumulation of carbon stocks that are verified on each of their lands.

A.4. Eligibility of land

This section was developed on the basis of the methodological tools required by the Executive Board of the Clean Development Mechanism, *"Procedures to Demonstrate the Eligibility of Lands for Afforestation and Reforestation CDM Project Activities", Version 01*[5].

1(a). Demonstrate that the land at the moment the project starts does not contain forest:
To evaluate the land cover within the project boundaries, the areas that do not apply under the definition of forest under resolutions 11/CP.7 and 19/CP.9 (UNFCCC) were identified. The existing regulations for Colombia issued by its Designated National Authority – the Ministry of Environment, OCMCC[6]--, according to which forests are characterized by: thirty percent (30%) tree crown coverage, areas with extensions of at least one hectare (1 ha) and minimum heights of five meters (5m)[7]. Considering the UNFCCC and the OCMCC definitions of forest, it was determined that the areas having *Gallery Forest, Stubble, Water* and *Cloud* coverage from 1988 to 2001, in each of the evaluated nuclei, would not be considered as potentially eligible areas, while *Grass* and *Scrubland* Land Uses would be.

1(b). Demonstrate that the activity is a reforestation or afforestation project activity:
After establishing the coverages considered potentially eligible in each time space, the Spatial Analysis necessary to determine which areas met the eligibility criteria was performed. Thus, areas under 1 hectare and which were considered at some point of time under *Gallery Forest*, *Stubble, Water* and *cloud* coverage, were discarded. Based on the information examined, it was concluded that since 1988 no forest cover existed in areas where the project is to be implemented. In addition, the existing coverages do not meet the definition of forest according to the Designated

[5] http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-10-v1.pdf

[6]http://cdm.unfccc.int/DNA/index.html

[7]http://cdm.unfccc.int/DNA/ARDNA.html?CID=49

National Authority for Colombia. The land uses within the project boundaries in 1988 were pasture grasses and have been remained so in the areas where the project will be implemented.

The tree stand models proposed for the Project Activity do comply with the national definitions of forests and are recommended for the area by the national research center (CORPOICA).

2. To demonstrate steps 1 (a) and 1 (b), project participants shall provide information that reliably discriminates between forest and non-forest land according to the thresholds adopted by the host country:
All the information below is available for validation and verification purposes.
LandSat satellite images were used that cover the area of interest (Figure A.19). The *LandSat* satellite images used are:

- *LandSat* (Path 5) (Row 56) of 1988 (p005r56_4t19880113.742)
- *LandSat* (Path 5) (Row 56) of 2002 (L71005056_05620021221).

1. Methodology

In accordance with CDM regulations and the objectives of the project, an eligibility analysis was performed for the project activity areas. The analysis identified eligible areas for the establishment of a forestry project under the Clean Development Mechanism of the Kyoto Protocol. It was conducted for two appropriate moments in time—1988 and 2002-- in accordance with the Tool. The *LandSat* images used are: *LandSat* (Path 5) (Row 56) of 1988 and Landsat (Path 5) (Row 56) of 2002 (Figure A.19). Eligibility analysis was performed for the seven properties associated with the Project Activity: Organización La Primavera S.A., Compañía de María – Padres Monfortianos, Reforestadora Guacamayas S.A., INCOMSER LTDA, Bosques de La Primavera S.A., Bosques de la Orinoquia S.A. y Reforestadora Los Cámbulos S.A.S. The seven properties assessed represent a total area of 34,923 hectares.

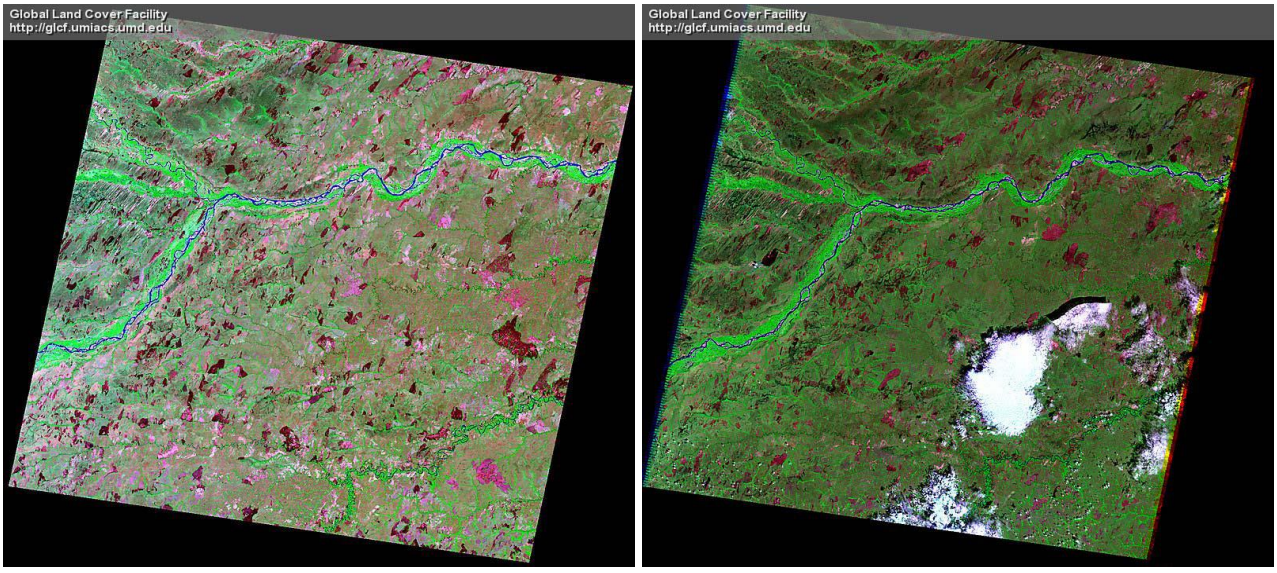

Figure A.19. *LandSat* Satellite Images used in the eligibility evaluation. Total area evaluated: 34.923 ha.

2. Assessment of Area-year 2002

The *LandSat* Image available for 2002 (L71005056_05620021221) displays the characteristics of Land Use Coverage of the region. The land uses identified in the vegetation map that year, are: *Gallery Forests*, *Stubble*, *Grass*, *Scrublands, Water* and *Clouds*. The results of the Digital Processing of the referenced *LandSat* satellite image for each forest nucleus that make up the project are shown in Figure A.20.

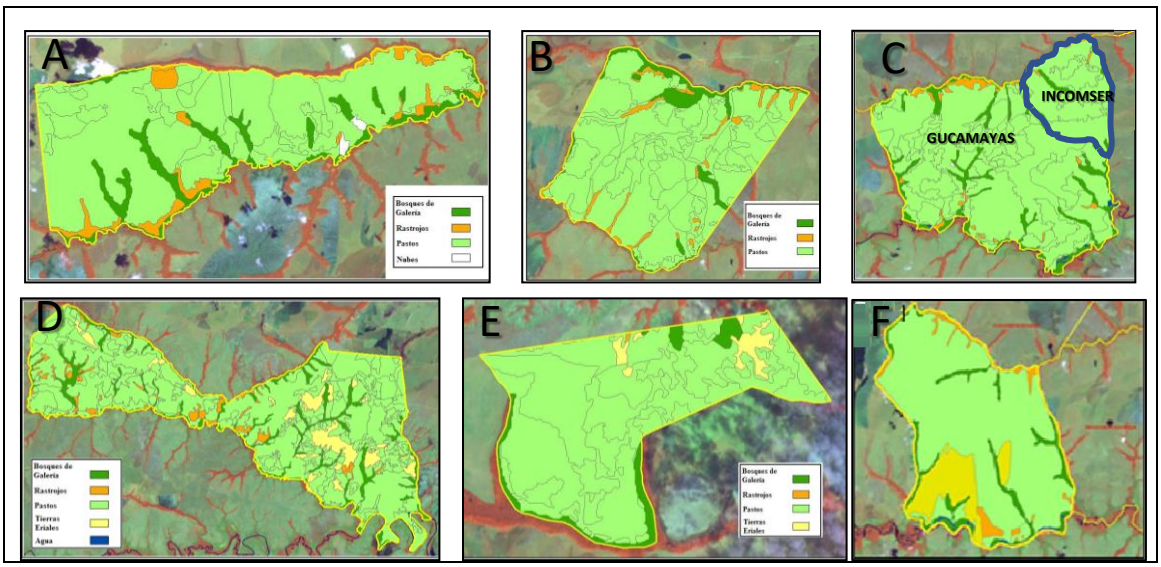

Figure A.20. Digital processing of the satellite images used to determine land use coverage in the year 2002; a. Organización La Primavera S.A., area evaluated 4,336 ha.; b. Compañía de María Padres Montfortianos, area evaluated 5,363.86 ha.; c. Reforestadora Guacamayas S.A and INCOMSER LTDA., area evaluated 6,541.75 ha.; d. Bosques de La Primavera S.A., area evaluated 12,849.02 ha.; e. Bosques de La Orinoquía S.A., area evaluated 2,172.26 ha.; f. Reforestadora Los Cámbulos S.A.S.: area evaluated 3,662 ha.

After considering the UNFCCC and the OCMCC definitions of forest, it was determined that the areas which presented *Gallery Forest, Stubble, Water and Clouds* coverage in 2002, in each of the nuclei tested, would not be considered as potentially eligible areas, while the Land Uses of *Grasses and Shrublands* are considered to be eligible. Table A.2 lists Land Uses and the percentage for each one of the Land Use Coverages, found in each nucleus.

Table A.2. Potentially eligible areas.

Nucleus	**Coverage**	**Area (ha)**	**(%)**
Organización La Primavera S.A.	Grasses	3,561.57	11.7
Compañía de María Padres Monfortianos	Grasses	4,764.15	15.7
Reforestadora Guacamayas S.A.	Grasses	5,701.64	18.8
Bosques de La Primavera S.A.	Grasses	10,003.41	36.7
	Burned Grasses	274.04	
	Scrublands	856.63	
Bosques de la Orinoquia S.A.	Grasses	1,947.08	6.7
	Scrublands	79.34	
Reforestadora Los Cámbulos S.A.S.	Grasses	1,780.14	10.5
	Scrublands	1,399.97	
Total		**30,367.97**	**100**

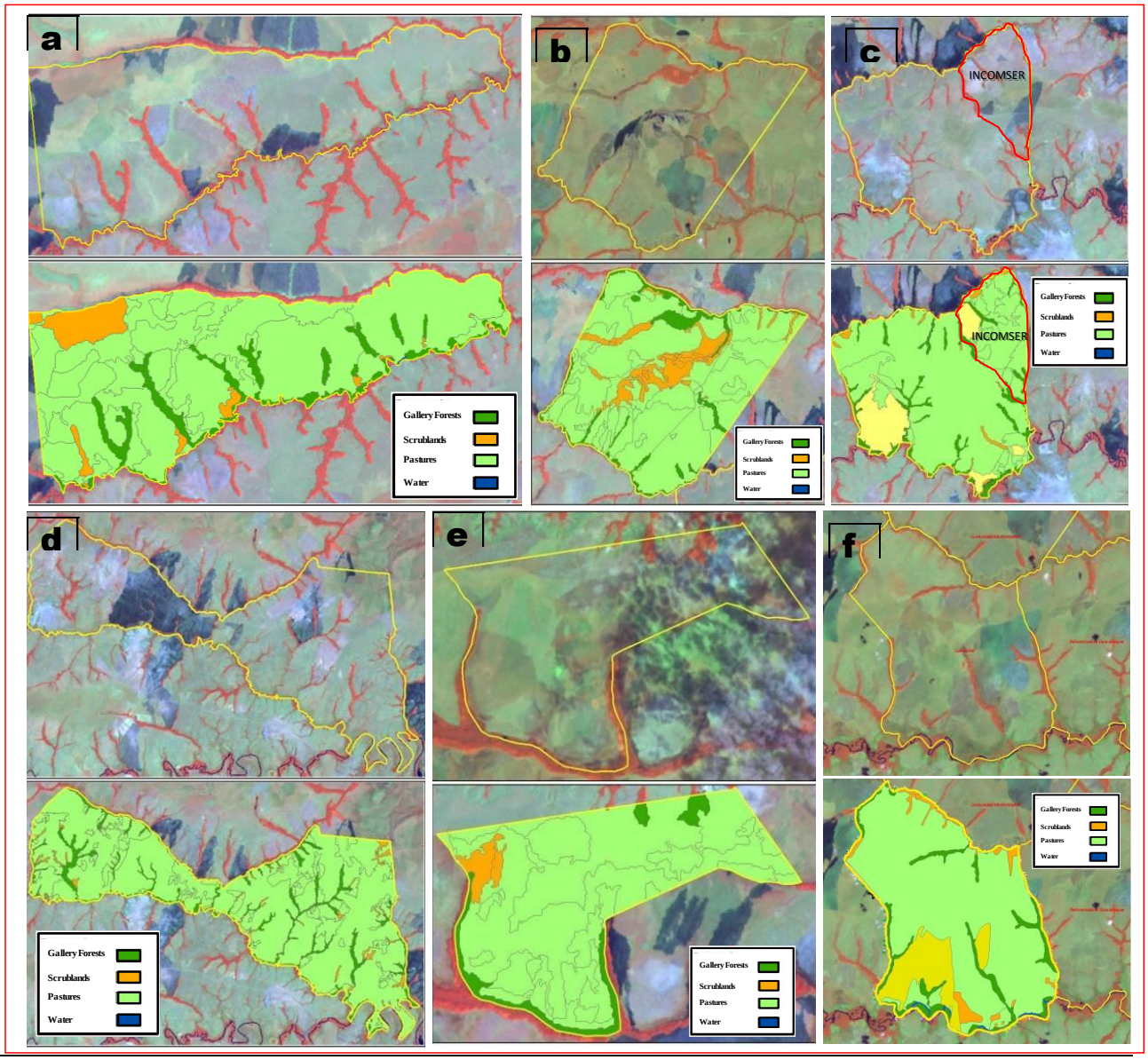

Figure A.20. Digital processing of satellite images used to determine land use coverage in 1988. a. Organización la Primavera S.A., area evaluated 4,335.99 ha.; b. Compañía de María Padres Monfortianos, area evaluated 5,363.86 ha.; c. Reforestadora Guacamayas S.A and INCOMSER LTDA., area evaluated 6,541.75 ha.; d. Bosques de La Primavera S.A., area evaluated 12,849.04 ha.; e. Bosques de La Orinoquía S.A., area evaluated 2,172.27 ha.; f. Reforestadora Los Cámbulos S.A.S.: area evaluated 3,662 ha.

3. Assessment of Area in 1988

Similar to the evaluation of the 2002 image, forest coverage was determined for 1988 using LandSat image ***p005r56_4t19880113.742***. The land uses identified in the map of vegetation cover for this year, were: *Gallery Forests*, Stubble, Grass, *Scrublands, Water* and *Clouds*. The results of the Digital Processing of the referenced LandSat satellite image for each forest nucleus that make the project are shown in Figure A.21.

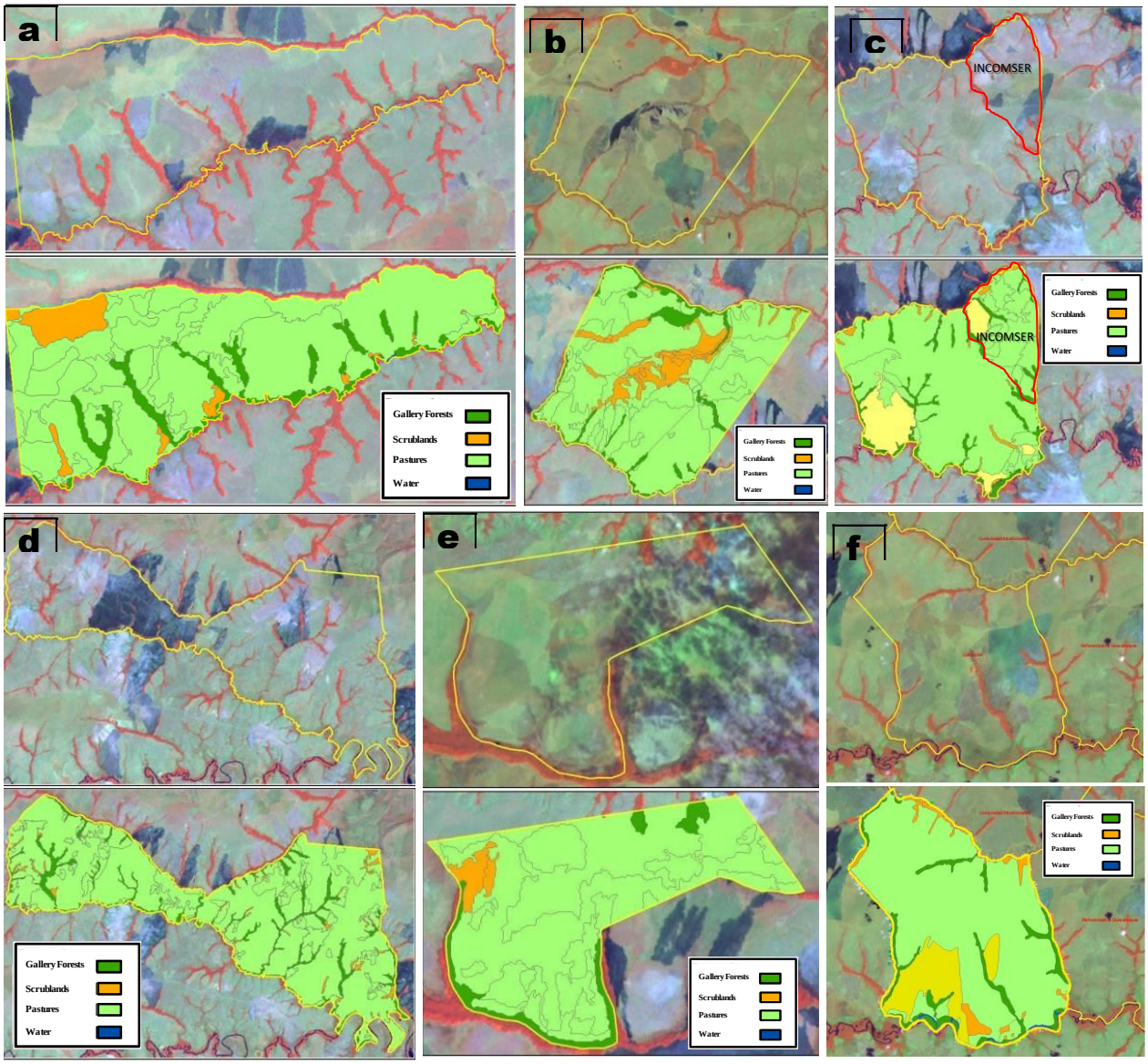

Figure A.21. Digital processing of satellite images used to determine land use coverage in 1988. a. Organización la Primavera S.A., area evaluated 4,335.99 ha.; b. Compañía de María Padres Monfortianos, area evaluated 5,363.86 ha.; c. Reforestadora Guacamayas S.A and INCOMSER LTDA., area evaluated 6,541.75 ha.; d. Bosques de La Primavera S.A., area evaluated 12,849.04 ha.; e. Bosques de La Orinoquía S.A., area evaluated 2,172.27 ha.; f. Reforestadora Los Cámbulos S.A.S.: area evaluated 3,662 ha.

It was also determined that the areas which had coverage of *Gallery Forests*, *Stubble*, *Water* and *Clouds* in 1988 would not be considered as eligible areas, while the corresponding areas of *Grass* and *Scrubland* are potentially eligible. Table A.3 lists the land uses and the percentages for each land use coverage, found in each nucleus.

Table A.3. Potentially eligible areas for 1988

Nucleus	Coverage	Area (ha)	Percentage (%)
Organización La Primavera S.A.	Grasses	3523.87	12%
	Burnt Grasses	136.3	
Compañía de María Padres Monfortianos	Grasses	3,435.41	14%
	Burnt Grasse	992.59	

Nucleus	Coverage	Area (ha)	Percentage (%)
Reforestadora Guacamayas S.A.	Grasses	3,805.94	15%
	Burnt Grasses	140.85	
	Scrublands	728.43	
Bosques de La Primavera S.A.	Grasses	6,238.45	37%
	Burnt Grasses	5,181.21	
Bosques de la Orinoquia S.A.	Grasses	1,804.79	6%
	Burnt Grasses	138.63	
Reforestadora Los Cámbulos S.A.S	Grasses	2,801.15	11%
	Burnt Grasses	454.04	
INCOMSER LTDA.	Grasses	1178.75	4%
Total		**30,560.4**	**100.0%**

4. Eligible Areas

After establishing the land coverage considered as potentially eligible at each moment in time, the spatial analysis required to determine the areas that met the eligibility criteria was performed. Thus, areas that were less than 1 hectare and at some point, were considered to have *Gallery Forest, Stubble*, Water or *Cloud* coverage were discarded. Areas defined as *buffer* (100 m) around existing riparian forests, which correspond to those areas where the project will implement Protected Natural Regeneration to support and preserve the natural forests in the Region, are considered eligible because of the corresponding land covers in 1988 and 2002. In conclusion, 29,019 hectares were considered eligible complying the necessary requirements for the implementation of an A/R project under the Clean Development Mechanism. Of the eligible areas, 20,573 ha will be used for commercial reforestation, 390 ha for Assisted Natural Regeneration and 8,056 ha for Protected Natural Regeneration (Table A.4 and Figure A.22).

Table A.4. Eligible Areas (ha) for CDM A/R in the Project Activity, by forestry nucleus.

Property	Areas evaluated by nucleus	CDM Eligible Areas per nucleus			
		Commercial stand model	ARN stand model	PNR stand model	Total eligible areas
Bosques de la Orinoquía S.A.	2,172.19	1140.2	30.0	750.9	***1,921***
Compañía de María, Padres Monfortianos	5,362.75	1905.2	90.0	2240.7	***4,236***
Reforestadora Guacamayas S.A.	5,362.52	3308.3	60.0	1179.3	***4,548***
Bosques de La Primavera S.A.	12,849.32	7641.4	30.0	3078.5	***10,750***
Organización La Primavera S.A.	4,334.84	2307.0	60.0	912.0	***3,279***
Reforestadora Los Cámbulos S.A.S.	3,662.36	2002.4	90.0	1172.4	***3,265***
INCOMSER LTDA.	1,178.75	876.6	30.0	114.1	***1,021***
Total per stand model	***34,922.73***	***19,181.09***	***390.00***	***9,447.78***	***29,018.87***

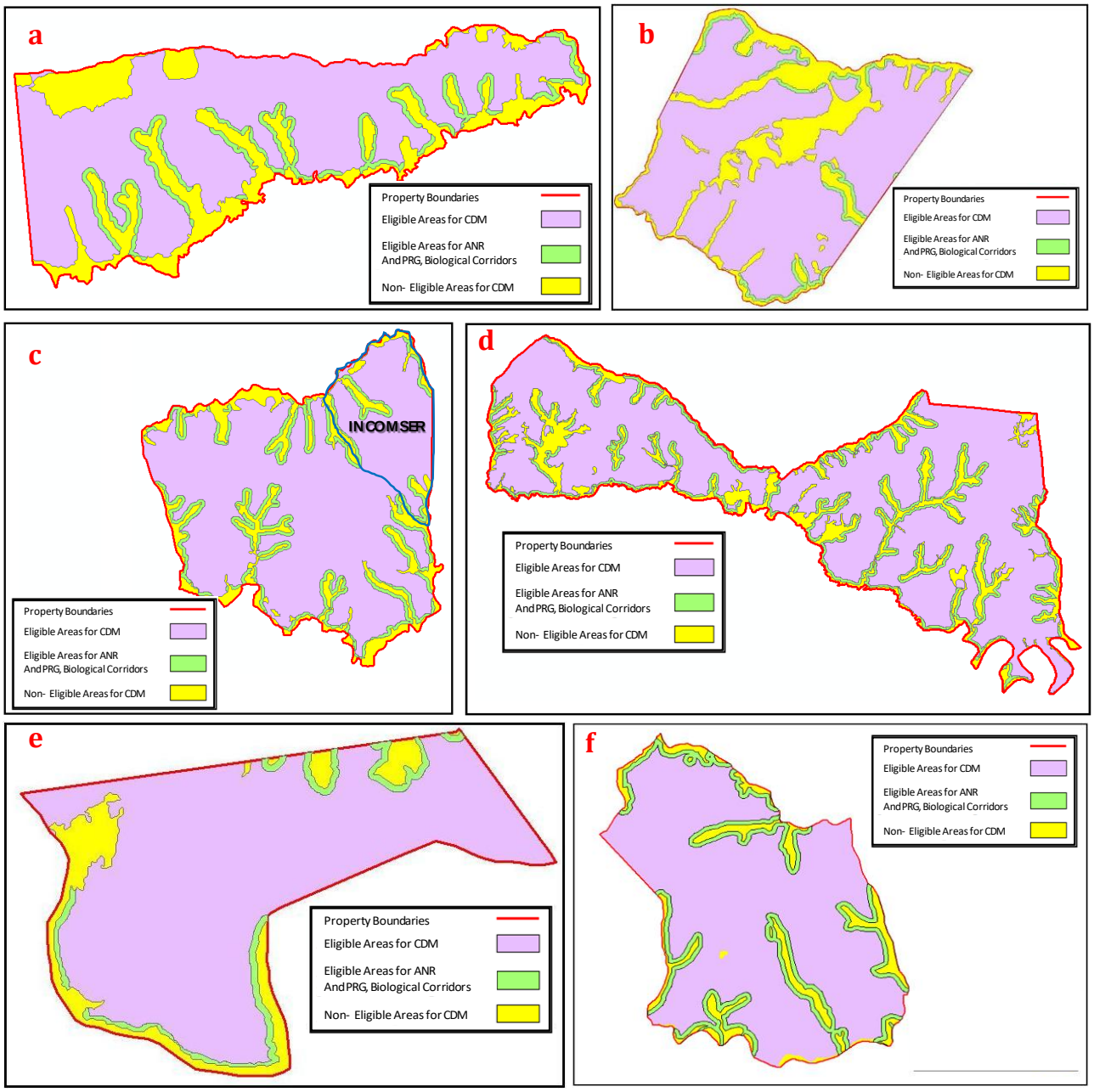

Figure A.22. Areas eligible for A/R CDM: a. Organización La Primavera S.A.; b. Compañía de María Padres Monfortianos.; c. Reforestadora Guacamayas S.A and INCOMSER.; d. Bosques de La Primavera S.A.; e. Bosques de La Orinoquía S.A.; f. reforestadora Los Cámbulos S.A.S.

A.5. Environmental conditions

Climate:

The climate is warm, with temperatures oscillating between 27 and 30°C. The median altitude of the Municipality is 117 meters above sea level, which corresponds with a warm thermal floor (Governance of Vichada 2008). The average rainfall for the period between 1975 and 2005 (September) was 3,450 mm (Figure A.10). The rain pattern is usually unimodal, with the wet season from April to October (CORPORINOQUIA, 2008).

a. Hydrology:

Various water sources are born and flow within the territory of the Municipality La Primavera. These lands are seasonally irrigated by the rivers, streams, brooks and other smaller waterways that traverse them. The Meta River is prominent due to its very large size and because it forms the northern boundary between the Department of Vichada and the depts. of Arauca and Casanare.

The Municipality belongs to the Great Watershed of the Orinoco River. The area includes the sub-watersheds of the Tomo and Bita Rivers that drain into the Orinoco River, covering an area of 43.5% and 52.5% respectively of the territory of La Primavera. Other significant sub-watersheds of the Meta River in the locality of La Primavera are: Caño La Balsa, Caño Aguas Claras, Laguna de La Primavera, Caño Aguaverde and Caño La Culebra (CORPORINOQUIA, 2008[8]).

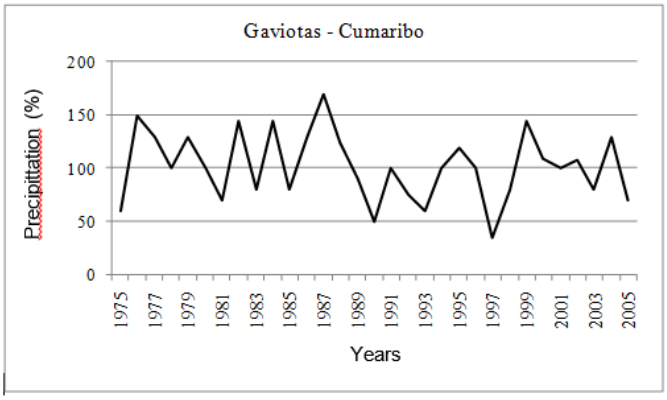

Figure A.10. Annual average precipitation percentage in the Gaviotas station – Cumaribo (Source: Organización La Primavera S.A. 2006).

The wealth of surface and ground waters in the Orinoco region is widespread. However, there is a lack of information to quantify the regional water supply, distribution and the quality of the resource, as no adequate network of hydro-climatic monitoring exists. Based on the scarce data available on historic flow rates in some waterways, we can infer by comparing differences between extreme flow rates, the growing loss of regulation capability of the hydrographic basins (CORPORINOQUIA, 2006).

b. Soils:

The soils of the High Orinoco plains display an ochre colored horizon at the surface with very low content of organic matter. As one moves to low areas or estuaries, where the plant formation associated with gallery forests provides biomass, the water content significantly increases and the soil displays histic or humbric horizons. The *mull* humus presents an average composition of fulvic acids to humid acids of over 1.2 and its humid content is under 50%. It provides little biomass (2.2 to 3.8 t ha^{-1} yr^{-1}) in herbaceous grasslands, but may increment to 28 or more t ha^{-1} yr^{-1} when taking into account rainfall patterns, the length of the dry season and the available nutrients (Lamotte cited by Malagon 2004).

The rainy season causes the loss of the few soluble or interchangeable elements in the soil generating high acidity. Soil pH is generally under 5.0 and in dry seasons favors the polymerization of humic substances, including the hardening of the horizons and cementation (petroferric materials) from the dehydration of iron compounds. In flat or dissected plains not affected by hydromorphism, this alteration is highly developed, reflected by the mineralogical composition of the sands and silts. Kaolinite, iron and aluminum oxyhydroxides are predominant in the clayey fractions, integrated at 2:1:1 with interlaminar aluminum, pyrophyllite and gibbsite (IGAC 1995[9]). This pertains mainly to ferralization processes (formation of oxisols) through processes of high conversion and depletion of elements such as Ca, Mg, K, Na and Si among others. The formation of Ultisols is present in a much smaller proportion. Additionally, there are some formations of Spodosols, and Inceptisols transitional to Oxisols. Indicators of these processes, other than the mineralogical, are those associated with the low capacity of cation exchange (CIC), measures less than 4 meq/1000 g of the effective capacity (IGAC 1995).

[8] CORPORINOQUIA 2008. Technical Document La Primavera Municipal Environmental Agenda. Departament of Vichada.

[9] INSTITUTO GEOGRÁFICO AGUSTÍN CODAZZI (IGAC). 1995. Suelos de Colombia: origen, evolución, clasificación, distribución y uso. República de Colombia, Ministerio de Hacienda y Crédito Público. Santa fe de Bogotá, D.C.

The soils are of very low fertility, both current and potential. A soil analysis effected for the El Deseo farm of the Organización La Primavera S.A. sub-project is featured in Table A.5.

Table A.5. IGAC Soil Analysis, property El Deseo (Organización La Primavera S.A. 2006).

Description	Characteristics	Percentage (%)
Granulometry	Sand	45.60
	Silt	36.30
	Clay	18.10
Texture	Blunt	
pH		5.00
Interchangeable acidity	A.I	0.79 meq/100g
Saturation % of Interchangeable acidity	S.A.I	
Organic matter	Organic Carbon	0.32
Change complex	Cation exchange capacity (CEC)	2.1 meq/100 g
	Calcium	0.04 meq/100 g
	Magnesium	0.01 meq/100 g
	potassium	0.01 meq/100 g
	Sodium	0.04 meq/100 g
	Total bases	0.10 meq/100 g
Percentage of base saturation		4.70%
Phosphorus		None detected

In general, the Orinoco region's soil types and evolution are linked to the origin of the sedimentary mega-basin located between the Guiana Shield and the eastern flank of the Cordillera Oriental (Eastern mountain chain). Quaternary deposits of fluvial origin, Tertiary sedimentary rocks (sandstone, mudstone and limestone) resting on Cretaceous, Paleozoic and Precambrian felsic crystalline rocks sediments are predominant. Located on these materials are foothill landscapes, vast plio-pleistocene highlands with variable dissection, partially dissected alluvial and eolic plains, cut by long and narrow alluvial valleys, recent and current, connected with major rivers. The faults on which the Meta River flows, establish two distinct subregions, the Orinoco High plains and the Orinoco Floodplain (Mendivelso 2003, cited by Malagon 2004[10]).

c. Soil use and management history

Land-use in the Municipality of La Primavera is different in urban and rural areas. In the town, it is primarily used for housing and commerce. In rural areas, it is used for livestock farming and small dairy industries. Approximately 90% of rural lands in the Municipality are used for livestock grazing, on which its economy depends. Approximately 2% is used for basic food crops. Generally, these crops are found in small parcels called –conucos on the banks of streams where native forest must be felled to accommodate them. Another 2% is used for the improvement of pastures with high productivity grasses in large-livestock farms, with species such as *Brachiaria humidícola* and *Llanero* grass. Finally, 6% is used for logging activities in areas like Santa Cecilia, Marandúa and Urillano (Land Management Plan, EOT 2000).

Natural fires occur on the plains with some regularity. In addition, it is common practice for cattle ranchers to burn the pastures to promote grass sprout renewal and increase its acceptance in cattle grazing. In summer months, the native grasses get very hard and dry and are not easily digested by the cattle. Therefore, the traditional practice is to burn the pastures twice a year to obtain grass re-sprouts to promote feeding by the cattle. These cyclical fires cause soil degradation since the soil loses minerals and porosity; this produces larger flood prone areas during winter months and decreases the capacity of native flora to naturally recuperate. Furthermore, flames generated during burning practices can occasionally affect gallery forests and decrease their density and land cover. Soils are degraded by over-grazing, anthropogenic burning, and the constant washing of the soils by the heavy rains.

[10] MALAGÓN, D. 2004. Tipología de suelos en las regiones naturales de Colombia.

d. Ecosystems:

Over 90% of the region belongs to the tropical savanna ecosystem. These are open land formations without a uniform canopy, where a perennial herbaceous matrix extends continuously and is occasionally covered by small-sized woody plants or scattered palms. The main genera of grasses found are: *Andropogon, Aristida, Axonopus, Leptocoryphium, Panicum and Trachypogon*. One of the most salient features of this biome is its tolerance to natural fires, adaptation to conditions of intense drought and flooding according to the variable patterns presented by precipitation, as well as the widespread low fertility of the soil and the strong winds (Figure A.11). These ecological factors have conditioned and aided the evolution of species by morphological, phenological and functional adaptations. The existence of fire in the evolution of these savannas can be seen by the presence of woody species, which are pyrophilic in nature (*Curatella americana, Byrsonima crassifolia, Bowdichia virgiliodes, Xylopia aromatica, Miconia* sp.) (Alvarado *et al*. 1991[11], Bosques de La Primavera S.A. 2006[12]).

The formation of "pyrophilic edges" is especially noticeable in the areas of contact between the high plains forest patches and the savannas. Overall, the dominant species are herbaceous: grasses and some cyperaceae -- juncaceae and xyridaceae-- among which the following stand out: *Aristida* sp. *Axonopus purpusii*, *Axonopus fissifolius, Digitaria decumbens, Eragrostis maypurensis, Panicum* sp., *Paspalum* sp. *Trachypogon plumosus*, among others. Riparian or gallery forests exist along the main rivers and streams of the region, in varying levels of conservation. These formations are important from an ecological point of view since they serve as corridors for the migration, reproduction and sustenance of fauna and flora. They are distinguished by the presence of palms in the canopy and co-dominant strata. Typical species include: *Socratea exorrhiza, Astrocaryum vulgare, Oenocarpus minor, Attalea maripa, precatoria, Iriartea deltoidea, Bactris gasipaes, Mauritiella armata*. The principal tree species present are: *Terminalia amazonica, Tabebuia serratifolia, Ceiba pentandra, Jacaranda copaia, Hymenaea courbaril, Enterolobium schomburgkii, Parkia pendula, Callophyllum* sp., *Inga* sp. *Spondias mombin, Guatteria* sp. *Bombacopsis quinatum*, among others (Alvarado *et al.* 1991).

The CDM project seeks to strengthen and interconnect these important, strategic ecosystems, through the establishment of swaths of assisted natural regeneration around the existing forest patches.

[11] Alvarado, P., Vásquez, C., y Aponte, M. 1991. Estudio semidetallado de suelos sector Carimagua – Gaviotas (Departamentos del Meta y Vichada). Instituto Geográfico Agustín Codazzi. Bogotá D.C., Colombia. 336 p.

[12] Plan de establecimiento y manejo forestal

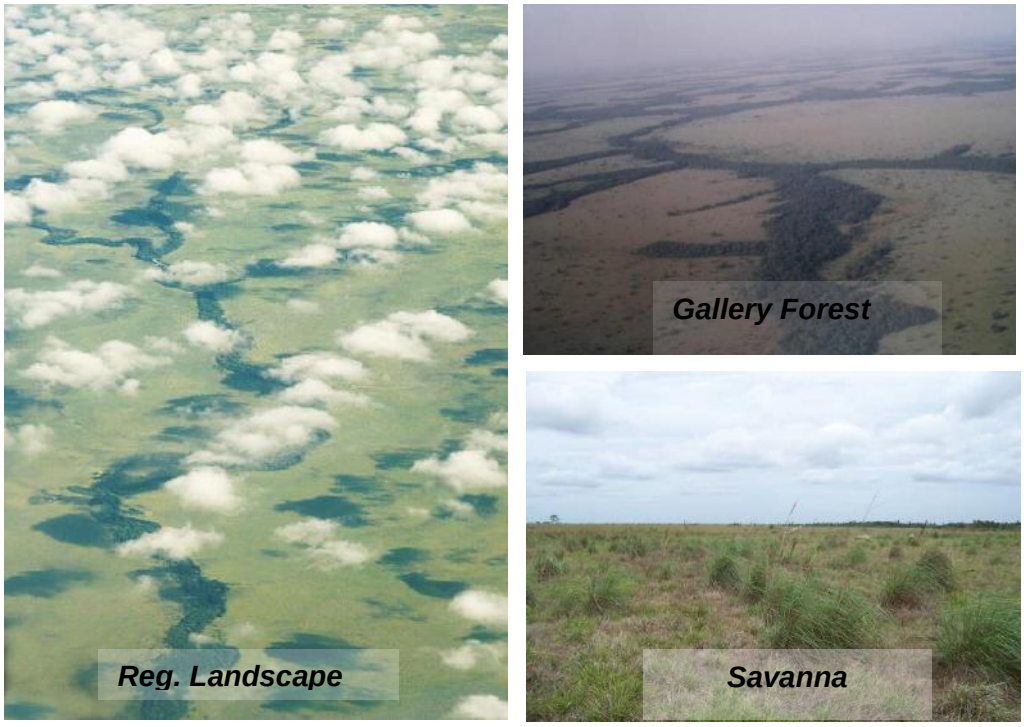

Figure A.11. Main ecosystems within project area.

e. Life Zones

The predominant life zone in the Department of Vichada is humid tropical forest (bh-T) according to the Holdridge classification system, followed to a lesser extent, by the area of tropical dry forest (bh-T) life zone. The area of the project activity also includes areas of the tropical wet forest (bh-T) life zone. This zone extends from sea level to 1,000 m and is characterized by temperatures between 24 and 35°C and annual rainfall between 2,000 and 4,000 mm (Holdridge1978).

f. Endangered species

The freshwater dolphin (*Inia geoffrensis*), the West Indian manatee (*Trichechus manatus manatus*) and the giant otter (*Pteronura brasiliensis*), are threatened aquatic mammals. In mammals, the pressures on their habitat represent the greatest threat to species like the leopard (*Leopardus pardalis*) and the *Cebus apella*. The "llanero" caiman (*Caiman intermedius*) is emblematic of the area and one of the most studied crocodiles in the basin; it is of commercial importance, endemic and in critical need of conservation. The morrocoy and charapa turtles (*Geochelone denticulata* and *Podocnemis expansa*), are also in danger of extinction; locals consume the eggs or meat of these species, they are hunted very young to be exported as aquarium pets (Figure A.12. Governance of Vichada 2008, CORPORINOQUIA, 2004).

Table A.6 presents the list of species reported as endangered in the region. None of these species depend on the well-drained high plains of the Orinoco for its survival, area in which the Forest Project will be developed. Much of the fauna in the region uses the gallery or riparian forests for their mobility, shelter and as nesting and feeding sites. These areas are not part of the areas eligible for CDM. The project seeks to conserve and expand these natural ecosystems by interconnecting the natural corridors with ANR and PNR models described above.

A key objective of the project activity is to determine whether the change in land use from extensive cattle grazing based on regular grassland burnings to restoration of natural forest cover, planting of commercial forests in areas previously used for grazing, and interconnection of the biological corridors will work to increase the populations and species of endemic and endangered species. The project has biologists carrying out baseline studies now, which will be compared with annual monitoring of the project activity in order to measure how populations and species change over time.

Figure A.12. Some endangered species of the Orinoco region. [1]www.andinos.blog.com, [2]www.arthurgrosset.com, [3]www.colombiacuriosa.blogspot.com, [4]www.andigena.org/herpetologica/, [5]animal-world.com/encyclo/reptiles/tortoises, [6]www.omacha.org/especies/delfin-rosado.

Table A.6. Endangered fauna species in the Orinoco region. EN: endemic, VU: vulnerable, NT: almost endangered, LR: low risk, DD: insufficient data.

Scientific name	Common name	Category
Fish		
Osteoglossum ferreirai	Arauana Azul, Arawana	*EN*
Colossoma macropomum	Cachama Negra, Cherna, Gamitana	*NT*
Brachyplatystoma juruense	Apuy, Manta Negra, Camisa Rayada	*VU*
Brachyplatystoma filamentosum	Valentón, Plumita, Lechero, Pirahiba	*EN*
Brachyplatystoma flavicans	Dorado, Plateado	*EN*
Brachyplatystoma vaillantii	Blancopobre, Pirabutón, Capaz	*EN*
Goslinea platynema	Baboso, Saliboro, Garbanzo	*EN*
Paulicea luetkeni	Saliboro, Bagre Sapo, Peje Negro	*EN*
Pseudoplatystoma tigrinum	Pintadillo Tigre, Bagre, Caparará	*EN*
Primates		
Aotus brumbacki		*VU*
Aotus vociferans		*LR*
Ateles belzebuth		*VU*
Callicebus torquatus		*LR*
Cebus apella		*LR*
Saimiri sciureus		*LR*

Scientific name	Common name	Category
Cacajao melanocephalus		*VU*
Lagothrix lagothricha	Choyo	*LR, VU*
	Mammals	
Leopardus pardalis	Leopardo	
Cerdocyon thous	Zorra	
Inia geoffrensis	Delfín rosado	*VU*
Lontra longicaudis	Nutria neotropical	*VU*
Leopardus pardalis	Tigrillo canaguaro	*NT*
Leopardus wiedii	Tigrillo peludo	*NT*
Myrmecophaga tridactyla	Oso hormiguero, oso palmero	*VU*
Odocoileus virinianus	Venado sabanero	*CR*
Pantera onc	Jaguar	*VU, NT*
Priodontes maximus	Armadillo gigante	*EN*
Pteronura brasiliensis	Perro de agua	*EN*
Puma concolor	Puma	*NT*
Tapirus terrestris	Danta común	*CR*
	Reptiles	
Crocodylus intermedius	Caimán del Orinoco, llanero	
Podocnemis expansa	Tortuga charapa	
Geochelone denticulata	Tortuga morrocoy	
	Birds	
Anas cyanoptera	Pava negra	*NT*
Ara militaris	Guacamaya verde	*VU*
Brachygalba goeringi		*EN*
Cacicus uropygialis	Arrendajo escarlata	*NT*
Basileuterus cinereicollis	Arañero pechigris	*NT, CE*
Chlorostilbon poortmanni	Esmeralda rabicorta	*EN*
Crax daubentoni	Pavón moquiamarillo	*VU*
Harpia harpyja	Águila moñuda	*NT*
Hypnelus ruficollis		*EN*
Morphnus guianensis	Águila arpía	*NT*
Neochen jubata	Pato carretero	*NT*
Falco deiroleucus	Halcón colorado	*DD*
Pauxi pauxi	Paujil Copete de Piedra	*VU*
Polystictus pectoralis	Tachurí barbado	*NT*

Source: Mojica et al. (2002)[13], Renjifo et al. (2002)[14], Corporinoquía (2004)[15], Romero et al (2009[16])., Rodríguez et al (2006).

[13] Mojica, J. I., C. Castellanos, J. S. Usma y R. Álvarez (eds.). 2002. Libro rojo de peces dulceacuícolas de Colombia. Serie Libros Rojos de Especies Amenazadas de Colombia. Instituto de Ciencias Naturales - Universidad Nacional de Colombia y Ministerio del Medio Ambiente. Bogotá, Colombia.

[14] RENGIFO, L. M., A. M. FRANCO-MAYA, J. D. AMAYA-ESPINEL, G. H. KATTAN Y B. LÓPEZ-LANÚS (eds.). 2002. Libro rojo de aves de Colombia. Serie Libros Rojos de Especies Amenazadas de Colombia. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt y Ministerio del Medio Ambiente. Bogotá, Colombia.

[15] Corporación Autónoma Regional de la Orinoquía (CORPORINOQUIA). 2004. Plan de Acción 2004-2006. Yopal, Colombia.

[16] Romero M.H., Maldonado-Ocampo J.A., Bogotá- Gregory J.D., Usma J.S., Umaña-Villaveces A.M., Murillo J.I., Restrepo-Calle S., Álvarez M., Palacios-Lozano M.T., Valbuena M.S., Mejía S.L. Aldana-Domínguez J. y Payán E. 2009. Informe sobre el estado de la biodiversidad en Colombia 2007- 2008: piedemonte orinoquense, sabanas y bosques asociados al norte del río Guaviare. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Bogotá D.C., Colombia. 151 p.

A.6. Measures

a. The baseline scenario is the same as the existing or historical land-use scenario.

b. The baseline scenario of the project activity corresponds to the pasture lands degraded by extensive cattle ranching with low production costs because it is done traditionally, with basic or traditional technologies. This activity lacks appropriate technological packages, generating high pressure on the grasslands and the only food and energy sources available for livestock. It leads to soil erosion and compaction, also, the introduction of non-native grasses for grazing cattle, produces the loss of biodiversity and land degradation[17]. As a result, it is reported that in some areas there is loss of capacity for natural regeneration of native flora of the region.

Overall, the dominant species are herbaceous, grasses and some sedges, rushes and *xyrydáceas*, among which are: *Aristida sp. Axonopus purpusii, Axonopus fissifolius, Digitaria decumbens, Eragrostis maypurensis, Panicum sp., Paspalum sp. Trachypogon plumosus*, among others (Alvarado et. al. 1991[18]).

Regular anthropogenic burning of grasses is a common practice in grazing activities in the region. This practice is carried out twice a year by cattle ranchers to obtain new grass re-sprouts which are palatable to the cattle and to the ranchers who seek to minimize their expenses. In summer, the grass is very dry, tough, and not easy to digest by the cattle grazing. Therefore, the tradition is to burn off the grasses, for pasture regrowth, for better assimilation by livestock (Rippstein et al. 2001). Additionally, natural fires occur in periods of intense summer or generated by dragging burning ashes of nearby places. These fires cause cyclic degradation in the soil as minerals and porosity are lost in this area leading to increased flooding in winter or less natural resilience of the native flora.

c. The project is made up of the following stand models:

- Commercial
- Assisted Natural Regeneration (ANR)
- Protection of deforested areas adjacent to gallery forests[19] to allow protected natural regeneration (PNR) of forest cover

The commercial model plans to use four forest species with high commercial value: *Pinus caribaea Morelet, P. oocarpa, Acacia mangium Willd., Tectona grandis Lf and Eucalyptus pellita F. Muell*. The ecological characteristics (e.g. environmental and soil requirements) necessary for their favorable establishment are presented in Table A.7. The following is a brief description of these species (Figure A.13).

Acacia mangium Willd.: A fast-growing species that adapts easily to poor soils, used in reforestation of degraded areas, soil restoration and conservation, and erosion control. Additionally, it has high competitiveness with respect to other species (e.g. grasses), which facilitates its establishment and harvest (Trujillo 2007[20]).

Eucalyptus pellita F. Muell. This species grows at altitudes between 0 and 700 meters. It requires temperatures between 24 and 30°C and average annual rainfall between 635 and 3,000 mm. It grows in dry forest and rainforest Holdrige Life Zones, tolerates slopes of 15-25%, and requires well-drained, slightly acid, and deep soils.

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[17] Instituto de Investigación de Recursos Biológicos Alexander Von Humboldt. 2004. Ecosistemas de la Cuenca del Orinoco Colombiano

[18] ALVARADO, P., VÁSQUEZ, C., Y APONTE, M. 1991. Estudio semidetallado de suelos sector Car imagua – Gaviotas (Departamentos del Meta y Vichada). Instituto Geográfico Agustín Codazzi. Bogotá D.C., Colombia. 336 p

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

[20] TRUJILLO, E. 2007. Guía de Reforestación – *Acacia mangium*. Editorial El Semillero. Bogotá, Colombia

Pinus caribaea* Morelet**. and ***P. oocarpa: The species is the only tropical pine that grows naturally at lower elevations. Because of its ability to grow in almost any soil type, it is one of the most widely planted pine species in the world. It is used in pure plantations, for natural fence lines along borders, windbreaks, for erosion control and the recovery of basins and degraded sites. It is well adapted to assisted natural regeneration models. This pine is grown extensively throughout the wet tropics. (CATIE *et al*. 2006[21], USDA 2006a[22]).

***Tectona grandis* L.f.**: Commonly known as Teak, this species is a large deciduous tree native of Southeast Asia, where it reaches heights of 45 m and develops a trunk with a prominent shaft when it reaches maturity. Teak is one of the most valuable and best-known tropical woods. It has been widely grown to produce wood for shipbuilding, fine furniture and construction (USDA 2006b[23]).

The selection of the species for the establishment of the forest plantations in the *CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia,* was based on the evaluation of the biophysical properties of the region and understanding of the technological packages that have been developed by Colombian research centers and forestry programs. All have traditionally been used for reforestation in Colombia, specifically in the Colombian Orinoco (Organización La Primavera S.A. 2006, Bosques de la Orinoquia S.A. 2007, Bosques de La Primavera S.A. 2007, Compañía de María – Padres Monfortianos 2007).

[21] CATIE, FORESTRY OXFORD INSTITUTE AND FORESTRY RESEARCH. 2006. Árboles de Centroamérica. Manual para extensionistas. *Pinus caribaea* Morelet And *Pinus oocarpa*

[22] USDA FOREST SERVICE. 2006. Washington - *Pinus caribaea* Morelet.

[23] USDA FOREST SERVICE. 2006. Washington – *Tectona grandis*

Table A.7. General description of the forest species selected for the commercial stand models in the *CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia*

Family	Species	t (°C)	Altitude (msnm)	Precipitation (mm)	Soil	Observations
Mimosaceae	*Acacia magium*	22-26	1700-3500	650-4300	Accepts shallow soils, compacted, supports pH levels from 4.2, with high aluminum contents.	Exotic species. Tree with a high potential in the recovery of degraded soils and to control erosion.[1, 3]
Myrtaceae	*Eucalyptus pellita*	24-30	0-700	635-3000	Requires well-drained soils, slightly acid and deep.	Species which grows well in silvopastoral systems.[2]
Pinaceae	*Pinus caribaeae* *P. oocarpa*[6]	20-27	0 – 850 (1500)	600-1800	Grows well in fertile to non-fertile grounds, sandy to sandy-clayey and deep.	Because they can grow in practically any soil, it is one of the most planted pine species worldwide. It is used in pure plantations, as borders, windbreaks and to control erosion, and the recovery of basins and degraded sites.[2, 5]
Verbenaceae	*Tectona grandis*	16-40	0-1200	1500-2000	It settles in a great variety of soils and formations. The best growth occurs in deep, porous, fertile and well drained, alluvial soils, with a neutral or acidic pH. Teak can tolerate extreme soil conditions if drainage is adequate.	Teak is one of the most appreciated and beautiful woods in the world, it is characterized by being slightly heavy, relatively soft (in humid climates) to moderately humid (in sub-humid climates) The heartwood is yellow-gold in recently cut trees which later turns dark creating overlapping striations with darks strips produced by its growth rings. [5].

[1] www.conafor.gob.mx/portal/docs/secciones/reforestacion/Fichas%20Tecnicas
[2] www.conabio.gob.mx/conocimiento/info_especies/arboles
[3] Trujillo (2007)
[4] www.herbaria.plants.ox.ac.uk/adc/downloads/capitulos_especies_y_anexos,
[5] www.fs.fed.us/global/iitf
[6] http://elsemillero.net/nuevo/semillas/listado_especies.php?id=84

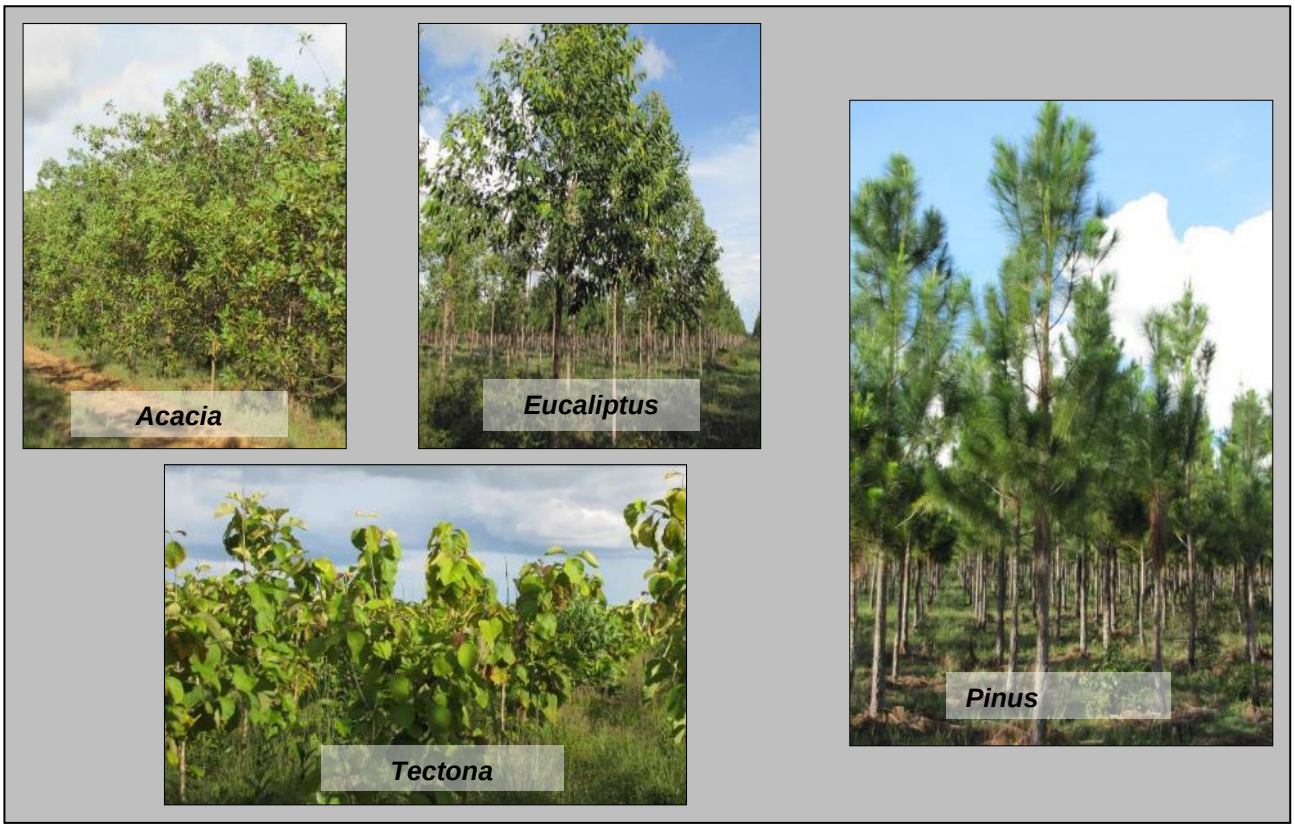

Figure A.13. Forest species, which are part of the project.

Table A.8. Forest species of the commercial tree stand model and projected areas within each forestry nucleus.

Specie	MONFORTIANOS	BOSQUESDE LA ORINOQUIA	BOSQUES DE LA PRIMAVERA	CAMBULOS	GUACAMAYAS	INCOMSER	O. LA PRIMAVERA	Total
A. mangium	162.03	157.72	199.85	19.41	220.10		110.12	869.23
E. pellita	127.61	46.81	707.19	145.09	76.49		98.66	1,201.85
P. caribeae	1,615.51	935.06	6,476.72	1,837.90	3,011.73	876.61	2,017.67	16,771.21
P. oocarpa		0.61					11.03	11.65
T. grandis			257.68				69.48	327.16
Total general	**1,905.16**	**1,140.20**	**7,641.44**	**2,002.40**	**3,308.32**	**876.61**	**2,306.95**	**19,181.09**

The model of assisted natural regeneration (ANR) will be implemented in 390 ha divided among the seven participating farms. Pioneer species will be used to help prepare the degraded sites and provide the conditions of shade and humidity necessary for the subsequent establishment and proliferation of species in different successional stages. Local species to be used in different successional stages are presented in Table A.9 and in Figure A.14.

Figure A.14. Some potential forest species to be used in the assisted natural regeneration system 1. *Astronium graveolens* (www.flickr.com), 2. *Ficus insipida* (www.burica.wordpress.com), 3. *Jacaranda copaia* (www.vinv.ucr.ac.cr), 4. *Spondias mombin* (www.ethnopharmacologia.org).

Table A.9. Potential species to be used in the assisted natural regeneration system.[24],[25]

Species		
Albizia guachapele	*Eugenia sp.*	*Pouteria caimito*
Albizia niopoides	*Ficus insipida*	*Pouteria reticulate*
Allophylus occidentalis	*Fissicalyx fendleri*	*Protium crenatum*
Annona montana	*Genipa americana*	*Protium llanorum*
Astronium graveolens	*Genipa caruto*	*Pseudolmedia laevis*
Bauhinia picta	*Guarea guidonia*	*Pterocarpus acapulcensis*
Bixa urucurana	*Guazuma ulmifolia*	*Rheedia madruno*
Bocageopsis multiflora	*Inga marginata*	*Rinorea flavescens*
Brosimum alicastrum	*Inga oerstediana*	*Sapium stylare*
Capirona decorticans	*Jacaranda copaia*	*Sloanea terniflora*
Caraipa llanorum	*Jacaranda obtusifolia*	*Socratea elegans*
Casearia nitida	*Jessenia bataua*	*Spondias mombin*
Cassia grandis	*Lecythis minor*	*Stemmadenia grandiflora*
Cassia reticulata	*Liabum astatum*	*Sterculia apetala*

[24] ALVARADO P., C. VÁSQUEZ Y M. APONTE. 1991. Estudio semidetallado de suelos sector Carimagua-Gaviotas (Departamentos del Meta y Vichada). Instituto geográfico Agustín Codazzi, Subdirección Agrológica. Santafé de Bogotá, D. C. 336p.

[25] NAVAS, G. E., C. A. BARRAGÁN. 2002. Caracterización y usos potenciales de especies vegetales de un bosque de galería secundario Municipio Fuente de Oro, Meta. Corporación Colombiana de Investigación Agropecuaria CORPOICA- Programa Nacional de Transferencia Tecnológica Agropecuaria PRONATA. Boletín técnico No. 28.

Species		
Cecropia discolor	*Licania apetala*	*Stylogyne venezuelana*
Cecropia peltata	*Licania subarachnophylla*	*Swartzia leptopetala*

The system of Protected Areas for Natural Regeneration (PNR) is planned for 9,447.78 ha. PNR areas will be focused on deforested areas adjacent to the gallery forests, which until the beginning of the project were devoted 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. In contrast to the ANR model, no planting will be done here. The proximity of these areas to the natural forest ecosystems should allow the initiation of succession processes for regeneration of natural forest cover, and consequently should produce an increase in the rates and stocks of carbon sequestration. These areas serve as a control to compare the ANR areas regarding the rates of carbon accumulation and biodiversity. Figure A.15 illustrates the general distribution of the three stand models in the project.

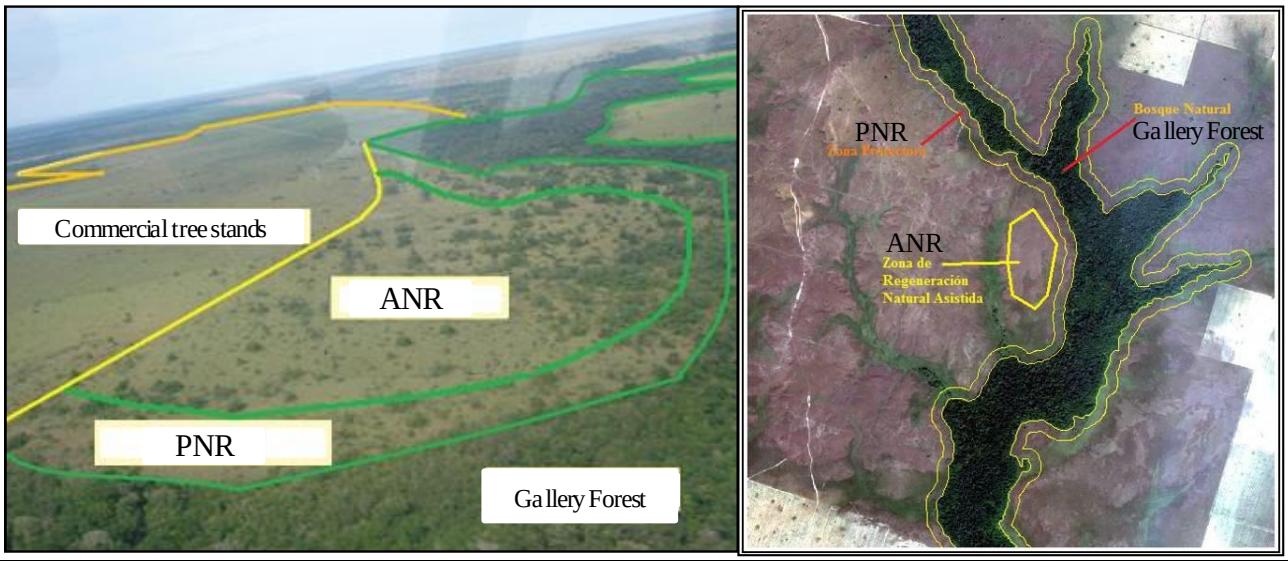

Figure A.15. Examples of the general placement of commercial, ANR and PNR tree stand models in the project activity.

Activities such as establishment of the areas to cultivate, planting, weed control, fertilizing and pruning procedures will be applied similarly in the commercial plantations of the four species and 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.

1. **Nursery**

The seedlings will be produced in a transitional nursery, which for this purpose will be installed on each farm with a capacity of 700,000 to 1,000,000 seedlings. The best quality seeds will be used and the seedlings will be produced in tubular bags (bottomless) of 40 mm in diameter and 12 inches 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.

2. **Establishing the plantation**

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

Planting density: planting density will be 1,040 trees per ha. Spaced at 3.1 x 3.1 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**:* Previous to 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.

***Planting*:** will be 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.

***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, in order to improve the resistance and the vigor of the plant for transplanting in the field and adaptation to the new habitat in which it will develop. In the field, fertilization will be carried out after 25 – 30 days after planting, by irrigation with a mix that includes mycorrhizae. 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.).

Fire control: firebreaks made up of lanes and streams especially during the dry season will surround the tree stand models in the field. These internal firebreaks will be reinforced by an additional one that will surround the boundaries of the properties, with the objective of protecting the project activity from the indiscriminate practice of pasture burning by neighboring cattle ranchers.

3. 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, P. oocarpa, T. grandis* 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*:** will be 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.

***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 will be done from the fifth year of the project. The procedure begins with the selection of individuals to be cut based on the intensity established (Table A.7).

For the *P. caribaea and p. oocarpa*, 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.

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.

***Fire 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.

4. 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* 10 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.

Table A.10. General thinning schedule for species, which make up the commercial stand model.

Species	N_0	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	1001	5	30	5	9	30	5	12	30	5	18	281
P. oocarpa	1001	5	30	5	9	30	5	12	30	5	18	281
A. mangium	1001	5	20	5	-	-	-	-	-	-	10	751
T. grandis	1001	10	20	5	15	30	5	20	30	5	25	332
E. pellita	1001	5	30	5	9	40	5	-	-	-	15	280

N_0: 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.

5. Marketing

One option is to sell the lumber locally to meet the needs of the region in the form of round wood and sawn timber. If the government eventually develops the promised roads, bridges and river transport infrastructure, it will open the alternative of selling to the domestic and/or international markets, depending on transportation costs. However, owners will continually compare the net income from harvesting, transport and lumber sales to the net income from leaving the trees standing and sequestering carbon to sell more tCER. They will select the alternative which produces the greatest net income.

6. Replacement plan

The project will develop a long-term management plan for a continual rotation program, so that harvested areas will be continually replanted, establishing a perpetual production cycle.

7. Planting schedule

29,015 ha will be planted and managed in three tree stand models: Commercial, Assisted Natural Regeneration (ANR) and Protected Natural Regeneration (PNR) and a Baseline level (pastures) as shown in Table A. 11. The Table A.12 shows the corresponding area for each species in the management model.

Table A. 11. Stand model distribution at Baseline level for the Project.

Stand model	Stratum(ha) Pastures
Commercial	19,181.09
Assisted Natural Regeneration	390
Protected Natural Regeneration	9,447.78
Total	**29,019**

Table A.12. Total area to be planted, by species, in the Commercial stand model.

Stand model	Species	Planted area (ha)
Commercial	*Pinus caribaea*	16,771.21
	Pinus oocarpa	11.65
	Acacia mangium	869.23
	Tectona grandis	327.16
	Eucalyptus pellita	1,201.85
Total		**19,181.09**

Tree Stand Models

Following is the description of each tree stand model and related activities.

1. **Commercial tree stand model**

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*
- *P. oocarpa*
- *Acacia mangium*
- *Tectona grandis*
- *Eucalyptus pellita*

Once the terrain has been prepared it will be laid out in squares at 3.1 m between seedlings and 3.1 m between paths (in a square) at a density of 1,001 trees per hectare.

This model will promote the protection of water sources. The establishment of this tree stand will always be at least 50 m away from natural waters or the gallery forests that protect them. In addition, the trees present in the plots will be preserved. The commercial model will also promote the ecological restoration of surrounding areas by creating connectivity between natural forest fragments. Planting schedules specific to this stand model are presented in Table A.10, which shows that the largest participation by species are *P. caribaea, P. oocarpa* and *A. mangium*. In the case of *P. caribaea, P. oocarpa* and *A. mangium* there will be two thinnings, and for *T. grandis* there are three thinning as indicated in the Plantation Maintenance section (Table A.13).

The thinnings will be between 30 and 40% of the volume and are specified in the per species management plans. Duration to harvesting will be 18 years for *P. caribaea*, 10 years for *A. mangium*, 12 years for *E. pellita* and 25 for *T. grandis*.

All the above projections for the forest management plan, including planting, maintenance, thinning and harvesting among others, will be susceptible to modifications during the period of implementation and growth of the project activity. The availability of resources, the weather, the growth and development of the species in response to the cultivation activities, the ability to transport product, and the security situation, among others, may affect the actual date of each planned activity.

Table A.13. Distribution over time of planting activity, per species, for the commercial stand model.

Project	*Specie*	*Year*										Total
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	
Monfortianos	***A. mangium***				5.05	73.88	83.10					162.03
	E. pellita					11.27	21.54	44.70	50.11			127.61
	P. caribaea				218.29	622.91	52.15	219.25	451.84	51.07		1,615.51
Bosques de la Orinoquia	***A. mangium***			83.70	63.04	10.98						157.72
	E. pellita								22.85	23.96		46.81
	P. caribaea			117.48	266.81	262.38			288.38			935.06
	P. oocarpa					0.61						0.61
Bosques de la Primavera	***A. mangium***					146.31	53.54					199.85
	E. pellita						144.64	156.48	39.38	297.35	69.33	707.19
	P. caribaea				482.89	627.89	1,398.11	919.77	866.10	1,442.21	739.76	6,476.72
	T. grandis					224.41			23.25	10.02		257.68
CAMBULOS	***A. mangium***									19.41		19.41
	E. pellita						39.03	98.72			7.34	145.09
	P. caribaea						580.03	468.58	234.16	413.64	141.50	1,837.90
Guacamayas	***A. mangium***					49.99	123.69	6.83	21.94	17.65		220.10
	E. pellita						23.47	22.57	30.45			76.49
	P. caribaea					696.29	550.21	901.98	263.17	600.09		3,011.73
INCOMSER	***P. caribaea***									876.61		876.61
Organización La Primavera	***A. mangium***	52.83	11.30	25.73	20.26							110.12
	E. pellita	27.11		11.08	37.69			22.78				98.66
	P. caribaea	267.60	437.50	530.91	257.88			63.85	128.35	184.35	147.23	2,017.67
	P. oocarpa		11.03									11.03
	T. grandis	3.36	30.08	24.80	11.24							69.48
Total general		**350.89**	**489.92**	**793.70**	**1,363.14**	**2,726.92**	**3,069.52**	**2,925.51**	**2,419.97**	**3,936.37**	**1,105.16**	**19,181.09**

2. Tree stand models for Assisted Natural Regeneration and Protected Natural Regeneration

The importance of establishing corridors for the conservation of biodiversity within the CDM framework

The loss of natural habitat and the fragmentation of natural corridors and strategic ecosystems due to anthropogenic intervention (ranching, industrial farming, mining, etc) are currently recognized as a major threat to the conservation of biodiversity. Biological corridors (BC) are geographical, continental or marine areas that connect areas or critical habitats to facilitate the dispersal and migration of flora and fauna and provide the natural conditions that ensure their conservation. Any habitat in any of the following categories can be considered an essential habitat:

- Ecosystems used by the biota at least in one critical stage of its ontogeny.
- Ecosystems with a significant combination of abiotic characteristics (water, climatic, geological and geomorphologic) and biotic (high biodiversity, productivity).
- Ecosystems with high structural complexity
- Ecosystems that favor reproduction, mating, feeding and protection.

One of the crucial aspects of this CDM forestry project has to do with the environmental criteria considered in its design and implementation. Special importance has been given to practices that contribute to the conservation of biodiversity, specifically through the restoration and expansion of strategic natural forest ecosystems. It is hoped that CER generated by CDM projects designed for ecological restoration in critical areas for biodiversity such as the Orinoco basin, will achieve a greater demand from the market and therefore could be marketed at higher prices than those generated in conventional reforestation projects.

BCs are a strategy used in conservation to address the problem of habitat fragmentation caused by anthropogenic economic activities such as agriculture, livestock, urbanization and infrastructure such as roads and dams. This is based on modern ecological theories applied to conservation such as island biogeography, metapopulations and minimum viable population. The central idea of the implementation and development of conservation corridors is that populations, communities and ecological processes can more easily maintain and reproduce themselves in landscapes covering an expanded and interconnected system of habitats. In literature, there are reports of different mechanisms, which contribute to mitigate the problem of biodiversity loss due to the destruction of habitats, such as creating *buffer zones* and *conservation corridors*. *Buffer zones* allow for a less abrupt transition between natural and artificial environments expanding the effectiveness of the protected area by reducing the border effect. For their part, corridors reduce the island effect and fragmentation.

Thus, the strategy of the project activity assumes that the restoration and re-construction of biological corridors that interconnect the existing forest patches, will increase organisms' habitat and thus help prevent the reduction of population size, inbreeding and extinction common to areas of high anthropogenic interventions (Haddad 1999[26]).

Design of biological corridors

The biological corridors of this CDM project activity were designed based on the concept of riparian corridors, which consist of a band of vegetation parallel to streams or water sourcees, which differs from the surrounding matrix. Such corridors may include only the channel and adjacent banks, or may be wide enough to include a flood plain, hills, and adjacent stretches in higher grounds. The structure of a riparian corridor is characterized by an internal entity (a body of water), an inner border area, a strip of forest (which is an internal environment, if it is wide enough), and an external border area. The inner central environment is flanked by the edges of the corridor, which in turn

[26] HADDAD, N. 1999. Corridor Use predicted from behaviors at habitat boundaries. American Naturalist. 153(2): 215-227

are surrounded by the matrix, which in the case study area is determined by savanna grassland (Figure A.16). In this type of corridors there are several types of movement: a movement within the range of the species' habitat, dispersal and migration. A gene flow is also present due to the sexual reproduction of resident individuals, progressively along the corridor. In addition, whole communities can move along the corridor, whether by seasonal migrations or in response to phenomena such as climate change (Forman 1997[27]).

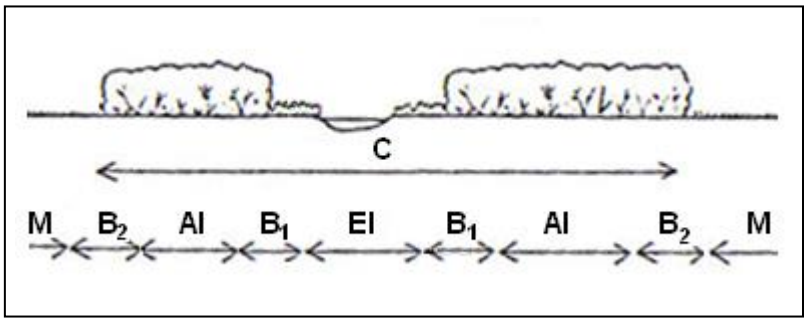

Figure A.16. Cross-section of the structure detail of a riparian corridor (C: corridor, M: matrix, B_1: internal border, B_2: external border, AI: internal environment) (Adapted from Forman 1997).

Because the objective of the biological corridors for the Project is to preserve and promote connectivity between forest ecosystems, at least two nuclei transects must connect the riparian forests within the project area, with larger areas of natural forest of great importance for conservation. In this way, some commercial species could serve as a launch for a process of natural regeneration, in which the species act as pioneers, and would be gradually replaced by natural forest.

It is essential to minimize any possible negative impacts the establishment, management and harvest of the commercial forestry production systems may have on the natural riparian vegetation. The creation of buffer zones between the bands of productive tree stands and riparian forests is indispensable, to promote the regeneration and succession of native vegetation. This will form part of the areas for Protected Natural Regeneration. The structure of the biological corridor will be constituted by its internal entity (waterway, which will vary in width along the corridor), its internal environment (riparian forests), a buffer zone (natural vegetation in succession-PNR) and a production corridor (forest production systems complemented by areas of ANR). The width of each band will be defined according to the current extension of natural forest in each sector of the corridor and its distance to the nearest fragment.

Species involved in the Assisted Natural Regeneration (ANR) model

The model focuses on planting a matrix of native tree species associated with different successional stages, to facilitate the process of regeneration of riparian forests of the Orinoco in areas eligible under the CDM. The matrix is set in a lattice of trees that cover the selected surfaces in bands of approximately 100 m in width, on suitable soils for the establishment of the species and bordering the gallery forests within the areas identified as eligible. First, a parent species will be planted to prepare the degraded sites and provide the shade and moisture necessary for the proliferation of other species in different stages of succession. It has been established that the introduction of tropical pines in the Orinoco plains favors the reduction of grasses, the proliferation of undergrowth and the appearance of layers that do not exist in the open savanna. Parent trees will be set up following a pattern of 12 x 3 m (Figure A.17, Table A.14). In areas with greater spacing, exclusion pioneer species, initiation pioneers and dominant late successional will be positioned (Figure A.18), following a 7:4:1 ratio.

[27] FORMAN, R. 1997. Land Mosaics. The ecology of landscapes and regions. Cambridge University Press. Cambridge, UK. 632 p

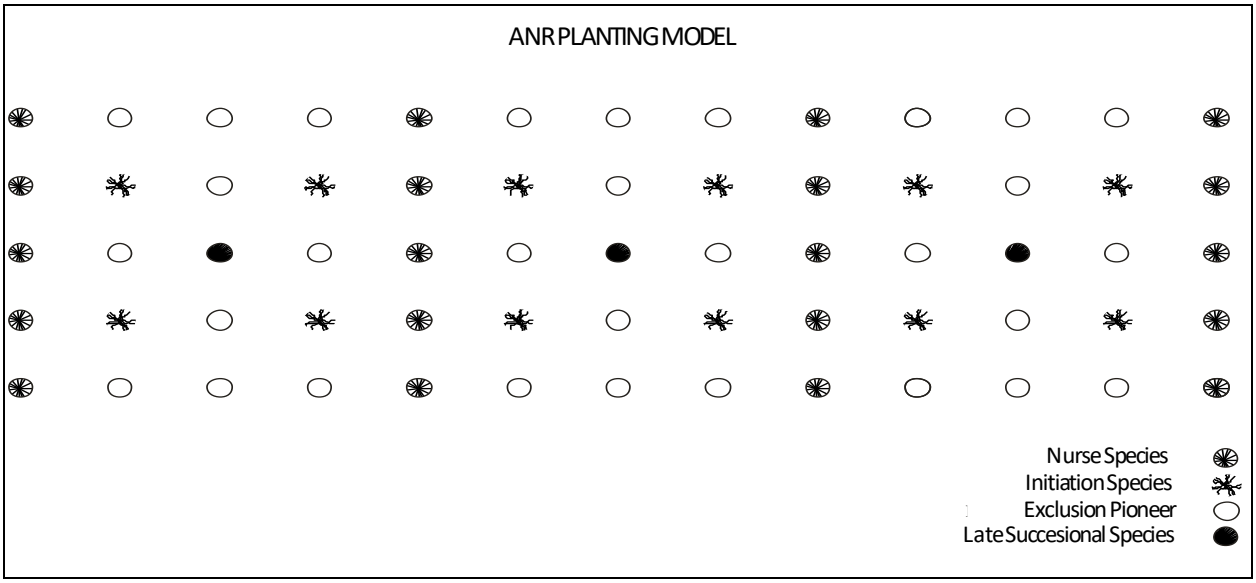

Figure A.17. One possible pattern for the stand model for natural regeneration in project area.

Table A.14. Specifications of the Assisted Natural Regeneration model: proportions of species, spacing (m) and tree density (ha).

Proposed corridor model			
Specie	**Proportion**	**Spacin**	**Tree density**
Parent species	-	12 x 3	278
Exclusion pioneer	7	3 x 3	486
Initiation pioneer	4	3 x 3	278
Succesional or delayed	1	3 x 3	69
Total	**12**		**1,111**

Figure A.18. Species included in assisted regeneration model. Sources: (1) http://upload.wikimedia.org (2) http://www.botany.hawaii.edu (3) http://www.jardin-mundani.org (4) http://aoki2.si.gunma-u.ac.jp (5,6) http://www.lancetilla.org (7) http://www.nativehabitat.com (8) http://stallcup.myweb.uga.edu (9) http://www.palli.ch

A.7. Approach to addressing non-permanence

The project will use tCERs as an approach to address the non-permanence of net anthropogenic removals achieved by the project activity, in accordance with Paragraph 38 and Section K of the CDM Modalities and Procedures for afforestation and reforestation.

A.8. Parties and project participants

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

A.9. Public funding of project activity

The project is a private initiative and is jointly funded by the Organización La Primavera S.A., Bosques de La Primavera S.A., Bosques de La Orinoquia S.A, la Compañía de María – Padres Monfortianos, Reforestadora Los Cámbulos S.A.S, Reforestadora Guacamayas S.A and INCOMSER LTDA. A small complementary source of project financing is the CIF (Forest Incentive Certificate), an incentive offered by the National Government in recognition of the benefits of reforestation, which reimburses a percentage on the cost scale for the establishment of forestry projects during their first five years. It is oriented only to assist in establishment costs. However, the CIF is an uncertain source because it depends on the budget availability of the National Government. When the national budget has other priorities, there is no CIF.

A.10. History of project activity

- The project proposal was never a CPA in a CDM PoA.
- The project never cancels the registration

A.11. Debundling

N.A

SECTION B. Application of methodologies and standardized baselines

B.1. References to methodologies and standardized baselines.

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

As presented on the website United Nations Framework Convention on Climate Change (UNFCCC for CDM project), the AR-AM0004 has been replaced by the methodology **AR-ACM0003**, the current PDD adjusts to the conditions set out in the methodology **AR-ACM0003 Version 2.0** and their methodological tools.

The following methodological tools were used:

- Procedures to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities Version 01.
- Tool for the demonstration and assessment of additionality in afforestation and reforestation CDM project activities Version 02.
- Methodological tool. Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R. CDM project activities. AR-TOOL14. Version 4.2[28].
- Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities.
- Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities

B.2. Applicability of methodologies and standardized baselines

Applicability of the baseline methodology is based on paragraph 22 (a) of the CDM/AR Modalities and Procedures, by establishing that the effective variations in carbon pools within the project areas would be the same which would have occurred due to typical land use. The baseline represents the continuation of the economic activities which have taken place historically, at present, and are unlikely to change in the absence of the project activity.

Lands to be afforested or reforested are severely degraded and the lands are still degrading or remain in a low carbon steady state.

As demonstrated in the eligibility analysis (Section A.7), the vegetation covers in the project activity sites are pasture grasses, burned grasses and scrublands. The predominant economic activity of the project area is based on extensive cattle ranching (90% of productive land in the Municipality of La Primavera is devoted to livestock), which is carried out throughout the eastern plains, and is characteristic of the Municipality La Primavera (Land Management Plan, EOT 2000). This activity is carried with an average of one animal per ten hectares. This activity usually lacks appropriate technological packages, generating high pressure on the grasslands and the only food and energy sources available for livestock. It leads to soil erosion and compaction, also, the introduction of non-native grasses for grazing cattle, produces the loss of biodiversity and land degradation[29]. As a result, it is reported that in some areas there is loss of capacity for natural regeneration of native flora of the region.

The combination of natural wildfires during periods of intense summer and regular anthropogenic grassland burning for cattle grazing degrade the soil, as minerals are lost and the physical conditions such as porosity, among others, are altered. Over–grazing and the lack of fertilization further deteriorate the soil. The degraded soils are washed out constantly by the heavy rains. The

[28] https://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-14-v4.2.pdf

[29] IAvH 2005. Ecosistemas de la Cuenca del Orinoco Colombiano. Instituto de Investigación de Recursos Biológicos Alexander Von Humboldt. 2005.

practice of grassland burning is carried out twice a year by cattle ranchers to obtain new grass re-sprouts which are palatable to the cattle and to the ranchers who seek to minimize their expenses. The regular burnings of pasture grasses prevent the accumulation of biomass and carbon in the areas involved. Gallery forests are also affected by the burning activities; uncontrolled flames often impact these forests causing the loss of forest density and reducing the area of forest cover. The regular burnings limit the ability of the native flora to naturally recover.

The biomass contribution is low (2.2 to 3.8 t ha^{-1} yr-1) in herbaceous savannas, but may increase to 28 or more t ha^{-1} yr^{-1} under the gallery forest covers, depending on rainfall patterns, the length of the dry season and available nutrients (Lamotte cited by Malagon). The heavy rains cause losses of the soil's few soluble or exchangeable elements, resulting in the high acidity found throughout the eastern plains. Soil pH is generally well below 5 and in the dry season favors the polymerization of humic substances and the hardening of soil horizons and cementing (petroferric materials) from the dehydration of iron compounds. The effect of marked climate seasonality, its relationship to tropical savanna vegetation and to the establishment of humus, has generated in conjunction with the advanced alteration of the soils, characteristics of very low fertility, both current and potential (Cortés 1982, cited by Malagon).

Site preparation does not cause significant longer term net decreases of soil carbon stocks or increases of non-CO_2 emissions from soil.

The Colombian *llanos orientales* (eastern plains) cover approximately 17 million hectares. As has been widely documented, the conditions of their soils are not highly suitable for agricultural activities, as they possess high acidity and high levels of aluminum (Rippstein *et. al*. 2001[30]), and low organic matter content. Plowing the land becomes necessary to achieve better physical, biological and chemical soil conditions. As a result of its low content of organic matter, emissions from tilling are low and otherwise promote the inclusion and increased organic matter and increase soil carbon.

Carbon stocks in soil organic carbon, litter and dead wood can be expected to decrease more due to soil erosion and human intervention or increase less in the absence of the project activity, relative to the project scenario.

In this case, carbon stocks in soil organic carbon, litter and dead wood can be expected to further decrease due continued cattle ranching based on regular grassland burnings and continual soil erosion from overgrazing and constant tropical rains or increase less in the absence of the project activity, relative to the project scenario. Given these activities and the type of coverage present in the baseline setting, the presence of debris and litter is practically zero, as well as the content of organic matter in soil.

By implementing the project activity, carbon stocks will be increased directly and very significantly due to the increase of biomass in the tree stand models established and the cycling of nutrients and carbon from forestry. The carbon stocks will increase indirectly due to the elimination of the fire management cycle, the movement of cattle grazing activities to other areas on the farms for intensive management, and the restoration of natural forests by the implementation of the Assisted Natural Regeneration and Protected Natural Regeneration models in approximately 9,447.78 hectares.

Flooding irrigation is not permitted.

[30] Rippstein et. al. 2001. CIAT, 2001. Agroecológia y biodiversidad de las sabanas en los Llanos Orientales de Colombia. Rippstein G, Escobar, G y Mota F. Editores. Centro Internacional de Agricultura Tropical (CIAT). 302 p. Publicación CIAT, no 322.

Rainfalls levels are very high and irrigation is not necessary. Further, the species used in the project activity do not support this type of irrigation, as it causes adverse effects in their growth as exemplified by the *P. caribeae* (Alvarado, 2006[31]).

Soil drainage and disturbance are insignificant, so that non-CO2 greenhouse gas emissions from this type of activities can be neglected.

Drainage of the highlands where the project activity areas are located is good, even in the rainy seasons. (The plains have highlands that do not flood, and lowlands that do flood.) Methane emissions from anaerobic digestion of flooded biomass due to the project activity are not a concern.

The A/R CDM project activity is implemented on land where there are no other on-going or planned A/R activities (no afforestation/reforestation in the baseline).

The poor or non-existent transport infrastructure, lack of paved roads, high travel costs, poor soils, presence of armed violent groups, and the presence illicit drug cultivation are conditions that have limited land use to extensive cattle farming. This is the first reforestation project in the area. As indicated above, additional incomes from carbon sequestration and carbon markets are an important source of income for investors and may become the only income if transport infrastructure is not developed in the coming years. However, if the project is successful, we expect other projects to follow this example.

Regarding the applicability conditions established by the AR-ACM003 method that replaces AR-AM0004, an applicability comparison is developed with reference to the proposed project.

[31] Alvarado, A. Rigosa, J y Oviedo, J. (2006). Nutrición y fertilización del Pino caribeño (*Pinus caribaea*). Informaciones Agronómicas Nº 62. P 8-12.

Analysis on the applicability conditions between the methodologies AR-AM0004 y la AR-ACM003.

Then a parallel shown concerning the conditions of applicability of the above methodology and AR-ACM0003 v02.0 to define its due applicability. Shows that the AR-AM004 has greater applicability conditions AR-ACM0003 vV02.0. When verifying the conditions of the two methodologies, the project complies with all of them and there is no restriction for updating to the AR-ACM003.

AR-AM0004	Justification	AR-ACM003 v02.0	Justification
Scope			
Reforestation or afforestation of land currently under agricultural use. "Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary."	The baseline represents the continuation of the economic activities which have taken place historically, at present, and are unlikely to change in the absence of the project activity. *The project meets this condition as seen in section B.2 of the PDD.*	This methodology excludes from its scope the land that falls into the category of wetland.	*Lands to be afforested or reforested are severely degraded and the lands are still degrading or remain in a low carbon steady state.* The areas are considered low in carbon content and are not organic soils and are instead degraded soils, derived from oxisols.
Applicability			
Afforestation or reforestation of degraded land, which is subject to further degradation or remains in a low carbon steady state, through assisted natural regeneration, tree planting, or control of pre-project grazing and fuel-wood collection activities (including in-site charcoal production).	As demonstrated in the eligibility analysis (see PDD Section A.7), the vegetation covers in the project activity sites are pasture grasses, burned grasses and scrublands. The predominant economic activity of the project area is based on extensive cattle ranching (90% of productive land in the Municipality of La Primavera is devoted to livestock). See PDD section B.2, for more details. The Project activities are defined as afforestation on historically degraded land, which exceed the carbon content compared to those identified in the baseline.	This methodology is applicable under the following conditions:	*Lands to be afforested or reforested are severely degraded and the lands are still degrading or remain in a low carbon steady state.* According to the zoning of permanent wetlands for the Region of the Colombian Orinoquia, developed by the Directions of Forests, Biodiversity and Ecosystem Services - DBBSE, Ministry of Environment of Colombia [32], it can be determined that the areas eligible for the project are outside said zoning, as can be seen in **¡Error! No se encuentra el origen de la referencia.**. A more detailed analysis of this condition is presented annexed to the monitoring report, with GIS files and shape file. (Wetlands_Anexx_Orinoquia).

[32] https://www.arcgis.com/home/item.html?id=a499da66b2814db48888343283b57cdb

The project activity can lead to a shift of pre-project activities outside the project boundary, e.g. a displacement of agriculture, grazing and/or fuel-wood collection activities, including charcoal production.	The A / R project activities did not lead to the ex-ante activity displacement, since the baseline activities were determined as extensive cattle ranching, and in section B.6.1.3 of the PDD there is a demonstration of how the treatment was of the ex ante activity, in which not even leaks are generated by the implementation of the project. Meets the condition	(a) The land subject to the project activity does not fall in wetland category.	*Lands to be afforested or reforested are severely degraded and the lands are still degrading or remain in a low carbon steady state.* The areas are considered low in carbon content and are not organic soils and are instead degraded soils, derived from oxisols See above
Lands to be afforested or reforested are degraded and the lands are still degrading or remain in a low carbon steady state;	See paragraphs above.	(b) Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when these lands are included within the project boundary: (i) Land containing organic soils. (ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to this methodology.	(b) (i) As can be seen in the PDD and in the applicability conditions of AR-AM004, the soils in the project areas are not organic soils, nor do they correspond to the category of wetlands (see previous paragraphs), hence this condition does not apply to the project area. On the other hand, the work of soil preparation, when chiselling, the alteration will be less than 10%, in soils derived from oxisols. (ii) The baseline represents the continuation of the economic activities which have taken place historically, at present, and are unlikely to change in the absence of the project activity (grassland). Lands to be afforested or reforested are severely degraded and the lands are still degrading or remain in a low carbon steady state. The areas are considered low in carbon content and are not organic soils and are instead degraded soils, derived from oxisols. Soils were never or were considered improved practices of their management in baseline actions. The soil are dedicated to grasslands (Anexx 2 Methodology) but they are degraded soils and
Site preparation does not cause significant longer-term net decreases of soil carbon stocks or increases of non-CO2 emissions from soil	The Colombian *llanos orientales* (eastern plains) cover approximately 17 million hectares. As has been widely documented, the conditions of their soils are not highly suitable for agricultural activities, as they possess high acidity and high levels of aluminum (Rippstein et. al. 2001), and low organic matter content. Plowing the land becomes necessary to achieve better physical, biological, and chemical soil conditions. As a result of its low content of organic matter, emissions from tilling are low and otherwise promote the inclusion and increased organic matter and increase soil carbon.		
Carbon stocks in soil organic carbon, litter and dead wood can be expected to further decrease due to soil erosion and human intervention or increase less in the absence of the project activity, relative to the project scenario	In this case, carbon stocks in soil organic carbon, litter and dead wood can be expected to further decrease due continued cattle ranching based on regular grassland burnings and continual soil erosion from overgrazing and constant tropical rains or increase less in the absence of the project activity, relative to the project scenario. Given these activities and the type of coverage present in the baseline setting, the presence of debris and litter is		

	practically zero, as well as the content of organic matter in soil. By implementing the project activity, carbon stocks will be increased directly and very significantly due to the increase of biomass in the tree stand models established and the cycling of nutrients and carbon from forestry. The carbon stocks will increase indirectly due to the elimination of the fire management cycle, the movement of cattle grazing activities to other areas on the farms for intensive management, and the restoration of natural forests by the implementation of the Assisted Natural Regeneration and Protected Natural Regeneration models		without management or improvement in their conditions, therefore they do not present restriction for the implementation of the methodology in the project. As demonstrated in the eligibility analysis (see PDD Section A.7), the vegetation covers in the project activity sites are pasture grasses, burned grasses and scrublands. The predominant economic activity of the project area is based on extensive cattle ranching (90% of productive land in the Municipality of La Primavera is devoted to livestock). Meets the condition
Flooding irrigation is not permitted	The species proposed in the stand models do not support flood conditions, therefore such activity is not considered in the project.		

B.3. Carbon pools, sources and greenhouse gases (GHGs) according to AR-ACM0003 V2.0

Carbon pools		Selected?	Justification/Explanation
Baseline	**Above-ground Biomass**	Yes	Major carbon pool subjected to the project activity
	Below-ground Biomass	Yes	Major carbon pool subjected to the project activity
	Dead wood	Yes	Conservative approach under applicability condition
	Litter	No	Conservative approach under applicability condition
	Soil organic carbon (SOC)	No	Conservative approach under applicability condition
Project activity	**Above-ground Biomass**	***Yes***	Major carbon pool subjected to the project activity
	Below-ground Biomass	***Yes***	Major carbon pool subjected to the project activity
	Dead wood	***Yes***	This component is a significant sink in the project compared to the baseline, where all the biomass is periodically burned.
	Litter	***Yes***	This component is a significant sink in the project compared to the baseline, where all the biomass is periodically burned.
	Soil organic carbon (SOC)	***Yes***	The soils are highly degraded, with very low carbon content due to historical burning, and the project's contribution significantly increases the carbon in the soil.

In the project proposal, only carbon sinks in the above-ground and underground biomes were considered as major carbon pool. Likewise, it stands out how other reservoirs such as dead wood, litter and organic carbon from the soil, carry out an important role in the carbon balances in the project proposal, however at the time of the project formulation only direct monitoring processes were considered generating high uncertainty in the estimation process, which is why they were not considered until they had elements of their follow-up through other tools. With the AR-ACM00003 methodology and its methodological tools, provides mechanisms for estimating this component indirectly through factors, which are accommodated and adjusted in the current project.

Source		GHG	Included?	Justification/Explanation
Baseline	Burning of biomass (AR-AM0004)	CO_2	No	Regarding the emissions from the burning of woody material, as previously described, it is unlikely that these emissions will be generated since the predominant coverage is degraded pastures.
		CH_4	Yes	Regarding the emissions from the burning of woody material, as previously described, it is unlikely that these emissions will be generated since the predominant coverage is degraded pastures.

Source		GHG	Included?	Justification/Explanation
		N_2O	Yes	Regarding the emissions from the burning of woody material, as previously described, it is unlikely that these emissions will be generated since the predominant coverage is degraded pastures.
	Removal of preexisting woody vegetation (AR-ACM0003)	CO_2	No	Carbon stock decreases due to burning are accounted as a carbon stock change.
		CH_4	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology.
		N_2O	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology.
Project activity	Biomass burning	CO_2	No	Carbon stock decreases due to burning are accounted as a carbon stock change
		CH_4	Yes	Non-CO2 gas emitted from wood biomass burning. However, in the project activity there will be no wood biomass burning for site preparation or for forest management.
		N_2O	No	Potential emission is negligible
	Removal of preexisting non-tree woody vegetation	CO_2	Yes	
		CH_4	Yes	
		N_2O	No	Potential emission is negligible

The methodology applied (AR-AM0004/Version 4) like AR-ACM0003 v2.0 methodology considers only one GHG emission by burning of biomass and woody biomass source within the project boundary, i.e., CH4 (Non-CO2 gas emitted from biomass burning). However, 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.

B.4. Establishment and description of baseline scenario

The conditions in baseline scenario areas are homogeneous. At the beginning of the project activity the vegetation cover is pastures and eroded soils, in which extensive cattle grazing (Land Management Plan, EOT 2000) has been and is the norm. Therefore, there is a single stratum in the baseline scenario: pasture grasses.

Approach to identify the most plausible baseline scenario:

Step 1*:* Demonstrate that the proposed A/R CDM forestry project activity meets the conditions under which the proposed methodology is applicable, and that baseline approach 22(a) can be used.

The applicability of the methodology selected (AR-AM0004/Version 04) and AR-ACM0003 was evaluated in Section C.2. The baseline approach was developed under 22 (a) of the CDM Modalities and Procedures / HR, which states that the effective variations with carbon pools within the project are the same as those that would have occurred due to land use. The baseline represents the continuation of the economic activities which have taken place historically, exist at present, and are unlikely to change in the absence of the project activity.

Step 2: *Define the project boundaries*.

It was shown in Section A.7 that the 7 nuclei are eligible for CDM using the tool (*"Procedures to Demonstrate the Eligibility of Lands for Afforestation and Reforestation CDM Project Activities"- Version 01*"). Under this procedure, 29,019 ha. are eligible in the 7 forest nuclei, of which 19,181.09 ha. are to de applied for the commercial model, 390 are planned to establish models of Assisted Natural Regeneration, and 9,447.78 ha. for Protected Natural Regeneration.

Step 3: *Analyze historical land use, local and sectoral land-use policies or regulations and land use alternatives.*

In general, government policies and incentives for reforestation have been very limited. Farming, cropping and cattle ranching have been promoted by policy and programs (Ministry of Agriculture and Rural Development, 2005[33]. Pg 17), but not commercial forestry. Restoration of natural forests has been promoted by policy, but not economically or financially.

As indicated above in sections A.2, A.5.1.3, C.2, and C.4.2, in the area of the project activity, lands have historically been devoted to extensive cattle ranching based on regular burning of pastures. This tendency has been expanding between 2001 and 2008, the area in the Orinoco in cattle pastures increased by more than 1.5 million hectares (Viloria, 2009[34], p54).

In the case of crops, soils have limitations and high costs related to low fertility, low organic matter content, low nutrient availability and low capacity to retain them. Consistently, it is estimated that only 2% of the soils of the locality are being exploited for agricultural activity. Small plots (conucos) for subsistence farming and other traditional crops such as cacao and sugarcane have been traditionally worked by the farmer and indigenous groups. These often deforest gallery forests with inadequate land management practices (CORPORINOQUIA, 2008). The alluvial soils near the larger rivers, though they flood regularly, are used selectively for crops like corn, bananas, cacao, sugarcane, rubber, pineapple, fruit and oil palm. Due to the low fertility of the degraded pasture areas, these cropping activities do not occur in them.

Nationally, before the project start date, there have been many laws and regulations related to the forestry sector, mostly oriented to conservation, but which have not been sufficient to encourage commercial forestry on a large scale. A national forest policy was espoused by national planning document *CONPES 2834, 1996* to be developed within the Environmental Policy framework. Given that the policy is strictly conservationist, the forestry industry has expressed the need to refresh it and to give more attention and guidelines to commercial forestry as a means to rural sustainable development and to combat poverty. Moreover, the state lacks a policy to govern of commercial forestry, with total clarity in the rules for the private investor is equally felt (Acosta 2004[35]). A more productive approach was adopted in 2000 under the National Forestry Development Plan. To implement this plan, there were some limited resources available to improve the competitiveness of the productive forest through research and development, but no funds were allocated for reforestation activities.

Colombian forestry legislation provides incentives to commercial reforestation through the Forestry Incentive Certificate (CIF) under Law 139 of 1994. However, the impact of this incentive has not been significant and effective in its aim to promote reforestation, due to high transaction costs and fact that the effectiveness of the incentive depends mainly on the availability of budgetary resources (Aldana 2004). When national fiscal resources become scarce, the CIF is often not funded due to other priorities.

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[33] MADR, 2005. La cadena Forestal y madera en Colombia. Una mirada global de su estructura y dinámica 1991-2005. Observatorio Agrocadenas, Colombia. Documento de trabajo No. 64.

[34] Viloria, 2009. Documento de trabajo sobre economía regional. Geografía económica de la Orinoquia.

[35] Acosta, 2004. Estudio de tendencias y perspectivas del Sector Forestal en América Latina Documento de Trabajo.

In conclusion, state policies and regulations have not successfully promoted reforestation in a significant manner. Cattle ranching continues to represent the most plausible land use scenario in the project area, due to the low investment required, custom and tradition, and the ease of land use[36].

Step 4: *Stratify the project area*

The project area will include three strata: Commercial tree stand model, Assisted Natural regeneration, and Protected Natural regeneration. The commercial stratum, as a result of the implementation of the monitoring, is sub stratified according to the accumulation of biomass. The substrata are defined as follows: Low, steady, middle and high development. The section C.3 defined the process of stratification.

Strata	Sub-strata	Area (ha)
Commercial	**LOW**	19,181.09
	STEADY	
	MIDDLE	
	HIGH	
	UPPER	
Assisted Natural regeneration		390
Protected Natural regeneration		9,447.78
Total		**29,019**

Step 5: *Determine the baseline land-use/land-cover scenario for each stratum.*

The baseline scenario is the same for each of the three strata. It is areas of degraded pasture, previously devoted to grazing activities, detailed in sections A.2, A.5.1.3, C.2, and C.4.2.

Figure B.1. Degradation of the soil in project areas

[36] According to Viloria 2009, the activity extensive livestock in the Orinoquia, It takes about 61 hectares to generate one employment in this activity.

Description of the identified baseline scenario:

The baseline scenario of the project activity corresponds to the pasture lands degraded by extensive cattle ranching and regular anthropogenic burning of grasses. Overall, the dominant species are herbaceous, grasses and some sedges, rushes and xyrydáceas, among which are: *Aristida sp. Axonopus purpusii, Axonopus fissifolius, Digitaria decumbens, Eragrostis maypurensis, Panicum sp., Paspalum sp. Trachypogon plumosus*, among others.

The vegetation covers in the project activity sites are degraded pasture grasses, burned grasses and scrublands. The predominant economic activity of the project area is based on extensive cattle ranching (90% of productive land in the Municipality of La Primavera is devoted to livestock), which is carried out throughout the eastern plains, and is characteristic of the Municipality La Primavera (Land Management Plan, EOT 2000). This activity is carried with an average of one animal per ten hectares. This activity usually lacks appropriate technological packages, generating high pressure on the grasslands and the only food and energy sources available for livestock. It leads to soil erosion and compaction, also, the introduction of non-native grasses for grazing cattle, produces the loss of biodiversity and land degradation[37]. As a result, it is reported that in some areas there is loss of capacity for natural regeneration of native flora of the region.

The combination of natural wildfires during periods of intense summer and regular anthropogenic grassland burning for cattle grazing degrade the soil, as minerals are lost and the physical conditions such as porosity, among others, are altered. Over–grazing and the lack of fertilization further deteriorate the soil. The degraded soils are washed out constantly by the heavy rains. The practice of grassland burning is carried out twice a year by cattle ranchers to obtain new grass re-sprouts which are palatable to the cattle and to the ranchers who seek to minimize their expenses. The regular burnings of pasture grasses prevent the accumulation of biomass and carbon in the areas involved. Gallery forests are also affected by the burning activities; uncontrolled flames often impact these forests causing the loss of forest density and reducing the area of forest cover. The regular burnings limit the ability of the native flora to naturally recover.

Figure B.2. Grassland areas devoted to extensive cattle farming in the area of the project activity, including the activities of regular burning and regeneration of grasses.

B.5. Demonstration of additionality

The evaluation and demonstration of additionality of the Project Activity was conducted using the "*Tool for the Demonstration and Assessment of Additionality in A / R CDM Project Activities "Version 02*[38].

STEP 0. Preliminary screening based on the starting date of the A / R project activity:

[37] Romero M., Galindo G., Otero J., Armenteros, D. 2004. Ecosistemas de la Cuenca del Orinoco Colombiano. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Bogotá. Colombia. 189p.

[38] http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-01-v2.pdf

The Colombian government has long attempted to promote forestry as a means of social and economic development of the distant eastern plains of Colombia. As indicated below, major barriers, high costs and risks have severely limited forestry investment in the region. This began to change in with new government programs focusing on the high potential carbon sequestration and publication of two major studies in 2004 and 2005 by the Presidency and the Ministry of Agriculture and Rural Development, which identified and promoted the CDM and the carbon markets as an additional income source that could make forestry investments in the High Orinoco more viable. The investors involved in this project activity were approached by the Ministry of Agriculture during this period and they responded positively, deciding to carry out a CDM forestry project, which began activities on June 2, 2005.

In 1999, national research center CORPOICA developed the study "Environmental Zoning as a Strategy for Environmental Planning of Agro forestry and the Recover and Conservation of Natural Resources" in areas of the *Llanos Orientales* and developed (Bustamante 1999)[39]. The study included the municipality of La Primavera and discussed a wide range of possibilities for land use including agro forestry. It indicated that a proper interpretation of technologies could support sustainable development, but that technical accompaniment and careful socio-cultural and economic characterization was needed to enhance the conservation of strategic areas.

In his first term beginning in 2002, President Alvaro Uribe promoted the High Orinoco (from the right bank of the Meta River from Puerto Lopez (Meta) to Puerto Carreño (Vichada) as a pole of economic development through conversion of extensive cattle ranching lands to reforestation, stressing the high employment benefits of forestry and the aptitude of the landscape. Forestry was promoted actively in the region by the government as of 2004. The program was entitled the "Rebirth of the Upper Orinoco region of Colombia: A mega-project for the World."[40] That year, the Ministry of Agriculture and Rural Development commissioned a feasibility study to evaluate the CDM as a new incentive for forestry: *"Implementation of CDM in the Renaissance of the High Orinoco Plains of Colombia".* It was published in 2005. The high potential for carbon sequestration identified in the study was communicated to potential investors and land owners by the Ministry of Agriculture, and the President visited Vichada several times to promote new investment. The Ministry and its research center CORPOICA generated and promoted a study entitled “An Agreement for the Formulation and Integral Evaluation of Agro Forestry Projects for the Sustainable Development of the Upper Orinoco of Colombia for the Benefit of the World” (Contract No. 008/2005, Convenio 004/2005, CORPOICA). That focused on the carbon sequestration capacity of developing forestry in the region, and identified viable species and production models.

Land owners and investors in Primavera Vichada were persuaded by the above-mentioned government programs and studies to invest in reforestation with carbon sequestration under CDM. The first tree plantings in the project activity took place on June 2, 2005, on the premises of Organización La Primavera S.A. The new CDM project activity was celebrated with the support and presence of Dr. Roberto Camacho representing the CDM Initiative of the Ministry of of Agriculture and Rural Development and the Director General of the Regional Environmental Authority of the Orinoco (CORPORINOQUIA), Dr. Orlando Piragauta (Figure B.3).

[39] La Zonificación Ambiental como Estrategia para la Planificación de los Sistemas Agroforestales y la Recuperación y Conservación de los Recursos Naturales http://www.fao.org/ag/AGA/AGAP/FRG/AFRIS/espanol/Document/AGROF99/BustamC.htm

[40] Ministerio de Agricultura y Desarrollo Rural. 2004. Renacimiento de la Orinoquia Alta de Colombia: Un Megaproyecto para el Mundo. Folleto divulgativo.

Figure B.3. Planting the first tree in the –*CDM Project for the Reforestation of productive biological corridors in the Llanos Orientales (Eastern Plains)"* on properties of the Organización La Primavera S.A. with Dr. Roberto Camacho of the Ministry of Agriculture (L), and Dr. Orlando Piragauta, Director of the regional environmental authority CORPORINOQUIA (R).

HISTORY OF CDM-RELATED ACTIVITIES, EVENTS AND DOCUMENTATION			
No.	DATE	DESCRIPTION	DOCUMENTATION
47	1-Jun-12	EVENT: Carbon Expo in Cologne, Germany. Participation of the project in the BioCarbon Fund/World Bank Stand, for promotion of the Clean Development Mechanism (CDM) project to buyers and investors of carbon certificates.	Photographs
46	5-Jun-12	EVENT: International day for the Environment. Socialization of the CDM project with the community of Primavera, Vichada.	Photographs
45	17-May-12	Official Correspondence Received: Letter from the Regional Environmental Authority CORPORINOQUIA thanking the project and recognizing its leadership in applying the CDM to forestry in the Vichada region.	Registered correspondence
44	10-May-12	CDM National Letter of Approval: Ministry of Environment/Designated National Authority (DNA) for Climate Change at the Ministry of Environment (MADS) emits National Letter of Approval for the CDM A/R Project.	MADS official LOA
43	10-Apr-12	Official Correspondence Received: Letter from PRIMAVERA'S MUNICIPAL OMBUDSMAN confirming that the responses to the questions from the community resulting from the stakeholder consultation, were published by the Mayor's from November the 11th of 2011 to November the 28th, and that no further comments were received.	Registered correspondence
42	15-Mar-12	Official Correspondence Received: Letter from the Designated National Authority confirming the inclusion of the Project on the CDM Project Portfolio to the Biocarbon Fund/World Bank, per the Project Participants request.	Registered correspondence
41	19-Oct-11	CERTIFICATION OF THE MINISTRY OF THE INTERIOR: Resolution that certificates the presence or absence of ethnic groups inside the Project, activities or construction areas to be implemented.	Resolution 156 / Oct 19th 2011
40	1-Sep-11	CDM Official Procedure: Technical Field Visit to the Project by the Designated National Authority's Forestry Director, required by the National Approval Process.	Photographs
39	19-Aug-11	CDM Non-Objection Letter: Letter from the Designated National Authority confirming no objection of the CDM component of the Project.	Registered correspondence
38	16-Aug-11	Letter of Invitation to DNA for site visit. Invitation letter addressed to the DNA Forestry Director (Lucio Santos) to carry out the Technical Field Visit to the CDM Project during the National Approval Process.	Registered correspondence
37	12-Aug-11	EVENT: EXPOPRIMAVERA (County Fair) August 2011. Project and CDM component socialization, presentations to stakeholders, with a stand at the Fair.	Attendance Record Photographs
36	12-Aug-11	CDM Stakeholder Consultation: Event, presentations, and meetings with stakeholders in accordance with requirements of the UNFCCC and Colombian Designated National Authority regulations for	Attendance Record; Photographs; CAEMA's Mission

		National Approval and CDM validation. Primavera, Vichada, during EXPOPRIMAVERA County Fair 12-15 august of 2011.	Record; Invitations; Stakeholder Surveys.
35	9-Jun-11	EVENT: International Convention and Exhibition AGROFUTURO, Medellin, Colombia. CDM Project Socialization and promotion to Investors and markets.	Attendance Record; Photographs.
34	2-Jun-11	EVENT: Cundinamarca's Regional Forestry Forum, State Government of Cundinamarca. Stand to promote CDM component of the project.	Attendance Record; Photographs
33	29-Mar-11	CDM STAKEHOLDER EVENT: Presentation of the PDD to the investors and shareholders of the 6 forestry nuclei, for comments and recommendations before initiating validation process. At Cité Hotel Bogota, Colombia.	Attendance Record Papers
32	1-Dec-10	EVENT: Presentation of the Project Activity's Research Program for Assisted Natural Regeneration (ANR) Models focusing on optimizing income from CDM carbon sequestration, in the High Orinoco landscape. CDM program presentation to key stakeholders including national authorities Colciencias, Agriculture Ministry, Environment Ministry, Central Bank of	Attendance Record; Photographs; PP Presentations;
31	4-Nov-10	Letter of invitation to key national institutions and stakeholders to an event for presentation of the Research Program of Assisted Natural Regeneration (ANR) Models focusing on the income for CDM carbon sequestration, on the High Orinoco.	Letter of invitation
30	26-Aug-10	EVENT: EXPOPRIMAVERA August 2010, Primavera, Vichada. CDM Project socialization to the community and stakeholders.	Attendance Record; Photographs
29	1-Jun-10	Receipt of technical proposals for the CDM Project stakeholder consultation and project socialization process.	Technical proposal CyB
28	9-Jun-10	EVENT: International Convention and Exhibition AGROFUTURO Medellin. CDM project socialization and promotion to markets and potential investors.	Attendance Record Photographs
27	28-May-10	CDM Meeting with the Regional Environmental Authority CORPORINOQUIA to present and discuss the —CDM PROJECT FOR FORESTRY RESTORATION IN PRODUCTIVE AND BIOLOGICAL CORRIDORS IN THE EASTERN PLAINS OF COLOMBIA‖	Official letter received from Corporinoquia
26	1-May-10	CDM Formulation Visit: part of a series of visits by CAEMA's CDM technical advisory team to the forestry project in La Primavera to carry out PDD formulation activities and for the preparation of the validation audit.	Photographs and CAEMA's record of trip
25	1-Aug-09	EVENT: EXPOPRIMAVERA August 2009. Project Participation in Regional Agrobusiness Fair. Presentations to the public on the Project and its CDM component. Project socialization to the community and stakeholders.	Photographs
24	5-Jun-09	EVENT: International day for the Environment at Primavera Vichada. Preparation of a flyer about the forestry Project and its CDM component.	Flyer
23	12-Mar-09	EVENT: Formal presentation of the Regulatory, Economic, and Technical Study of the CDM Project to the shareholders and investors of the project.	Attendance Record; Photographs; PPt Presentations.
22	1-Feb-09	CAEMA Regulatory, Economic, and Technical Study for the implementation of the CDM Project to the —CDM PROJECT FOR FORESTRY RESTORATION IN PRODUCTIVE AND BIOLOGICAL CORRIDORS IN THE EASTERN PLAINS OF COLOMBIA‖ Final Report	Final Report
21	16-Jan-09	Invitation letter from the Project Manager to the President of the CE WOOD company in the Czech Republic to visit the forestry projects and to attend to the presentation of the Feasibility Study for the implementation of the CDM Project.	Registered correspondence
20	15-Dec-08	Pre-feasibility report for the Application of the CDM.	Technical Report
19	10-Dec-08	Letter from CORPORINOQUIA sent on November the 10th, confirming the support from this institution to every effort and activity involved on the CDM Project.	Official Correspondence
18	1-Nov-08	Letter to CORPORINOQUIA thanking them for their collaboration and institutional support, letting us to access the mapping information and tools needed for the formulation of the CDM Project.	Registered correspondence
17	17-Oct-08	CAEMA'S PRESENTATION OF THE CDM FORESTRY PROJECT TO MR. CERNY, PRESIDENT of CE WOOD FROM PRAGUE, CZECH REPUBLIC, seeking international investment in the project, focusing on the CDM component.	CAEMA International Mission Report
16	10-Oct-08	Letter from the Project Manager granting Thomas Black auth ority to	Registered

		present the Forestry Project and its CDM component to international investors (Czech Republic) CE WOOD.	correspondence
15	2-Sep-08	Letter of Presentation of the —CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia‖ to the Mayor of Primavera, Vichada, Mr. Kennedy Sánchez Godoy.	Official communication received by the Mayor's office.
14	30-Jul-08	EVENT: Shareholders meeting to inform them of the initiation of the pre-Feasibility Study of the CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia	Attendance Record; Photographs
13	31-Oct-07	Letter from the Project manager to communicate to investors at CORPOVERDE about the number of hectares to be included on the CAEMA's pre-Feasibility Study.	Registered correspondence
12	1-May-07	Technical Proposal from CyB to develop the Feasibility Study for the implementation of the CDM in the selected areas of La Primavera, Vichada, Colombian Orinoco.	Proposal for consideration of the shareholders
11	13-Jan-07	Bosques de la Orinoquia S.A. Shareholders Annual Ordinary Assembly. Presentations regarding the CDM activities being developed and the steps to being followed by the company to apply the CDM correctly.	Record of the Meeting of Shareholders
10		Forestry Establishment Plan Presented to the Ministry of Agriculture and Rural Development in order to access the CIF (Forestry Incentive Certificate), with reference to the CDM, with letter of presentation received by the Ministry.	Forestry Management Plan & registered correspondence
9	23-Sep-06	La Primavera S.A. Organization, Annual Shareholders Ordinary Assembly. Presentations on the CDM activities being developed and the steps to follow by the company to apply the CDM.	Record of the Meeting of Shareholders
8	27-Sep-05	La Primavera S.A Organization's Certificate of Existence and Legal Representation. The social objective in the Certificate includes the role of CDM in the forestry project.	Existence certificated
7	8-Jul-05	001 Committee Record of Meeting, La Primavera S.A Organization. Setting up the CDM work team, goals and activities to develop the CDM component during the project life time.	Record of meeting
6	12-Jun-05	El Espectador National Newspaper report "Una Aventura Agroambiental" (An Agro environmental Adventure‖) On the event which launched the Project, the participants, including details on the role of the CDM in the project.	Newspaper clipping
5	2-Jun-05	**EVENT**: Launch of the Project Activity: La Primavera S.A Organization's event invited dozens of institutional and community stakeholders to launch the project, including the Ministry of Agriculture's Director of CDM. Specific references to the CDM's key role in the project from the Ministry of Agriculture are clearly observed in the video.	Photographs; Video
4	27-May-05	Official Record of Incorporation of La Primavera S.A. Organization. The social objective in the Certificate includes the role of CDM in the forestry project.	Public Instrument, at Notary Public 28 of Bogotá
3	6-May-05	Letter from the Project manager to regional environmental authority CORPORINOQUIA establishing that Anisol Ltda, Amparo Mora, Carlos Eduardo Garzón, Héctor Moisés Camacho, Clara Patricia Agudelo, Edwin Agudelo, Elkín Rodriguez are participants in property that belongs to a project nucleus of 2.800 hectares that form part of the CDM Project.	Registered correspondence to CORPORINOQUIA to Access to Forestry Certificate CIF, link to the CDM
2	20-Apr-05	Letter from BEATRIZ HELENA BARBOSA, a political and social leader of the municipality La Primavera, Vichada, regarding the beginning of the Project and looking forward to the improvement of the environment and the carbon sales from the CDM component.	Registered correspondence
1	1-Apr-05	Letter from the CATTLE RANCHERS ASSOCIATION expressing questions regarding the involvement of natural forests by establishing forest plantations and asking about the CDM component of the project.	Registered correspondence

Step 1: Identification of alternative land use scenarios to the A / R project activity.

The non-forested soils of the area have been degraded due to extensive grazing and burning practices, activities that have intensified and expanded progressively through the years. Natural and anthropogenic burning of grasslands, intense periods of drought and flooding, high winds, and low

soil fertility characterize the region and influence land use. As indicated throughout the PDD, the predominant alternative land use scenario to the project activity is cattle ranching.

For the area of the project activity, the aptitude for crops is limited given the low fertility, low nutrient availability and low capacity to retain them. The few crops presents are typically for subsistence and are located in small plots –conucos‖ on the banks of streams, often cleared from within tracts of gallery forest (Land Management Plan, EOT 2000).

As indicated above, the government has promoted the Orinoco region for commercial forestry since the early 1990s. The National Geographic Institute Augustin Codazzi has classified the area as appropriate for forestry activities, both for conservation/protection and for production (IGAC 1992). The National Institute for Forestry Research CONIF published the *"Guide for Commercial Forest Plantations in the Orinoco Region"* which mapped the areas with aptitude for commercial plantations in the region. Using the information on soil types, climate, and land use from the Regional Environmental Authority CORPORINOQUIA, the study identified a total of 5,954,962 ha. as suitable for reforestation in the departments of Casanare, Meta and Vichada.

Cattle raising and reforestation were the main land use activities promoted in the Plan of Development for the Vichada region (2008)[41]. For livestock, the development plan seeks to provide technical and economical tools to technify the sector based on the support policies provided by the Ministry of Agriculture to improve the breeding stocks, increase the export potential and reconvert parts of the sector to milk production (Department of Vichada 2008). In the case of forestry, the plan emphasizes planting native species that support the rational use of environmental services and the conservation of biodiversity. It also promotes joint development of projects with indigenous communities (Department of Vichada 2008).

Step 2: Investment Analysis. Investment analysis is not undertaken in this PDD.

Step 3: Analysis of barriers.

Investment barriers

In Colombia, obtaining long term financing for forestry is difficult and costly, due to the high perceived risks and high costs of working in forestry in this remote region. There is no guarantee fund to allow banks or investors to reduce the risks of participating in forestry projects as a financial partner (Marin 2009[42]). Of all agricultural financing lines, forestry credit is perhaps one of the most complex and constitutes a challenge for economists and bankers. There are few credit alternatives that actually conform to the needs of reforestation (Marín 2010[43]). Historically, most commercial reforestation efforts in Colombia have formed their own resources. (Marín 2010). Commercial reforestation is supported by limited tax incentives and benefits granted by the State, which, though valuable, are irregular (depending on government budget priorities year to year) and are insufficient for the sector to grow at the speed needed (Marin 2010). Financial intermediaries have little knowledge of the sector and perceive it to be high-risk. This has been further affected by the legal vacuum left by the declaration of unconstitutionality of the General Forestry Law in January 2008, a main cause of the reluctance of banks to expand credit lines for forestry projects (Marín 2010). Bank credit lines are limited medium-term loans with high rates that do not conform to the characteristics and needs of this activity (Marín 2010).

As a result, reforestation is a marginal activity in the country, as reflected in the lack of importance of the sector in the national economy. Despite the large expanse of natural forests and the great

[41] Departamento de Vichada, 2008. Plan de desarrollo de Vichada.

[42] Marín, C. 2009. Inversión Forestal Es el Momento Ideal para Avanzar.

[43] Marín, C. 2010. Financiación Forestal, Estímulos y Exenciones.

potential for forest plantations, the contribution of forestry and logging to agricultural GDP is only 1.2% and is only 0.2% of national GDP. The jobs generated annually are only 1% of the employment jointly generated by the agriculture and agribusiness sectors (Acosta 2004). This indicates the marginal contribution of forestry within the national economic sectors. For this reason, it is normal to find that major publications regarding the economic performance data of the agriculture sector do not include statistics for the forestry sub-sector (Acosta 2004).

If investment in forestry is difficult throughout Colombia, consolidating investment is much more difficult for the Vichada region, which investors and banks perceive as remote, difficult to access, lacking infrastructure, costly to manage and costly to extract lumber and products.

The strong push from national and regional government institutions to promote and implement CDM in forestry in the High Orinoco region signaled strong government support and presence to accompany new projects, which was absent before, and has been an important support for investment in this project activity. The National Government created and promoted a major new program for CDM forestry development for the region entitled –THE RENAISSANCE OF THE ORINOCO RIVER SAVANNAHS: A COLOMBIAN MEGA PROJECT FOR THE WORLD**II**[44] which identified forestry carbon sequestration as a key incentive for new forestry activities in the region, stating: *"This mega project is aimed at creating the world's largest carbon dioxide sink in recent history, with the potential to sequester 25 tons of carbon dioxide per hectare per year through reforestation. That is, a potential to sequester 7,900 million tons of carbon dioxide over a 50-year period (section 11)"*.

The Ministry of Agriculture and Rural Development commissioned a major feasibility study to apply the CDM in four large areas of the High Orinoco, which quantified the contribution of the CDM to the forestry activities. The report by the Ministry of Agriculture and Rural Development, "*Aplicacion del Mecanismo de Desarrollo Limpio al Proyecto Renacimiento de la Orinoquia Alta de Colombia"* (CAEMA, 2004-5) was a key driver for the investors in this Project activity. The director of CDM from the Ministry of Agriculture and the Director of the Regional Environmental Authority Corporinoquia signaled their support regionally by attending the launch event of the project activity, and have continually supported the project throughout its development, as is demonstrated in the above table, (History of CDM-Related Activities, Events and Documentation). The strong support from the national and regional governments has thus been a positive force in reducing the investment barrier, because investors and bankers perceive less risk because of this strong support.

The investment barrier does not affect the baseline case: investment in extensive cattle ranching is facilitated because of the long and proven experience of this economic activity in the eastern plains. For over a century rancher has produced millions of head of cattle from the eastern plains, demonstrating to investors that all the risks and barriers can be managed using the traditional ranching model. The taxes collected from sales and transport of cattle in the municipality represent 23% of total tax incomes[45]. Additionally, small producers have the possibility to obtain loans through the local Agrarian Bank (Banco Agrario Colombiano), in order to increment the size of their landholdings and their cattle stock, in order to fortify their economic base[46].

Barriers due to social conditions

High security risks from illegal armed groups and drug cultivation.

Violence between armed groups and illicit drug cultivation have been prevalent in the Vichada since the early 1990s, creating very high risks to investment. The remoteness and high indices of

[44] http://www.minagricultura.gov.co/archivos/cartilla%20orinoco%20completa.pdf

[45] Municipio de La Primavera, Vichada. 2004. Plan de Desarrollo Municipal 2004-2007.

[46] Esquema de ordenamiento municipal. Municipio de La Primavera. 2000. Dimensión económica.

unsatisfied basic needs in the towns (41.94%) and the rural areas (84.4%) (Dane, 2005), have made this territory a haven for cultivation and processing of coca, arms trafficking and the flourishing of illegal armed groups, both from the left and the right[47]. Security risks are a major barrier to investment, and the practice of kidnapping by violent groups compounds the risks. The 16th Front of the FARC and the Paramilitary Auto-defense groups have fought for dominion of the area because they consider the region strategic for the cultivation, processing and commercialization of coca. The principal victims of kidnapping and violence have been the national armed forces who are fighting to regain control of the region, cattlemen, farmers and public servants. Kidnapping in this area has been used to finance the illicit groups and to debilitate the state presence in the area[48]

The strong support from the national government institutions promoting and backing CDM forestry in the region has thus been a positive force in reducing the security barrier, because investors and bankers perceive less risk because of this strong support. The government has been responsive to the project owners and has established a military base in the region.

In contrast, extensive cattle ranching has long coexisted with the violent armed groups and illegal crop cultivation, and although these have been negative forces, they have coexisted for decades.

Lack of skilled labor

Another key social barrier has to do with the shortage of skilled labor in the area for reforestation activities. The few communities that inhabit the area do not have experience in reforestation. Their economic activity is based primarily on cattle, fishing and subsistence farming. There is no local supply of labor with experience in forestry, so training is more costly and skilled labor must be paid a higher wage to move them from other regions of the country to this remote region. The population density in the department of Vichada is very low (1.8 inhabitants per Km^2) and therefore insufficient to supply the labor requirements of the project activity.

The application of the CDM imposes rigor and capacity building into the project. The CDM process introduces improved organizational, management, accounting, monitoring and measurement techniques, software, hardware and communication systems, which strengthen the project's skill level. This in effect reduces the skill barrier.

While traditional cattle ranching requires one person for the management of 100 ha, forestry activities require one person to manage 10 ha (Organización La Primavera S.A. 2006). Social conditions are adequate for extensive cattle ranching: watching over and herding of cattle is done by any local worker, regardless of level of education and training. In the same way, technical assistance is available to them through the UMATA (Municipal Unit for Agricultural Technical Assistance of the township of Primavera, the Colombian Agicultural Institute ICA, and the local Cattle Association[49]. In contrast, commercial forestry requires a team of trained foresters for genetic and phytosanitary management of the nurseries and plantations, skilled workers to harvest and process the lumber, and administrators and managers to run the business.

Infrastructure Barriers

Primavera, Vichada is a remote region, far from the urban and productive centers of the country, with very poor transport infrastructure to connect with domestic or international markets. Financial revenues from carbon sequestration will help investors to offset the risks of investing in

[47] Misión de Observación electoral y Corporación Arco Iris, 2008. Monografía Político Electoral del Departamento de Vichada 1997 a 2007.

[48] Ibid, p. 15.

[49] Municipal Land Use Planning. Municipio de La Primavera. 2000. Economic Dimension

the area and the high costs of accessing distant markets for the future sale of timber and the development of products made of tropical woods. If the government fails to build highways and river transport infrastructure to the region, the transport costs of taking the lumber to market may outweigh its value, and the sale of certificates of emission reduction may end up being the primary source of income to the project.

There is no infrastructure for commercial or forestry industry activities in the region. No forestry sawmills, lumber drying plants, organized carpentry or furniture manufacturing exist in Vichada. The components of a forestry industry chain are not present. These are all significant barriers to new investment in forestry.

The lack of transport infrastructure is the most severe barrier. As demonstrated below, the lack of roads and railways, and poor river navigation infrastructure, raise the costs for access to the site, and from the site to lumber markets. The few existing roads are in poor condition and are often impassable in the rainy season (Viloria of Hoz 2009).

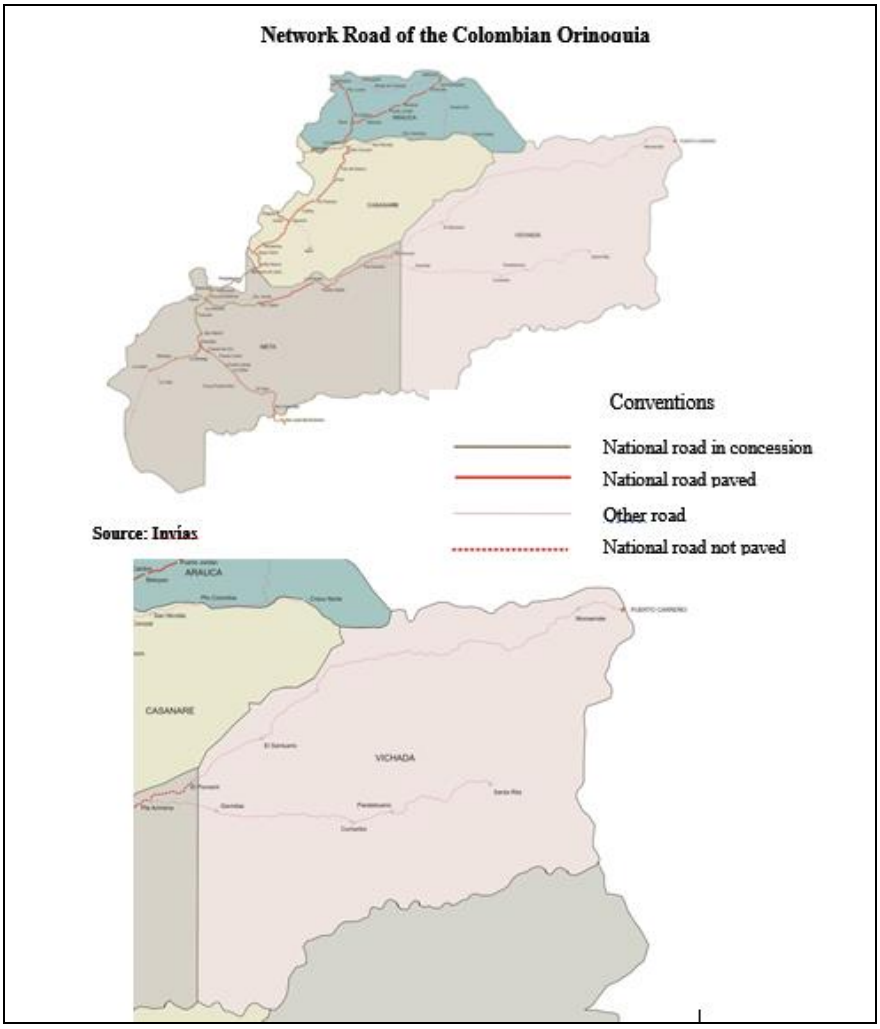

Figure B.4. Road network of the Colombian Orinoco region and the Department of Vichada. Source: Ministry of Transport, National Roads Institute (INVIAS), 2006.

Table B.1. Number of roads in the Department of Vichada.

Networks	Km	Traffic (%)	
		Dry Season	Rainy Season
Secondary	1670	95	25
Tertiary	835	85	15

Source: Development Plan 2008 – 2011[50]

The poor transportation infrastructure constitutes a costly constraint to the project activity because it hinders and prevents displacement of personnel, increases the costs of all-silvicultural practices and timber harvesting, and increases the travel time of all access routes (Figures B.5, B.6, B.7). These adverse conditions represent an important barrier that must be overcome by the technical staff to reach the plantations and carry equipment, materials, technology and tools needed for the work. They impact directly on project profitability and competitiveness.

Figure B.5. National roadway that traverses the Department of Vichada.

Figure B.6. Common difficulties faced in the project region to transport personnel and equipment.

Figure B.7. Common difficulties faced in the project region to transport personnel and equipment, due to bad road conditions.

[50] Departamento de Vichada, 2008. Plan de desarrollo de Vichada 2008_2011.

The application of the CDM is an important asset to the project, one that helps to overcome the infrastructure barrier: the investors have clearly stated that even if the roads and bridges promised by the central government are never built, limiting the ability to transport the lumber and products to international and national markets, the project would still have a long-term income from the sequestration of carbon and sales of tCER´s that would help to offset costs and repay debts. If the transport infrastructure does not materialize, they would not harvest the forests; instead they would continue to sequester atmospheric carbon and maximize the sequestration capacity of the forestry project during the entire accreditation period (3 x 20yrs).

Extensive cattle ranching is not limited by the infrastructure barriers that limit the project activity. Cattle are traditionally herded by men on horseback across the eastern plains from farm to farm, town to town, and market to market: paved roads, bridges, electricity, processing plants nor public services have not been necessary to carry out this activity since it began well over a century ago. Cattle markets exist in every town and city, cattle buyers come to the landowners, and transactions are easily carried out in Primavera or in Bogotá, where most of the landowners live. In contrast, paved roads, bridges, electricity, public services and processing plants are necessary for a commercial lumber and wood products venture. Harvesting, processing, and transporting the wood to market is severely limited by the lack of infrastructure.

B.6. Estimation of net anthropogenic removals

B.6.1. Explanation of methodological choices

1. Estimation of the ex-ante baseline net GHG removals by sinks

The vegetation covers in the project activity sites are pasture grasses, burned grasses and scrublands (Section A.7). 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 grassland burning for cattle grazing degrade the soil, as minerals are lost and the physical conditions such as porosity, among others, are altered. The practice of grassland burning is carried out twice a year by cattle ranchers to obtain new grass re-sprouts which are palatable to the cattle and to the ranchers who seek to minimize their expenses. The regular burnings of pasture grasses prevent the accumulation of biomass and carbon in the areas involved. The regular burnings limit the ability of the native flora to naturally recover.

Besides, according to the economic tradition and social conditions in the region the baseline represents the continuation of the economic activities which have taken place historically, at present, and are unlikely to change in the absence of the project activity.

Therefore, as per the conditions under the proposed project, lands to be afforested or reforested are degraded lands, subjected to pre-project grazing activity, with vegetation having area, crown cover and tree high values below the thresholds used in the national definition of forest, and the lands are still degrading or remaining in a low carbon steady state. For this reason, in the baseline scenario of the project:

a. There is no presence of trees or woody vegetation.
b. During the crediting period considered, there would not be residual trees or woody vegetation that would start growing.

Therefore, Equation 1 of AR-AM0004/Version 04 determines the net CO_2 removals in the baseline scenario:

$$C_{BSL} = 0 \text{ for all } t^* \leq tcp \qquad \text{(Ec. 1 AR-AM0004/Version 04)}$$

Where:

C_{BSL} = net GHG removals in baseline scenario; t CO2-e
t^* = Number of years since starting date of CDM forestry activity; years
tcp = Year when first crediting period ends; year.

According to the AR-ACM0003 methodology and the tool "Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" $C_{BSL} = 0$ is equal to the estimate of:

$GHG_{SPF,t} = 0$ (EC. 2 Tool/ V04.0.0).

Where:
$GHG_{SPF,t}$ Emission of non-CO2 GHGs resulting from use of fire in site preparation in year t; t CO2-e.

The foregoing is demonstrated with the historical analysis, which shows the periodic burns suffered by the project areas, prior to its implementation, for which it meets this condition, likewise it is reiterated that burning is not a practice for the project. management of waste resulting from management activities and are prohibited by law in Colombian territory.

And, *GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as* **zero. (AR-ACM0003).**

It is expected that net removals in the baseline scenario would be negative due to the continuous process of soil degradation. However, the methodology conservatively assumes that these are equal to zero.

2. Ex ante estimation of actual net GHG removals by sinks

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 equations 13 and 14 of methodology AR-AM0004/Version 04.

$$C_{ACTUAL} = \Delta C_{P,LB} - GHG_E \qquad \text{(Eq 13) and (Eq 2, AR-ACM0003)}$$

$\Delta C_{P,LB}$ = changes in carbon stored in the living tree biomass compartments in the project activity scenario; t CO_2-e
GHG_E = sum of the increments in GHG emissions within the project scope attributable to the project implementation; t CO2-e.

$$\Delta C_{P,LB} = \Delta C_{P,LB} - E_{biomassloss} \qquad \textit{(Eq.14)}$$

$$\Delta C_{P,LB_T} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{BL}} \sum_{k=1}^{K_P} \Delta C_{P,LB,ikt} \qquad \text{(Eq. 16)}$$

$\Delta C_{P.LB}$ = 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,…mBL

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.

For its part, the AR-ACM0003 V02.0 methodology determines this balance as:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t} \quad \text{(Eq. 2, AR-ACM0003)}$$

Where:

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year *t*; t CO_2-e

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e

$GHG_{E,t}$ = Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

- ***Stored carbon, volume and biomass estimates***

The carbon content stored by the tree species at different ages was estimated via dendrometric information (*e.g.* diameter, height, wood density and volume) published for each of them in the technical literature. Where possible, we applied the von Bertalanffy model (von Bertalanffy 1976[51], Zeide 1993[52], Lei & Zhang 2004[53]) using raw data from the measurement of permanent and consigned monitoring plots from relevant studies in Colombia (CONIF *s.f*, Correa *et al*. 2000[54], Laguado 2004[55], Riaño *et al*. 2004[56], USDA 2006b[57], Vega and Gonzalez 2003[58], Peter 1993[59]). When the existing data was not sufficient to adjust the model, we used the average annual increases and the carbon asymptotes of each species to adjust the von Bertalanffy model through mathematical approximation (Lei & Zhang 2004). This approximation is accepted by the IPCC Good Practices Guide (2003), although it may produce overestimation when using information from tree stands at an early age, or underestimation in data from later years. From the carbon accumulation curve and by using accepted expansion factors (Brown 1997[60], IPCC 2003[61]) we were able to obtain the biomass values and the related volume equations.

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[51] VON BERTALANFFY, L. 1976. General system theory. George Braziller. New York.

[52] ZEIDE, B. 1993. Analysis of Growth Equations. Forest Science 39(3): 594-616

[53] LEI, Y. C., AND S. Y. ZHANG. 2004. Features and Partial Derivatives of Bertalanffy-Richards Growth Model in Forestry. Nonlinear Analysis: Modelling and control 1(9): 65-73.

[54] CORREA, J. E., H. I. RESTREPO, O. A. SÁENS Y J. C. SÁNCHEZ. 2000. Evaluación de las plantaciones de *Acacia mangium* en áreas degradadas del Bajo Cauca antioqueño Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA) – Universidad Nacional de Colombia Sede Medellín

[55] LAGUADO, W.G. 2004. Viabilidad ambiental y financiero de los sistemas silvopastoriles del bajo Cauca Antioqueño como parte del Mecanismo de Desarrollo Limpio. Trabajo de Grado. Universidad Nacional de Colombia, Sede Medellín.

[56] RIAÑO, N., C. OSPINA, L. GÓMEZ, J. LÓPEZ, C. URREGO, O. OSORIO, D. BONILLA Y G. TANGARIFE. 2004. Asistencia técnica al desarrollo del sector forestal a nivel nacional. Componente: Determinación de la capacidad de captura de carbono en ocho especies forestales. Informe Final. Corporación Nacional de Fomento Forestal (CONIF) – Centro Nacional de Investigaciones de Café.

[57] USDA FOREST SERVICE. 2006b. Washington. *Tectona grandis*.

[58] VEGA, L. Y GONZÁLEZ, H. 2003. Evaluación del crecimiento de especies forestales de mayor uso comercial en el país establecidas bajo el convenio MADR-CONIF. Análisis a partir de la Red de Parcelas de Cerecimiento. Informe Técnico. Corporación Nacional de Fomento Forestal (CONIF).

[59] Peter 1993. *Tectona grandis* L. f.

[60] BROWN, S. 1997. Estimating biomass and biomass change of tropical forest. FAO forestry paper 134. FAO. Rome.

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

Carbon accumulation equations were created for the proposed stand models using information taken from existing scientific literature and giving priority to the information reported for Colombia. Additionally, the adjustment of Bertalanffy type equations was used as a resource employing available information. The species, the carbon accumulation equations, the parameters and sources consulted are presented in Table B.2.

Table B.2.Regresion parameters of the carbon accumulation functions in relation to time, for the species of the commercial tree stand model. Letters A and b are the regression parameters, c = 1/1-m, where m = 2/3.

Species	Model			Value (R^2%)	Data source
	A	b	c		
Acacia mangium	84.93	0.31	3.00	0.45	Correa *et al*. (2000), Laguado (2004)
Eucalyptus pellita	47.26	0.36	3.00	0.70	Riaño *et al.* (2004)
Pinus caribaea[a]	156.66	0.12	3.00	_	Vega y González 2003
Tectona grandis[a]	109.09	0.184	3.00	-	CONIF (*s.f.*), USDA (2006b), Peter 1993,Trujillo 2007.
Pioneer exclusion	12.8	0.44	3.00	-	Arias *et. al*. 2009[62]; Casanova *et al*. 2010[63]; El Semillero, IPCC 2003; Conabio 1987[64]
Pioneer inclusion[a]	122.3	0.316	3.00	-	Montagnini et. al. 2003[65]; IPCC 2003
Late stage species[a]	50.97	0.388	3.00	-	Montagnini et. al. 2003; IPCC 2003
	B ($t*ha^{-1}$)		**IMA C ($tC*ha^{-1}*año^{-1}$)**		
PNR	280.88		1.66		Martinez *et al*. 2006[66]

[a] Model obtained through mathematical approximation.

For each species, we generated a representative volume curve (Figure B.8). The total curve of the commercial stand model was obtained by adding the volumes of each species weighted by the participation of this species with respect to the total project area.

In the case of the models for assisted natural regeneration (ANR) and protected natural regeneration (PNR), estimates are based on the capacity of the ecosystem and the type of species present in the ANR model (nurses, pioneers and late stage).

[61] INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC). 2003. Good practice guidance for land use, land – use change and forestry. Institute for global environmental strategies of IPCC, Hayama.

[62] Arias, L., Camargo, J.C., Dossman, M., Echeverry M., Rodríguez J. Molina C. Molina E. & I. Melo. 2009. Estimación de biomasa aérea y desarrollo de modelos alométricos para *Leucaena leucocephala* en sistemas silvopastoriles de alta densidad en el valle del Cauca, Colombia. Recursos Naturales y Ambiente/no.58: 32-39.

[63] Casanova F., Caamal J., Petit J., Solorio F. y J. Castillo. 2010. Acumulación de carbono en la biomasa de *Leucaena leucocephala y Guazuma ulmifolia* asociadas y en monocultivo. Revista Forestal Venezolana, Año XLIV, Vol 541(1). Pp 45-50.

[64] Conabio. 1987. *Leucaena leucocephala.*

[65] Montagnini F., Ugalde L. and C. Navarro. 2003. Growth characteristics of some native tree species used in silvopastoral systems in the humid lowlands of Costa Rica. Agroforestry Systems 59: 163–170, 2003.

[66] Ramírez H., Ablan M., Torres A. y M. Acevedo. 2006. Simulación de la dinámica de un bosque tropical en los llanos occidentales de Venezuela. Interciencia Vol 31. No.2.

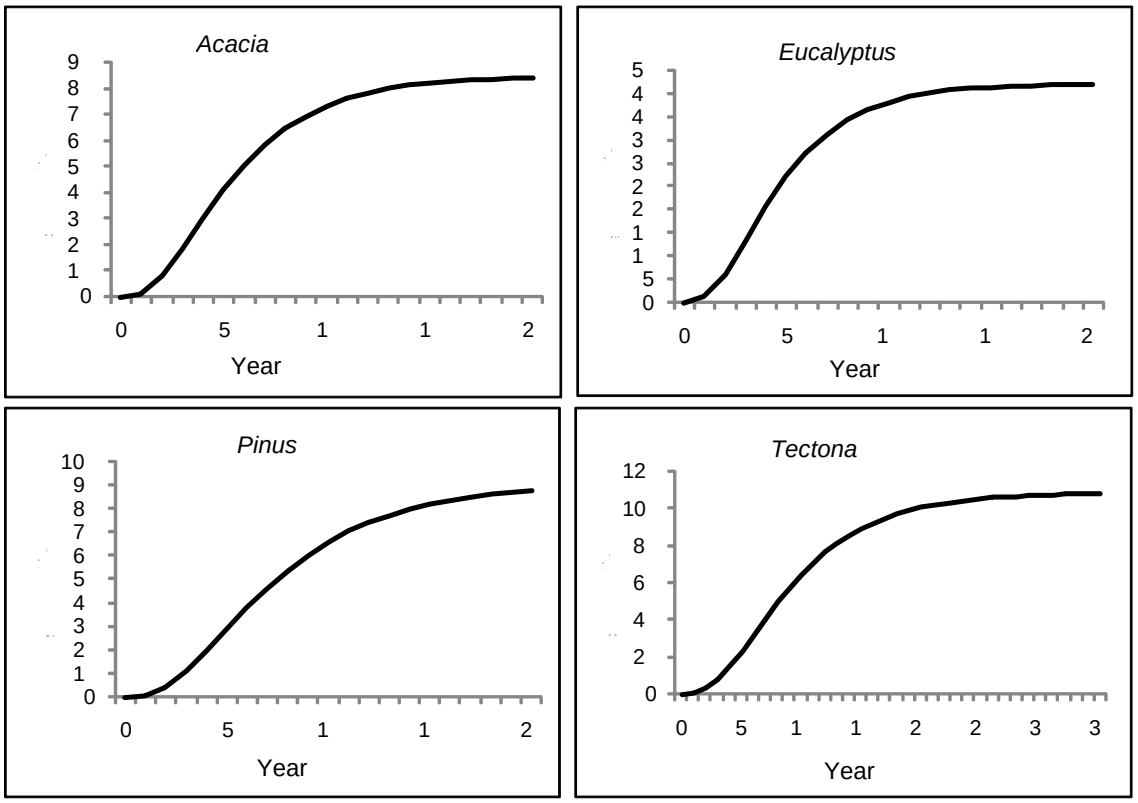

Figure B.8. Growth curves for the forest species included in project activity; the models were obtained after adjusting the von Bertalanffy equations.

Finally, the changes in living biomass carbon stocks are estimated using the stock change method as proposed in the applied methodology AR-AM0004 / Version 04. Thus, the equations (9) to (11) are used

$$C_{ikt} = C_{AB,ijt} + C_{BB,ijt}$$

$$C_{AB,ijt} = A_{ijt} \cdot V_{ijt} \cdot D_j \cdot BEF_{2,j}$$

$$C_{BB,ijt} = C_{AB,ijt} \cdot R_j$$

Where:

C_{ikt}	Carbon stock in living biomass for stratum *i,* stand model *k*, time *t*; t C
C_{ABijt}	Carbon stock in above-ground biomass for stratum *i,* species *j*, at time *t*; t C
C_{ABijt}	Carbon stock in below-ground biomass for stratum *i,* species *j*, at time *t*; t C
V_{ijt}	Average merchantable volume of stratum *i,* species *j*, at time *t*; m^3 ha^{-1}
D_j	Basic wood density of species *j*; t d.m. m^{-3} merchantable volume
BEF_{2j}	Biomass expansion factor for conversion of merchantable volume to above-ground tree biomass for species *j*; dimensionless
Rj	Root-shoot ratio for species *j*; dimensionless

- ***Removed biomass (Ebiomassloss)***

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.

- ***Treatment of pre-existing vegetation***

Given the conditions in baseline scenario (large savannas where pastures and livestock activity predominate) carbon stocks in the living biomass of pre-existing non-tree and tree vegetation are not significant, then according to the methodology ARAM004, Version 04 (*Treatment of pre-existing vegetation*):

The carbon stock in the living biomass of pre-existing non-tree and tree vegetation are not significant:

Carbon stock changes in the living biomass of pre-existing non-tree and tree vegetation are not included in the ex ante calculation of actual carbon stock changes, regardless if the pre-existing non-tree and tree vegetation is left standing or is harvested;

- ***Increase in GHG emissions of the project activity (GHG Emissions)***

According to the AR-AM0004/Version 04 its applicability conditions, only emissions from burning of biomass activities are considered. However, 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 taken into account; $GHG_E = 0$.

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.

$$C_{ACTUAL} = \Delta C_{P,LB_t}$$

3. Ex ante estimation of leakage:

In the execution of the project activity, there will be no leakage, given the elements considered in AR- AM0004/Version 04, Section II.8:

- Decrease in carbon content, due to displacement of agricultural crops, cattle grazing or fuel-wood collection activities.

- $LK_{ActivityDisplacement}$

Estimation of $LK_{conv\text{-}graz}$

The baseline scenario and the area of influence of the project activity correspond to areas of degraded pasture, under extensive cattle ranching aprox 0.02 head/ha. With the implementation of the project activity it is expected that owners will move their cattle towards other areas of their own property outside the project boundary which now have grass cover. This corresponds to Case 2 of AR- AM0004/Version 04, where the population of animals is higher in the baseline scenario than it is in the project activity scenario. To determine the displacement of cattle ranching activity, a series of interviews were carried out with the owners or administrators of the properties. According to this information, the pre-project animal population from different livestock groups that are grazing in the project area (NaBL) is 610 animals. These animals were moved to grazing land areas (EGL) under the control of the project owners that were sub-utilized.

Table B.3. Pre-project animal population and movement to existing grazing land areas under control of project owners.

Nuclei	Na_{BL}	*EGL*	$Na_{EGLt=1}$
Bosques de La Primavera S.A.	250	10,000	270
Reforestadora Los Cámbulos S.A.S.	70		
Reforestadora Guacamayas S.A.*	80		

Bosques de La Orínoquia S.A.	40	2,000	-
Organización La Primavera S.A.	90	1,000	-
Compañía de María Padres Montfortianos	80	1,200	60
Total	**610**	**14.200**	**330**

*Includes INCOMSER estimate

Next, the annual animal biomass consumption over the project area was determined ($\Delta C_{L\ PA}$; t d.m. yr^{-1}), maximum annual biomass that EGL areas can produce for animal feeding (ΔC_{Lmax}) and annual biomass that EGL areas are currently producing for animal feeding ($\Delta C_{Lcurrent}$).

ΔC_{Lmax} was calculated on the basis of the average value for carrying capacity in the Orinoco plains región (head of cattle per ha). This value oscilates between 0.09 head per ha to 1.56, with an average of 0.39 (Romero *et. al*. 2004[67]).

Table B.4. Annual animal biomass consumption over the project area ($\Delta C_{L\ PA}$; t d.m. yr^{-1}), maximum in EGL ΔC_{Lmax}) and currently in EGL areas ($\Delta C_{Lcurrent}$).

Variable to calculate	***DBI*** (kg d.m. $head^{-1}$ day^{-1}	***npgt***	**Average number of days in month**	**Frac ton/kg**	**Result**
1					
$\Delta CLcurrent$	6	270	30	0.001	48.6
$\Delta CLmax$	6	3900	30	0.001	702
$\Delta CL\ PA$	6	400	30	0.001	**72**
$\Delta CLmax - \Delta CLcurrent$					**653.4**
2					
$\Delta CLcurrent$	6	0	30	0.001	0
$\Delta CLma$	6	780	30	0.001	140.4
$\Delta CL\ PA$	6	40	30	0.001	**7.2**
$\Delta CLmax - \Delta CLcurrent$					**140.4**
3					
$\Delta CLcurrent$	6	0	30	0.001	0
$\Delta CLma$	6	390	30	0.001	70.2
$\Delta CL\ PA$	6	90	30	0.001	**16.2**
	DBI		Average		
$\Delta C_{Lmax} - \Delta C_{Lcurrent}$					**70.2**
4					
$\Delta C_{Lcurrent}$	6	60	30	0.001	10.8
ΔC_{Lma}	6	468	30	0.001	84.2
$\Delta C_{L\ PA}$	6	80	30	0.001	**14.4**
$\Delta C_{Lmax} - \Delta C_{Lcurrent}$					**73.4**

1. Calculated values for the displaced animal population of the Nucleus Bosques de La Primavera S.A.
2. Reforestadora Los Cámbulos S.A.S..Reforestadora Guacamayas S.A.
3. Calculated values for the displaced animal population of the nuclei Bosques de La Orínoquia S.A.
4. Calculated values for the displaced animal population of the nuclei Organización La Primavera S.A.

[67] Romero M., Galindo G., Otero J., Armenteras, D. 2004. Ecosistemas de la Cuenca del Orinoco Colombiano. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Bogotá. Colombia. 189p.

5. Calculated values for the displaced animal population of the nuclei Compañía de María Padres Montfortianos

***DBI*:** Daily Biomass Intake (kg d.m. head^{-1} day^{-1})
npgt: Number of individual animals from the livestock group *g* at parcel *p* at time *t*; dimensionless

On the basis of the results from the previous table, it is concluded that *EGL* areas are sufficient for feeding the entire population of displaced animals, given that:

$(\Delta C_{Lmax} - \Delta C_{Lcurrent})_{EGL} \geq \Delta C_{L\ PA;}$ e.g. $LK_{conversion} = 0$

Besides, the increase in GHG emissions due to displacement of pre-project grazing activities attributable to the A/R CDM project activity is insignificant because next conditions are met (according to EB 51, Annex 13):

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

(2) Existing grasslands with the carrying capacity that allows for accommodation of the displaced animals during the entire period of displacement;

And,

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

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

Total area where the animal population is expected to be displaced (EGL) are sufficient for feeding the entire population of displaced animals, because the annual animal biomass consumption over the project area (ΔC_{LPA}), is lower than maximum annual biomass consumption (ΔC_{Lmax}) minus the current annual biomass consumption ($\Delta C_{Lcurrent}$) (Table B.4).

- $LK_{conv\text{-}crop}$ and $LK_{fuel\text{-}wood}$

On the other hand. fuel-wood collection and agricultural activities are not carried out in baseline scenario. Because of the low supply of wood in the area, the bulk of wood for the owners' domestic uses such as firewood is not gathered in eligible areas. In the region. the wood comes from the gallery forests and high shrubs and these coverage's are not considered as eligible areas for the project. Subsequently the project activity can represent a source of wood material for the first years when the wood thinning and pruning activities are carried out.

In synthesis and according to the AR-ACM0003 methodology, the anthropogenic net removals are as follows:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$ (Eq. 5 AR-ACM0003).

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$

Where:

$\Delta C_{AR-CDM,t}$ = Net anthropogenic GHG removals by sinks, in year *t*; t CO_2-e

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year *t*; t CO_2-e

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks, in year *t*; t CO_2-e

LK_t = GHG emissions due to leakage, in year *t*; t CO_2-e

For the current project proposal as it has been demonstrated, $LK_t = 0$ and $\Delta C_{BSL,t} = 0$.

Therefore:

$$\Delta C_{AR\text{-}CDM,t} = \Delta_{ACTUAL,t}$$

B.6.2. Data and parameters fixed ex ante

In this updated PDD, the methodological AR-AM TOOL 0014 V.4.2 is included, to monitor the early successional states in the natural regeneration and PNR. Likewise, the recommendations of tool were embraced by the project, in the biomass of trees with DBH less to the range defined by the applied allometric or volume equations. These adjustments are developed to the monitoring plan, to estimate the biomass in the stand models.

In addition, estimates for carbon pools are included, established by the AR-ACM0003 methodology.

Change in the carbon stocks in project, occurring in the selected carbon pools in year *t* shall be calculated as follows:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t}$$ (Eq. 03 AR-ACM0003)

Where:

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e

$\Delta C_{TREE\_PROJ,t}$ = Change in carbon stock in tree biomass in project in year *t*, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO_2-e

$\Delta C_{SHRUB\_PROJ,t}$ = Change in carbon stock in shrub biomass in project in year *t*, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO_2-e

$\Delta C_{DW\_PROJ,t}$ = Change in carbon stock in dead wood in project in year *t*, as estimated in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”; t CO_2-e

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

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

Under baseline conditions (see section D), 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"*[68]*.*

In order to follow conservative estimates, the recommendations of the methodological tools are taken and the default values detailed in these are assumed

The parameters determined by the tool are included in the following tables.

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

Data/Parameter	$BEF_{2.\ j}$
Data unit	Dimensionless
Description	Biomass expansion factor for conversion of stem biomass to above-ground tree biomass for tree species *j*
Source of data	Annex 3A.1 Table 3A.1.10 of IPCC GPG LULUCF
Value(s) applied	*T. grandis*: 3.4; *A. mangium*: 3.4; *E. pellita*: 3.4; *P. caribaea*: 1.3; *P. oocarpa:* 1.3 Several species (ANR and PNR stand models): 2.0
Choice of data or measurement methods and procedures	-
Purpose of data	(ii) Calculation of actual net GHG removals by sinks
Additional comment	*BEFs* in IPCC literature and national inventory are usually applicable to closed canopy forest. If applied to individual trees growing in open field it is recommended that the selected *BEF* be increased by a further 30%

Data / Parameter	*CF j*
Unit	tC *td.m^{-1}.
Description	Carbon fraction of dry matter for species of type *j*
Source of data	IPCC GPG-LULUCF 2006, AR-Tool 14 Version 04.2
Value(s) applied	*0.47 for all specie and models.*
Choice of data or Measurement methods and procedures	default value
Purpose of data	Actual net GHG removals by each species in the project activity. AR-Tool 0014 V.04.2 in the section 11 for the biomass and carbon shrubs
Additional comment	It was applied to each stand model.

Data / Parameter	*D j*
Unit	t d.m. m^{-3}
Description	Basic wood density for species j
Source of data	*T. grandis*: El Semillero[69], USDA 2006b., Peter 1993; *A. mangium*: El Semillero; *E. pellita*: CONIF; *P. caribaea* and *P. oocarpa*: USDA 2006a; Several species (ANR and PNR stand models):USDA 2006a, IPCC 2003.
Value(s) applied	*T. grandis: 0.55 (El Semillero, USDA 2006b., Peter 1993);* *A. mangium: 0.53 (El Semillero);* *E. pellita: 0.48 (CONIF);* *P. caribaea and P. oocarpa: 0.55 (USDA 2006a);* *Several species (ANR and PNR stand models): 0.58 (El Semillero, USDA 2006a, IPCC 2003)*

[69] Trujillo N. 2013. Guía de Reforestación. 3º edición. Bogotá 254 p.

Choice of data or Measurement methods and procedures	-
Purpose of data	(ii) Calculation of actual net GHG removals by sinks
Additional comment	Basic wood density for dominant species DS when j=DS

Data / Parameter	***R j***	
Unit	dimensionless	
Description	Root-shoot ratio appropriate for biomass stock. for species j	
Source of data	Table 3A.1.8 of IPCC GPG LULUCF, 2003	
Value(s) applied	*Pino sp*	0.46 (<50 t.ha above biomass) 0.32 (50-150 t.ha above biomass) 0.23 (>150 t.ha above biomass)
	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)
	A. mangium	0.20 (<125 t.ha above biomass)
	Several species (ANR and PNR stand models): 0.27	
Choice of data or Measurement methods and procedures	Default value	
Purpose of data	(ii) Calculation of actual net GHG removals by sinks	
Additional comment	Conservative choice of default values: 1. If in the sources of data mentioned above. data are available for conditions that are similar to the project (same vegetation genus. Same climate zone similar forest type). then mean values of default data may be used and are considered conservative; 2. Global values may be selected from Table 3A.1.8 of the *GPG-LULUCF* (IPCC 2003). or equivalently from Table 4.4 of the AFOLU Guidelines (IPCC 2006). by choosing a climatic zone and species that most closely matches the project circumstances; 3. Alternatively. given that many datasets of root-shoot ratios are relatively small because of the difficulty of determining this parameter. Conservative selection of a value from the global study by Cairns *et al.* (1997) is likely to provide a reliable default value.	

Data/parameter:	**Root-shoot ratio, *Rs***
Unit	dimensionless
Description	Root-shoot ratio for shrubs
Source of data	IPCC and UNFCCC AR Tool 0014 V4.2.
Value(s) applied	0.4
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 Assisted natural regeneration and Protected natural regeneration.

Data/parameter:	***BDR_{sf}***
Unit	dimensionless
Description	Ratio of shrub biomass per hectare in land having a shrub crown.
Source of data	AR Tool 0014 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:	b_{FOREST}
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. the tropical humid forest in Colombia. Phillips, et al, IDEAM 2014.
Value(s) applied)	231.7 t d.m. ha^{-1}
Choice of data or measurement methods and procedures	Default
Purpose of data	Applied in the biomass and carbon shrubs in the regeneration stratum.
Additional comments	This process is applied for the early successional states in the natural regeneration and PNR, accord tool AR-AM Tool 0014 V4.2.

Data / Parameter	***DLP***
Unit	%
Description	Desired level of precision
Source of data	-
Value(s) applied	10%
Choice of data or Measurement methods and procedures	Defined
Purpose of data	(ii) Calculation of actual net GHG removals by sinks
Additional comment	Required for the calculation of the number of plots ex-post

Data/parameter:	$CC_{SHRUB,I}$
Unit	dimensionless
Description	Crown cover of shrubs in shrub biomass stratum *i*
Source of data	Field measurement
Value(s) applied	***0.5***
Choice of data or Measurement methods and procedures	N.A
Purpose of data	Applied in the biomass and carbon shrubs in the regeneration stratum (ANR and PNR) and shrubs commercial stand.

Additional comment	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 covers 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.

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[70].
Purpose of data:	Applied for estimation of change in *Shrubs* carbon stocks
Additional comments	

Data/parameter:	$SOC_{REF,i}$
Unit	$tCha^{-1}$
Description	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation ñ normally forest) by climate region and soil type applicable to stratum i of the areas of land;
Source of data	*"Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities. V01.1.0*
Value(s) applied)	60
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	

[70] 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:	$F_{IN,i}$
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:	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:	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)	6%
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	$Z_{\alpha/2}$
Unit	Dimensionless
Description	Value of the statistic z (normal probability density function)
Source of data	*Excel program*
Value(s) applied	*1.97*
Choice of data or Measurement methods and procedures	Measured, according to the confidence level
Purpose of data	(ii) Calculation of actual net GHG removals by sinks
Additional comment	Required for the calculation of the number of plots ex-post

B.6.3. Ex ante calculation of net anthropogenic removals

The net anthropogenic GHG removals by sinks is the actual net GHG removals by sinks minus the baseline net GHG removals by sinks minus leakage, therefore, the following general formula can be used to calculate the net anthropogenic GHG removals by sinks of an A/R CDM project activity ($C_{AR\text{-}CDM}$), in *t* CO_2-e.

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

Where,

C_{AR-CDM} = Net anthropogenic greenhouse gas removals by sinks; t CO_2-e

ΔC_{ACTUAL} = Real GHG removals in the project (t CO_2-e)

ΔC_{BSL} =Baseline net greenhouse gas removals by sinks; t CO_2-e.

LK =Total GHG emissions due to leakage; t CO_2-e

B.6.4. Summary of ex ante estimates of net anthropogenic removals

Year	Baseline net GHG removals by sinks (tCO_2e)	Actual net GHG removals by sinks (tCO_2e)	Leakage (tCO_2e)	Net anthropogeni c GHG removals by sinks (tCO_2e)	Cumulative net anthropogeni c GHG removals by sinks (tCO_2e)
2 Jun 2005		10,648		10,648	10,648
2 Jun 2006		30,005		30,005	30,005
2 Jun 2007	-	67,184	-	67,184	67,184
2 Jun 2008	-	137,677	-	137,677	137,677
2 Jun 2009	-	270,154	-	270,154	270,154
2 Jun 2010	-	463,565	-	463,565	463,565
2 Jun 2011	-	747,037	-	747,037	747,037
2 Jun 2012	-	1,113,245	-	1,113,245	1,113,245
2 Jun 2013	-	1,597,828	-	1,597,828	1,597,828
2 Jun 2014	-	2,078,824	-	2,078,824	2,078,824
2 Jun 2015	-	2,603,300	-	2,603,300	2,603,300
2 Jun 2016	-	3,132,633	-	3,132,633	3,132,633
2 Jun 2017	-	3,609,791	-	3,609,791	3,609,791
2 Jun 2018	-	4,038,293	-	4,038,293	4,038,293
2 Jun 2019	-	4,486,608	-	4,486,608	4,486,608
2 Jun 2020	-	4,935,375	-	4,935,375	4,935,375
2 Jun 2021	-	5,300,024	-	5,300,024	5,300,024
2 Jun 2022	-	5,689,177	-	5,689,177	5,689,177

2 Jun 2023	-	6,054,254	-	6,054,254	6,054,254
2 Jun 2024	-	6,236,269	-	6,236,269	6,236,269
2 Jun 2025	-	6,368,010	-	6,368,010	6,368,010
Total					**6,368,010**
Total number of crediting years			20		
Annual average over the crediting	***0***	***311,813***	***0***	***311,813***	***311,813***

B.7. Monitoring plan

For the detailed elements of the monitoring plan, see appendix 5

B.7.1. Data and parameters to be monitored

Data and parameters considered for monitoring are in accordance with methodology AR-AM0004, version 4. These should provide transparency and veracity to the information produced for the estimates of the project's net carbon removals.

Data / Parameter	***A***
Unit	ha
Description	Total project area;
Source of data	LandSat Satellite Images Field surveys concerning the project boundary within which the A/R activity has occurred. site by site
Value(s) applied	29,019
Measurement methods and procedures	Measuring geographical positions (latitude and longitude of each corner polygon sites) using GPS Input the measured geographical positions into the GIS system Measurements will be undertaken by project staff
Monitoring frequency	Annual
QA/QC procedures	Checking whether the afforested/reforested areas are consistent with the eligible areas as defined in the PDD
Purpose of data	(ii) Calculation of actual net GHG removals by sinks;
Additional comment	If tree cover is affected by natural hazards (forest fires. plagues. etc.) or human interventions (harvesting. deforestation) area of the deforested land and carbon losses shall be identified. These areas shall be treated as separate strata.

Data / Parameter	A_{ikt}
Unit	Ha
Description	Area of stratum i
Source of data	Monitoring of strata and stand boundaries shall be done preferably using a Geographical Information System (GIS). which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data)
Value(s) applied	Commercial stand model: 20,573.1 ha ANR stand model: 390 ha PNR stand model: 8,056 ha

Measurement methods and procedures	Measuring geographical positions (latitude and longitude of each corner polygon sites) using GPS
Monitoring frequency	
QA/QC procedures	
Purpose of data	Input the measured geographical positions into the GIS system and calculate the implemented area of each stratum and stand
Additional comment	Measurements will be undertaken by project staff

Data/parameter:	$A_{SHRUB,i}$
Unit	ha
Description	Area of shrub biomass estimation stratum *i*; ha
Source of data	Measured in field with GPS and verified with GIS.
Value(s) applied	N_R (Natural Regenerations) 390 ha and PNR 9,447.78 ha. And shrubs inside the plantation.
Measurement methods and procedures	Geographical information system GIS
Monitoring frequency	Each verification
QA/QC procedures:	
Purpose of data:	Calculation of project emissions or actual net GHG removals by NR and PNR.
Additional comments:	

Data / Parameter	***AP***
Unit	m^2
Description	Sample plot area
Source of data	Field measurement
Value(s) applied	-
Measurement methods and procedures	The central point of the plot is located in the field with the help of GPS. The entry route of the plot must be marked to facilitate its location in later monitoring of the auditing process. Measurements will be undertaken by project staff
Monitoring frequency	At every verification
QA/QC procedures	Field-team members shall be fully aware of all procedures and the importance of collecting data as accurately as possible. In each verification process, new metric tapes will be available to ensure proper operation and accuracy of measurements.
Purpose of data	To verify that plots have been installed and the measurements taken correctly. 10-20% of plots shall be randomly selected and re-measured independently.
Additional comment	(ii) Calculation of actual net GHG removals by sinks

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*;
Source of data	Field measurement
Value(s) applied	N.D

Measurement methods and procedures	Measured This variable is measured especially with harvest procedure, when trees have a diameter restriction to apply volumetric or allometric equations. Harvest from outside the plot area a few saplings having diameter close to the mid-way diameter and obtain the mean biomass per sapling. The other values of individual biomass per tree, are estimated with the proposed equations and within the ranges established by these for each species.
Monitoring frequency	At every verification
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.
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 or volume equations is high.
Additional comment	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 of the commercial stratum. 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 and by species is estimated in the commercial stratum. This procedure conforms to the recommendation of AR-AM Tool 0014 V.4.2. Appendix 1.

Data / Parameter	***DBH***
Unit	cm
Description	Diameter breast height of tree
Source of data	Field measurements in sample plots
Value(s) applied	-
Measurement methods and procedures	Typically measured 1.3 m above-ground. Measure all the trees above some minimum DBH in the permanent sample plots that result from the A/R CDM project activity.
Monitoring frequency	Measurements will be undertaken by project staff.
QA/QC procedures	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	Persons involving in the field measurement work should be fully trained in the field data collection.
Additional comment	Field measurements shall be checked by a qualified person to correct any errors in techniques.

Data / Parameter	***H***
Unit	m
Description	Height of tree
Source of data	Field measurements in sample plots

Value(s) applied	-
Measurement methods and procedures	Measure the heights of all trees within plots
Monitoring frequency	Measurements will be undertaken by project staff
QA/QC procedures	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	Persons involving in the field measurement work should be fully trained in the field data collection
Additional comment	Field measurements shall be checked by a qualified person to correct any errors in techniques

Data / Parameter	$CC_{SHRUB,I}$
Unit	dimensionless
Description	Crown cover of shrubs in shrub biomass stratum *i*
Source of data	Field measurement
Value(s) applied	0.5
Measurement methods and procedures	Calculated. 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.
Monitoring frequency	At every verification
QA/QC procedures	It comes from ocular way to estimate the canopy cover of the shrubs, you can have more choice between two professionals to its estimate, as an alternative remote sensing can be used.
Purpose of data	Applied in the biomass and carbon shrubs in the regeneration stratum.
Additional comment	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.

B.7.2. Sampling plan

Stratification

Stratification procedures shall be in accordance with the AR-AM0004/Version 04. It is possible that during the project the number of strata vary as a result of variations identified in certain areas caused by existing natural factors such as physical and chemical conditions of soil, topography, climate, hydrology, history of land use, type of vegetation existent, among others. In these cases, a re- stratification would be necessary. Another factor that influences the differentiation of the strata is the ability of stand models to capture carbon. In this sense, when sequestering differences are identified in like strata, new strata may be originated, according to the differences found. Similarly, should a similar behavior be observed between two or more different strata, these could be joined to form a single stratum.

After the first sampling, re-stratification may be performed according to biomass accumulation results, planting dates and forestry actions undertaken and/or productivity achieved by the different forest systems present in the project. The information required for the stratification process will be determined by forest inventories, evidence of changes in vegetation through aerial photography or other information, always attempting to present the fewest possible strata that facilitate the overall assessment of the scope of project.

Sampling structuring

The establishment of permanent sample plots is considered: their number will depend on the number of strata present in the project area taking into account cost-effectiveness. These plots will allow the monitoring of changes in aboveground and belowground biomass carbon content during different stages. The monitoring will assess the evolution of biomass in those stands or restoration coverages that comprise the project activity and have been subjected to various forestry activities (*e.g.* soil preparation, fertilization, thinning, harvesting, enrichment, etc.). All parcels shall be properly numbered, geo-referenced and located within a map of coverages present within the project scope.

Determining sample size

The number of plots will be determined by the number of species, number of strata identified, accuracy and monitoring intervals, considering cost-effectiveness. The sample size (n) is estimated with fixed precision levels, assuming no cost differences exist between the **strata and sub-strata**, as described the AR-AM0004/Version 04 and the tool *"Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/RCDM project activities*". Based on assessments made in stands with similar characteristics or information in available literature sample size is calculated following the steps described in the methodology (Appendix 5):

The sample size may vary according to the results of subsequent monitoring and variations in strata as well as the dynamics of biomass accumulation by the project.

Parcel size or sampling units.

In principle, the type of forest system to be evaluated and the planting density will determine the size of the monitoring plots. Establishing 100 m^2 plots is recommended in stands with high density and up to 1,000 m^2 in more open stands. This size range is considered cost effective given the A/R models planted. This decision will be determined by factors such as: stratum, species, planting system or even by variations in the project stand models.

An alternative recommended in the AR-AM0004/Version 04 regarding sample size, is to apply the next equation, where the variation coefficients of two measurements are associated the different respective areas.

$$CV_2^2 = CV_1^2 \cdot \sqrt{\frac{AP_1}{AP_2}} \qquad CV_2^2 = CV_1^2 \cdot \sqrt{\frac{AP_1}{AP_2}}$$

Where:

CV_1 = Variation coefficient of type 1 plot
CV_2 = Variation coefficient of type 2 plot
AP_1 = type 1 plot size
AP_2 = type 2 plot size

Location of the plots on the field.

To guarantee that the variability generated is sufficient. The sampling units will be in random manner or systematically with a randomly selected starting point in the distinct strata established and existing for the first verification period. This will be defined before the first carbon monitoring program of the project. Subjective location of the plots should be avoided (plot center, plot points of reference or movement of the center of the plot to a more "convenient" location), following the principle of randomness. If the plots of each stratum are separated, a uniform distribution of the plots according to plot size should be sought. GPS will be used for locating and geo-referencing in the field, allowing for clarity in inclusion, location and monitoring over time. Sampling plots will be identified with a series of alphanumeric codes and geographic positioning information (GPS coordinates). The location of the sampling unit and strata will be recorded and archived.

Monitoring frequency.

Time intervals between monitoring activities depends largely on the variation of the carbon content in the carbon sinks. However, to reduce implementation costs, a monitoring frequency will be used that is consistent with the years in which verifications are to take place, thus assuming a monitoring frequency of five years. In general, monitoring years are linked to tCER crediting periods and verification, given that monitoring should coincide with the first commitment period, which is decided for the year 2013 (Table B.5).

Table B.5. Number of controls and year.

Sampling	Year monitored
1	2015
2	2020
3	2025

Measurement and estimation of carbon content changes.

In the following procedure, the actions to estimate the biomass in the early stages of natural regeneration are described.

To obtain conservative estimates, assuming the default values of TOOL (AR-TOOL 014 V0.4.2) and national reports in relation to contents of total forest biomass in the project region.

The new fixed parameters and new parameters to be monitored included in the monitoring plan are described in B.6.2 and B.7.1 sections.

Only the increase of aboveground (tree in all strata and shrubs in the RN and PNR) and belowground biomass in tree vegetation established in the Project is considered (accord to AR-TOOL 014 V0.4.2). Increases in biomass of disperse and pre-existing trees are not accounted for, given that these individuals are part of the baseline. Therefore, only the individual growth of each tree in the sampling plots will be monitored. The increment in biomass in early successional stages of the NR strata, will be considered the biomass of shrubs and will be measured as the tool AR-TOOL 014 V0.4.2[71], subsequently, measurements of the trees in the RN in addition to the shrubs will be included.

The shrubs biomass can be estimated accord *to AR-TOOl 0014, section 11*. Its estimation way does not imply any plots assembly in land:

[71] In the early stages of successional of RN, the biomass is superior to the baseline and is composed of seedlings and shrubs characteristic of the successional process in the natural regeneration of the forest. Therefore, its measurement is in accordance with the methodological recommendations of the UNFCCC.

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

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 $CC_{SHRUB,i}$ = 0.10); dimensionless.

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:

$$\Delta C_{DW,i,t} = C_{TREE,i,t} \times DF_{DW}$$ Equation 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

Change in SOC stock.

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"*[72].

In order to follow conservative estimates, the recommendations of the methodological tools are taken, and the default values detailed in these are assumed

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

Where:

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

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

$SOC_{INITIAL,i}$ = 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.

Estimates for species of commercial stratum.

Allometric or volume equations are applied for the species of the commercial stratum. 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 V1.0.1* [73] " and "*Demonstrating appropriateness of allometric equations for estimation of aboveground biomass in A / R CDM project Activities V.1*[74]". 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.

Equations by species and their application according to the tools, are in Table B.6:

[73] EB 67 annex 24.

[74] EB 65 annex 28.

Table B.6. Equations of volume and biomass applied for included species in work-field survey.

Specie	Equations	*Observation /applied*	Source
P. caribaea	$\text{Ln(Vol)}=-9.66+1.834*\ln(\text{DAP})+1.007\text{Ln}(h_t)$	**Edafo climatic conditions:** Temperature: 21.7 °C Soils: Ultisols, red clay soils and acidic. Very humid, tropical premotane forest **Statistics:** ✓ R2= 0.97 ✓ N=45 **Application range:** DAP≥ 10-28 cm	Salazar, 198575.
	$BA = 0.887 + \left(\frac{10486*DAP^{2.84}}{(DAP^{2.84})+376907}\right)$	**Edafo climatic conditions:** Pines of temperate and tropical zones **Statistics:** R2= 0,98 N= 137 **Application range:** DAP 0,6 - 56 cm.	IPCC 200376.
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:** R2: 0.991 N: 105 **Application range:** Not defined.	INDERENA, 198977 OIMT-CONIF-MINAMBIENTE, 199978.

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

[76] 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.

[77] 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.

[78] 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.

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 R2= 0.94 **Application range:** *DAP> 5cm*	Recommended in the national carbon protocol of Colombia, Yepes et al, IDEAM, 201179.
E. pellita	$BA = 1.22 * DAP^2 * h_t * 0.01$	**Edafo climatic conditions:** *Subtropical zone*. Temperature: 17.3 °C. **Statistics:** R2= 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:** R2= 0.97. N= 102 **Application range:** *DBH:1.75-31.1 cm*	*Torres, D.A. 200480.*

[79] 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.

[80] 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.

This value will be estimated based on the increase in shaft size determined during each monitoring activity. The changes of carbon contained in other components of the aboveground biomass (branches and leaves) and belowground (roots) of the trees of each plot, will be estimated by the *Biomass Expansion Factor Method-BEF*. This process is accepted by the IPCC[81] and UNFCCC[82].

- **Process for trees with DBH less than that defined by the allometric equations**

On the other hand, for trees that do not comply with the minimum size of DBH for the application of allometric equations, the procedure to follow is the one recommended by the appendix 1, AR-AM Tool 0014 V.4.2. This appendix defines that:

> *Where the number of saplings with diameter below the range of diameter applicable to the allometric equation is high, the mean biomass of the saplings in a sample plot can be estimated as follows: (1) Determine the diameter mid-way between the diameter of the smallest sapling existing and the smallest diameter allowed by the allometric equation. (2) Harvest from outside the plot area a few saplings having diameter close to the mid-way diameter and obtain the mean biomass per sapling; (3) Count all the samplings in the sample plot and multiply this number by the mean sapling biomass to obtain their contribution to the plot biomass.*

This process is carried out in each of the verifications for the trees that do not meet the minimum diameter in the sampling plots and for each of the commercial species planted.

B.7.3. Other elements of monitoring plan

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 sylvicultural activities of the project activity. Each one of the seven nuclei 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 seven 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. Data is archived both in electronic and paper forms. All electronic data and reports shall also be copied on durable media such as CDs and copies of the CDs are stored in two locations (La Primavera and Bogota Offices). 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.

[81] The Intergovernmental Panel on Climate Change (IPCC) 2003. IPCC Good Practice Guidance for LULUCF.

[82] AR-Tool 14-V.14.V0.4.2.

All this information be kept for at least two years after the end of the crediting period or the last issuance of CERs. for this project activity. whichever occurs later.

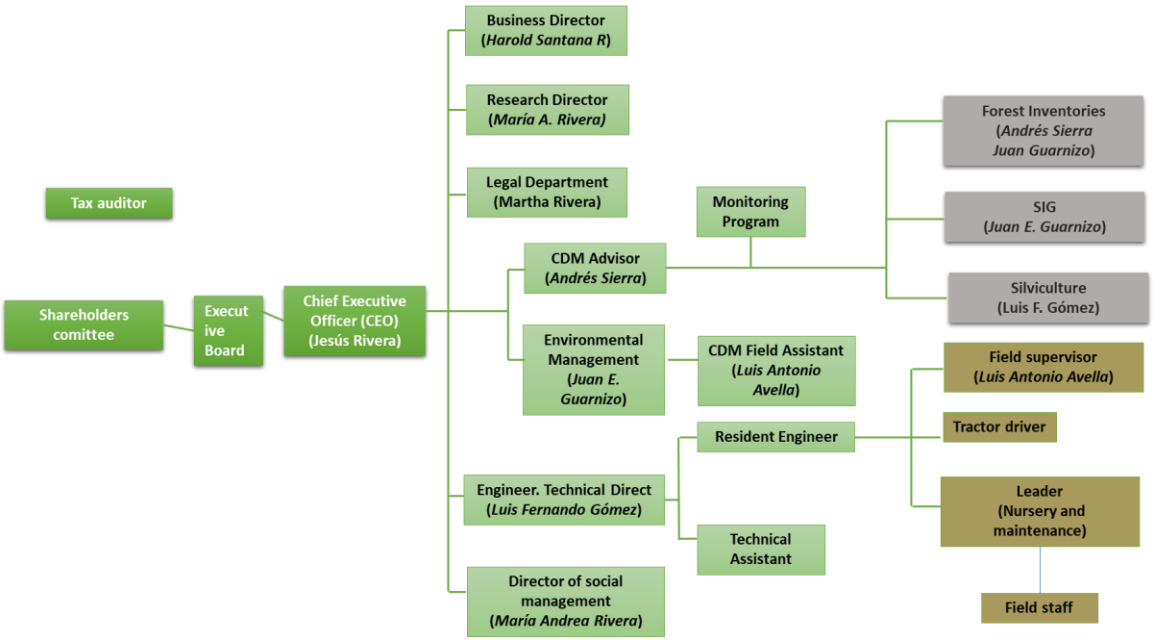

Figure B.9. Operational and Management Structure of the Project Activity

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

02/06/2005

C.2. Expected operational lifetime of project activity

60 years, 0 months, 0 days.

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period

C.3.2. Start date of crediting period

02/06/2005

C.3.3. Duration of crediting period

20 years, 0 months, 0 days; and two equal renewal periods.

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

To characterize the potential impacts that the project activity could generate, a general outline of how the baseline activities are influencing the ecological conditions of the region and the impacts

being generated today. This allows the establishment of a comparison of how the proposed forestry activity adds, decreases, or creates new environmental impacts.

There are two main ecosystems in the project area: open grasslands, characterized by the presence of grasses mixed with shrubs, some occasional trees and palms; and natural gallery forests. Both ecosystems have been degraded by the baseline land uses described above (extensive cattle ranching based on regular burning of grasslands). The environmental effects of are represented primarily in the continual degradation of the soils and the grassland ecosystem. In the Colombian Orinoco region, the occupation and destruction of forests for the establishment of livestock has increased significantly since the mid-twentieth century. A comparison of the dynamics of forest cover for the basal region of Vichada, shows that between 1984 and 2002 it decreased by 20%, with most of this change attributed to livestock (CORPORINOQUIA, 2007[83]).

Sustenance food crops are sometimes carried out through felling and burning within gallery forests which have more fertile and organic soils. These are short lived and precarious, causing serious damage to the natural forest ecosystems. Their use is about three years, until the soil is depleted. Then they move on to intervene new forest areas.

Similarly, due the remoteness and the lack of profitable productive alternatives, illicit crops have increased substantially (coca mainly) in the municipalities of Cumaribo and La Primavera, which has led to an environmental deterioration, both in establishment endeavors and in the eradication activities (Romero et al, 2009[84]): as a result of this clandestine activity large areas of gallery forests and morichales have been destroyed, with negative consequences for biodiversity and the depletion of sources water.

Figure D.1. Typical landscape in the project area: pastures with few cattle per hectare.

Burnings in the savannas of the region.

The impacts generated by extensive cattle ranching in the region are not limited to soil degradation. Ecological studies have determined that this activity impacts the region's complex natural ecosystems, ground and surface waters, climate, biodiversity, and natural vegetation, among others. As detailed above sections, extensive cattle ranching based on the practice of regular burning of pastures, has been carried out for hundreds of years in the project area, leading to a decline in the quality of grass produced. Sometimes, natural forest ecosystems are burned to

[83] CORPORINOQUIA. 2007. Una década de gestión ambiental corporativa en la Orinoquia Colombiana, 1995-2005. Quevedo, L y Baquero O. editores. 280 p. Yopal, Casanare.

[84] Romero M.H., Maldonado-Ocampo J.A., Bogotá-Gregory J.D., Usma J.S., Umaña-Villaveces A.M.,Murillo J.I., Restrepo-Calle S., Álvarez M., Palacios-Lozano M.T., Valbuena M.S., Mejía S.L. Aldana-Domínguez J. y Payán E. 2009. Informe sobre el estado de la biodiversidad en Colombia 2007-2008: piedemonte orinoquense, sabanas y bosques asociados al norte del río Guaviare. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Bogotá D.C., Colombia. 151 p

establish pastures (CIAT, 2001[85]) (Figure D.2). Cattle ranching removes trees from gallery forests for use as fence posts or firewood, which deplete forest cover and affect water sources, leads to erosion and loss of habitat of the associated fauna and flora of the forest. Regular burnings of grasslands prevent the accumulation of soil organic matter: studies estimate that the recurrent use of fires remove up to 82% of the forage biomass-produced by the bush, preventing the improvement of soil chemical characteristics, which is a major constraint to agricultural development in the region (Rivas, et al. 2004[86], CORPORINOQUIA, 2007). In an attempt to increase the profitability of cattle ranching, African pastures species have recently been introduced *(Hyparrenia rufa, Melinis minutiflora, Panicum maximum, Brachiaria spp.)*; these pastures have increased the frequency of savanna fires, and caused the displacement of native vegetation (CONIF, 1998[87]).

Figure D.2. Pastureland burnings for the regeneration of new re-growths for livestock feed. An ancestral practice carried out in the project region that has a significant impact on the ecosystems.

Regular anthropogenic burnings implemented on soils of low natural fertility and high acidity conditions (CONIF, 1998[88]), results in soils characterized by: 1) very shallow soils, with thin A horizons. 2) Soils highly susceptible to erosion. 3) Weak structure. 4) Low organic matter content. 5) They are prone to sealing, by hardening of the surface layer. 6) Low filtration capacity. 7) Hard soils with low aeration capacity. 8) Not easily penetrated by roots (Figure D.3). 9) Low nutrient content. 10) Low retention of water needed for plants (Rivas, 2004[89]). In many cases, the lack the forest cover in the savannas has been associated with the origin and maintenance of pasture

[85] CIAT, 2001. Agroecológia y biodiversidad de las sabanas en los Llanos Orientales de Colombia. Rippstein G,

Escobar, G y Mota F. Editores. Centro Internacional de Agricultura Tropical (CIAT). 302 p. Publicación CIAT, No 322.

[86] Rivas, L; Hoyos, P; Amezquita, E y Molina, D. 2004. Manejo y uso de los suelos de la Altillanura Colombiana. Análisis económico de una estrategia para su conservación y mejoramiento: construcción de la capa arable. Centro Internacional de Agricultura Tropical (CIAT). 43 p.

[87] CONIF. 1998.Guía para plantaciones forestales comerciales, Orinoquia. Roncancio, D; Vega E. y Herrera G. Editores. Corporación Nacional de Investigación y Fomento Forestal (CONIF); Ministerio del Medio Ambiente; Organización Internacional de las Maderas Tropicales (OIMT). 48 p. Santa Fe de Bogotá.

[88] CONIF. 1998.Guía para plantaciones forestales comerciales, Orinoquia. Roncancio, D; Vega E. y Herrera G. Editores. Corporación Nacional de Investigación y Fomento Forestal (CONIF); Ministerio del Medio Ambiente; Organización Internacional de las Maderas Tropicales (OIMT). 48 p. Santa Fe de Bogotá.

[89] Rivas, L. 2004. Resultados, adopción e impactos en los Llanos Orientales de Colombia. Centro internacional de Agricultura Tropical (CIAT); Ministerio de Agricultura y Desarrollo Rural. 281 p. Documento de trabajo no. 194. Cali, Colombia.

burnings, which has become a serious limitation for the forest successional process. (Romero, 2008[90]) (Figure D.4).

Figure D.3. Compaction and hardening of the top soil, as a result of repeated burnings on soils lacking organic horizons, rich in iron sesquioxide that restrain aeration and water filtration to deeper soil layers

Figure D.4. Landscape impacted by regular burnings, a widespread practice in the region to support extensive cattle ranching. The ecosystems are highly vulnerable to these actions. Forest remnants that may have survived the burnings, sooner or later will be reached by new uncontrolled burnings

[90] Romero M.H. 2009. Dinámica de fuegos de las de las sabanas orientales de Colombia para el periodo seco (diciembre 2007 a abril 2008). En:Romero M.H., Maldonado-Ocampo J.A., Bogotá- Gregory J.D., Usma J.S., Umaña A.M., Álvarez M., Palacios-Lozano M.T., María Saralux-Valbuena M.S., Mejía S.L. Aldana-Rodríguez J. y Payán E. 2009. Informe sobre el estado de la biodiversidad en Colombia 2007-2008: Piedemonte orinoquense, sabanas y bosques asociados al norte del río Guaviare. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Bogotá D.C.,Colombia. 151 p.

Table D.1. Activities carried out by the cattle ranching sector and related impacts on the natural resources in the Orinoco region

	Impacted resource						
	Soil	Water	Air	Energy	Biodiversity		
Cattle ranching processes and practices	**Compaction, erosion and biological activity**	**Reduction of water balance, organic and chemical contamination, eutrophication.**	**Greenhouse gases, foul odors, methane emissions, hydrocarbons.**	**Heat radiation, reduction in photosynthesis, and use of fossil fuels.**	**Transformation of land and aquatic biomes.**	**Loss or severe transformation of natural ecosystems**	**Threat or extinction of flora and fauna species.**
Forest logging and burning.	****	***	***	**	****	****	*****
Opening of livestock ranch roads.	**	**	*	*	**	***	***
Desiccation of wetlands.	**	*****	**		**	***	****
Pasture Grass monocultures.	***	***	**	**	***	****	****
Burnings	***	***	****	***	**	***	***
Physical control of the succession of vegetation.	**	*		*			**
Chemical control of the succession of vegetation.	***	***	*	**		**	***
Installation and repair of fences, enclosures and corrals	*				*	**	***
Animal trampling	*****	***		**	*	**	***
Cattle paths and roads	*****	*		*		*	**
Chemical fertilization (nitrogen)	***	***	**	**		*	*
Pesticides (against ticks and flies)	**	**	*			*	**
Non-biodegradable product packaging	*	***	*	***			**
Medications (hormones, antibiotics, etc.)	**	*					**
Ground transport of cattle	**		**	***		*	*
River transport of cattle		***	*	*	*	*	**
Slaughter houses	**	****	***	***			*
Dairy plants.	**	***	*	***			*
Hide processing industries.	**	*****	***	**	*	**	***

Impact levels: * Reduced, ** Light, *** Considerable, **** High, *****Very high.

Source: CORPORINOQUIA, 2007.

Table D.1 identifies more than 100 different affectations of the ecosystems caused by livestock, of which 35% are between the values of *considerable* and *very high*. Under a continuation of baseline activities, the natural potential of degraded grassland ecosystems in this region of Colombia is poor, as the level of soil fertility is very low, with deficient levels of organic matter, high acidity, low phosphorus content, toxicity due to the high concentrations of aluminum and a nearly complete absence of minerals and elements required for plant growth. The soils have very low biological activity in terms of macro-invertebrates and at a microbiological level.

Expected environmental benefits from the introduction of the forestry project activities

The project activity will be developed in areas highly impacted at the environmental level. The project activity replaces the above-mentioned forms of intervention and production with forest systems which are in greater harmony with the regional environmental conditions.

Woody species, among other important functions in ecosystems, have the advantage of being able to cycle nutrients and water to greater soil depths, are a barrier against the winds, and protect the sandy soil of the plains from the effects of wind erosion and flooding.

In general, we expect the following benefits because of the implementation of the project activity:

- The elimination of grassland burnings inside the project boundaries allows natural regeneration of native species.
- Faster and better recycling of nutrients.
- More nutrients are deposited and accumulate in the soil due to the slower decomposition of organic matter from forestry.
- Under or nearby the tree stands, native forest species can establish themselves, and species of later successions can have a chance to appear and thrive.
- The biomass in the soil increases from forestry cycling, improving the density of the micro and macro-fauna.
- The summer rains are absorbed and used more efficiently in new forestry activities than in degraded grasslands.
- The plantation serves as a windbreak barrier, which favours the permanence of precipitated waters, reducing evaporation.
- The restoration of natural forests with the ANR and PNR models, and the interconnection of forest masses into biological corridors, will increase habitat, improve availability of foods for fauna, and increase species and their populations.

The National Corporation for Forestry Research and Promotion (CONIF), has highlighted how the establishment of forest cover with native and introduced species on non-productive and degraded soils, have a positive impact on the environment of the Orinoco region, contributing to on the conservation of water resources, wetland restoration, enhancement and protection of biodiversity, and conservation and management soil, acting as connectivity corridors between isolated forest fragments (CONIF, 1998[91], CONIF 2000[92]).

Expected environmental benefits from the introduction of the Assisted Natural Regeneration (ANR) and Protected Natural Regeneration (PNR) models.

The natural regeneration of native forest species in these ecosystems is not possible in the baseline conditions of cattle ranching and pasture burnings. The establishment of forest species in

[91] CONIF. 1998. *Op. cit*

[92] CONIF. 2000. Impacto ambiental de plantaciones forestales. Síntesis de resultados 1996-2000. Corporación Nacional de Fomento Forestal (CONIF) con el apoyo del Ministerio de Medio Ambiente y el BIRF. Serie Técnica no 47. 150 p.

degraded areas can improve the microclimate and provide shelter and nesting sites for species of seed dispersers (including birds and bats), which accelerates the process of succession in the forest.

The regeneration of native trees, shrubs, palms and epiphytes and herbaceous communities can also promote the restoration of animal communities and different kinds of insect pollinators that act to strengthen the regulatory capacity of the ecosystem and genetic mobility.

Risks.

Forestry activities established by the project could suffer because of naturally caused fires typical of the climate dynamics of the region. However, this risk can be mitigated by silvicultural control actions such as establishing buffer zones, firebreaks, etc.

The texture and structural organization of these soils warn of big risks from erosion when using elements of traditional farming. Special precautions should be considered both in soil preparation and use of fertilizers.

Genetic tree material should have a high potential for root production and biomass cycling that would simultaneously achieve a high uptake and good coverage in such a way that will increase biological density over time.

In conclusion, the areas dedicated to the commercial reforestation project (excluding areas for restoration and biological corridors -ANR and PNR-), are suitable for plantation development due to their use history, soil characteristics, topography, current land use and climatic conditions. Additionally, the four proposed commercial species are well adapted to the low natural fertility of the soils. The *Pinus caribaea, P. oocarpa* and *Acacia mangium* generate in the medium and long term, a gradual recovery of the physical-chemical properties of the soils, increasing the organic matter content and fertility. This has been reported in some studies (Osorio 2000, Montoya y González 2007, CONABIO s.f., CONAFOR s.f., USDA s.f.).

D.2. Environmental impact assessment

The environmental impacts of activities associated with farming developed in the project area have been assessed and identified in Table D.1.

During implementation of the project activity, all rules, regulations and permits have been complied with. All requirements and requests from the regional environmental authority CORPORINOQUIA have been promptly and completely addressed[93]

SECTION E. Socio-economic impacts

E.1. Analysis of socio-economic impacts

In order to adequately assess the socio-economic impact of the Project Activity in the region, it is important to understand the social and economic context without the project. The Vichada region is distant, remote and very poor; the state offers a scant presence, transport and economic infrastructure are lacking, the municipality has a miniscule budget, and there are limited employment opportunities. Productivity levels are low - cattle ranching only employs one unskilled worker per 100 hectares. Approximately 30% of the population does not read or write

The population suffers from a lack of public services: there are no potable water plants, no wastewater piping in the towns, no wastewater treatment, no garbage collection and no landfills.

[93] As confirmed by DOE interviews with the Director of CORPORINOQUIA and the Designated National Authority.

People are vulnerable to health problems because of scant medical facilities and a lack of medical professionals. The very low-income levels make the population vulnerable to malnutrition.

Because of the remoteness, lack of roads, and lack of state presence, economic development opportunities are very limited. As a result, the region has been a haven for illicit drug crop cultivation and a refuge for illegal armed groups such as the FARC and paramilitaries.

In this context, the introduction of large-scale reforestation and forest restoration activities with formal labour arrangements creates an important number of new jobs for professionals, skilled and unskilled workers. The project demands numerous goods and services from the local economy and will do so for the long term. Because of the large scale of the project, the direct and indirect incomes to the local populations are very significant, and they recycle through the local economy as demand for housing, clothing, food, transportation, recreation and various services.

E.2. Socio-economic impact assessment

The principal impacts that the project is expected to produce are formal labour arrangements, an important number of new jobs for professionals, skilled and unskilled workers. The project injected US$6,1Mn in wages to over a thousand workers during the period 2005-2010 and is planning to pay over US$11.5 Mn in wages over the period 2011-2014. These incomes provide a major boost to social and economic wellbeing of the region.

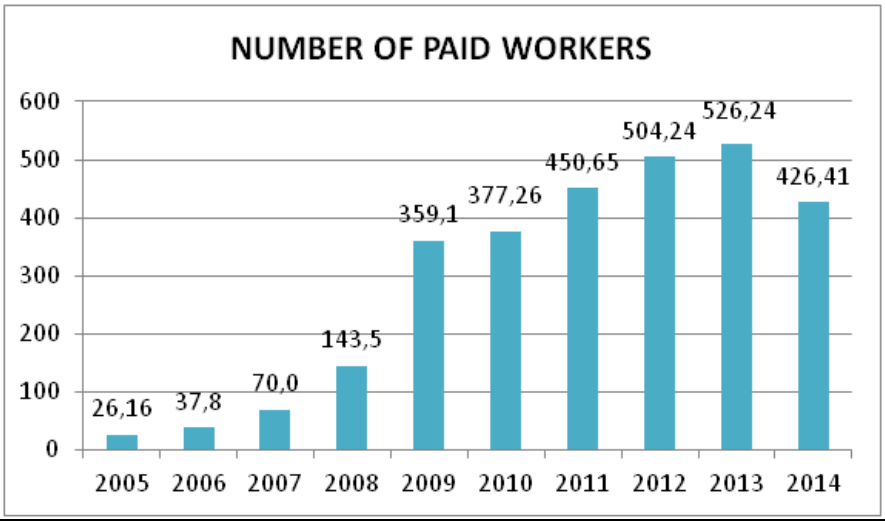

Figure E.1. Number of paid workers

Table E.1. EMPLOYMENT AND WAGES PAID, 2005-2010	
Number of jobs	1,014
Days worked	364,936
Wages Paid	Col$ 11,313,002,270
	US$ 6,115,136

Source: Bosques de la Primavera, 2011

Table E.2. EMPLOYMENT AND WAGES PLANNED, 2011-2014	
Number of jobs	1,908
Days to be worked	686,711
Wages to be Paid	Col$ 21,288,047,582
	US$ $ 11,507,052

Source: Bosques de la Primavera, 2011

In addition, the Project is working with state officials and other private organizations to bring adequate health facilities to the region. The project provides professional training for skilled positions that did not exist in the region. It provides health services, lodging, and food services to its workers on site. It provides an alternative to employment in illicit crops or with illegal armed groups. GTZ has stated that reforestation projects such as these are a major contributor to peace and stability in Colombia's outlying regions. In conclusion, the project activity contributes a great

deal to improving the social and economic well-being of the region and does not generate negative impacts.

SECTION F. Local stakeholder consultation

F.1. Modalities for local stakeholder consultation

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In preparation for the public consultation, the PDD was presented to and posted by the Mayor's office and the Office of the Public Defender on 28 July 2011. Invitations were sent to all relevant agencies and to stakeholders throughout the community two weeks prior to the event. The public consultation event was carried out on August 12, 2011, during the Annual Primavera Fair at the fairgrounds, in accordance with the procedures stipulated by resolution 2734 of December 29th of 2010 issued by the Ministry of Environment, Housing and Development. All aspects of the project activity were presented in detail during the four-hour presentation. Photographs, audio recordings and film document the event, which was attended by 90 stakeholders. 55 participants presented signed surveys on their perceptions regarding the project activity.

F.2. Summary of comments received

>>

As indicated in the tabulations, below, the community and stakeholders strongly support the project and do not identify significant problems related to sustainable development or community acceptance. No significant opposition was documented. This remote region sees the project as a welcome source of employment and related economic activities, and one that positively contributes to local environmental considerations.

Figure F.1. Participation in the social consultation event by Luz Dersi Rodriguez, Regional Director of the Environmental Authority CORPORINOQIA.

Table F.1. Attendance by Type of entity.

Attendance: 90 persons.	
Public Sector Agencies	27.3%
Other	27.3%
Cattle ranching	23.6%
Comercial Enterprise	7.3%

Table F.2. Environmental and Community Impacts

Considering the social and environmental conditions in the area before the project, please indicate whether the changes in the social and environmental conditions

Industrial or agroindustrial entity	5.5%
Agriculture – other crops	3.6%
Not specified	3.6%
Agriculture – Palm	1.8%
Total	100%

caused by the project are positive or negative.	
Positive:	96.4%
Negative:	1.8%
No change:	1.8%

Table F.3. Community support for this type of project in the region

Do you support this type of project in the region?		
Response	**%**	**Reasons Stated in the survey**
Yes	98.2%	Provides employment
		Improves quality of life in the area
		Contributes positively to the environment, biodiversity and environmental services
		Contributes to progress in the region
		Generates legal employment, transforms the use of land and soils, conserves and generates environmental services, mitigates climate change
		Contributes to the reduction of violence in the region
		Motivates the community not to deforest, and improves quality of life
No	1.8%	Responder indicates that has no knowledge of forestry and is his first participation in an event on forestry

F.3. Consideration of comments received

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A diverse range of questions and comments were received regarding the project, all of which were answered either in person by the speakers or in writing in the formal written response which was presented to the Mayor's office and the Office of the Public Defender for public posting and distribution. Given that there was no opposition or significant criticism of the project, changes to the project management were not necessary.

SECTION G. Approval and authorization

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The Letter of Approval of the project, was issued on May 10, 2012 by the Ministry of Environment and sustainable development, acting as the Colombian DNA

Appendix 1. Contact information of project participants

Organization name	Bosques de la Primavera S.A.
Country	Colombia
Address	Street/P.O.Box: Cra. 14 No 78-30, level 3 y 4, Bogota
Telephone	(57) 310 4266776
Fax	
E-mail	jesusrivera@proyectosforestales.com
Website	http://www.proyectosforestales.com
Contact person	Jesus Rivera

Organization name	Bosques de la Primavera S.A.
Country	Colombia
Address	Street/P.O.Box: Cra. 14 No 78-30, level 3 y 4, Bogota
Telephone	(57) 310 4266776
Fax	
E-mail	proyectosforestales@proyectosforestales.com
Website	http://www.proyectosforestales.com
Contact person	Maria Angelica Rivera

Appendix 2. Affirmation regarding public funding

N.A. The project is financed by private investors participating in the forestry project. A small complementary source of project financing is the CIF (Forest Incentive Certificate), an incentive offered by the National Government in recognition of the benefits of reforestation, which reimburses a percentage on the cost scale for the establishment of forestry projects during their first five years. It is oriented only to assist in establishment costs. However, the CIF is an uncertain source because it depends on the budget availability of the National Government. When the national budget has other priorities, there is no CIF.

Appendix 3. Applicability of methodologies and standardized baselines

Information on the applicability of the methodology is described in Section B.2.

Appendix 4. Further background information on ex ante calculation of net anthropogenic removals

Information on ex ante calculation of removals by sinks is described in Section B.7

Appendix 5. Further background information on monitoring plan

The monitoring plan should establish standardized procedures to capture accurately and in a controlled manner all the relevant information regarding the development of tree stands planted under the CDM. The methodological elements for monitoring of the plantation, are combined and adapted with the procedures determined by the UNFCCC methodology (AR-AM0004 v.4). It will be complemented by silvicultural procedures manuals designed to train technicians in the field and staff responsible for collecting and processing the information generated in the field.

The selected methodology provides for the monitoring of the following elements:

- **Project Boundary.** Defines all areas to be intervened by the proposed project activity. It includes the monitoring of all project areas where stand models planting activities will take place. These are defined as areas under control. These areas should be monitored regularly to detect any changes in the geographic characteristics of the project or variations in the strata established at the beginning of the project.

- **Forestry Activities.** Establishment of tree stands, silvicultural management and harvesting. This section will include, if appropriate, the removal of biomass associated with thinning, pruning and weeding. This activity affects the amount of carbon sequestered by the project proposal and makes its monitoring and evaluation necessary.

- **Quality control of the information generated**. Control and quality of the information collected. The process focuses on a set of procedures to control the collection of field data, archives, verification and internal audits of the resulting information, ensuring the integrity of the data collected for each monitoring period and throughout the execution the proposed project activity, establishing a chain of custody of the information.

Components to monitor.

1. **Monitoring the development of all A/R CDM activities.**

   a) **Monitoring project boundaries**.

The project boundary will be monitored periodically through the crediting period. If the boundary is changed during the crediting period, the boundary will be modified and reported to DOE for subsequent verifications.

   b) **Monitoring of forest establishment to ensure the quality of the plantation and the fulfilment of the practices described in Section A.4.**

The technical body appointed for this purpose will monitor the development, quality procedures and survival of the stands. The information relevant to forestry development will detail, among other things:

Site preparation: In the involved stands in the areas under control, land preparation is done as described in the PDD (Section A.4). The information on the activities will be monitored and verified, keeping track of the dates on which this activity is carried out on each lot.
Appendix 6.

Verification of species and strata: The established stands which make up the project activity are verified against predefined species and strata in the PDD and stored in the project database, depending on the species and stand model they belong to.

***Survival*:** Monitoring of survival will be performed after the first maintenance activity of the managment units (approximately three months after the plots are planted). If a survival rate detected is less than 90% of the initial amount sown, replanting of the missing material should be performed using the same species, seeking to maintain the plots homogeneous in age and development. The estimation is done by a simple count of the individuals within each managment unit, verifying its state of vitality; then the density of the living individuals is determined, and finally it is compared to the initial density of the establishment. The results are reported by means of the reports from the contractors charged with the establishment and first maintenance of the forestry plantations.

c) Monitoring of forest management.

The activities of thinning, fertilization and clearing the stands will be monitored, ensuring the correct implementation of designed practices. Other activities such as: pruning, thinning and removal of wood, replanting as a result of mortality or use at the end of the rotation are also considered.

The presence of anomalies, such as fires, plagues, diseases or disturbances and the technical recommendations for plantation management shall be documented and reported promptly recording dates, location, area, and species. The minimum preservation time of the information shall be the rotation period according to the tree stand model or two years after the end of the crediting period or the last issuance of CERs. Whichever occurs late.

2. Monitoring of net removals by carbon sinks and data acquisition

The monitoring of this section is done using permanent plots, where the dynamic process of plantation growth is evaluated, to estimate carbon contents present in the arboreal biomass. The inventory of the plots allows the comparison of species planted to those proposed in the project as well as the plantation density. The plot establishment and dendrometric variable measurement protocol will be followed to estimate the volumetric increases in each tree stand. This information will serve as input to validate the volumetric equations by species, or to reformulate new equations that enable the more precise modelling of the volume attained by the species planted for the project area.

Some of the most important aspects in monitoring include:

Stratification.

The strata defined, will be monitored in a database that lists species, area, plot, date of planting, etc. This database will be stored both in physical and digital format. This database will be additionally supported by the respective cartography. An annual update of the project areas is suggested, due to the gradual process of intervention, as this allows a permanent control and monitoring of the areas per stratum.

Strata monitoring.

The areas of strata previously defined will be periodically monitored in accordance with the criteria established for the monitoring of project boundaries, seeking to identify changes in the parameters of the initially established areas, and promoting the unification of strata considered as dissimilar in the *ex-ante* phase. According to changes in the accumulation of carbon in each monitoring period, a new stratification that would group stands with similar accumulations and

other aspects in common. If a pre-sampling is conducted before the first monitoring, the results will allow a re-stratification to be made, according to the following parameters:

- Age
- Silviculture management
- Carbon capture
- Cost-effectiveness of the monitoring process
- Disturbances (plagues, fire, pathologies, etc.)
- Others

Monitoring changes in the Carbon contents.

A series of permanent sampling plots will be established to allow the identification of changes and evolution in the accumulation of Carbon in the tree stands, according to the criteria of cost-effectiveness, keeping a precision level of ± 10% in relation to the mean.

Sample size

Sample size is calculated following the steps described in the methodology or forest inventory common practice.

Distribution of the plots.

To guarantee that the variability generated, in the growth process of each distinct stratum, is taken into account, the plots will be distributed in random manner or systematically, with a randomly selected starting point in the distinct strata established and existing for the first verification period. This will be defined previous to the first monitoring activity.

Location and establishing the plots

After having carried out the plot distribution, the central point of the plot is located in the field with the help of GPS. The entry route of the plot must be marked to facilitate its location in later monitoring of the auditing process. Project geodatabase and maps of different scales may be used for this activity. The shape of the monitoring plots is rectangular, with an area between 100 m^2 (possibly for ANR and PNR stand models) and 500 m^2 (possibly for commercial stand models).

Monitoring

Frequency

The first monitoring is expected in the year 2013 and then monitoring activities every 5 years (Table 1).

Table 1. Monitoring schedule for the plantations established in the Project Activity for the first accreditation period.

N° of monitoring	Year
1	2015-2016
2	2020
3	2025

According to paragraph 12 of Appendix B under decision 19/CP.9, monitoring must not be performed during the maximum Carbon peaks of the distinct plots; therefore, this will be avoided. Nevertheless, the distinct plots are established dynamically, with no preference for species since they depend on the environmental conditions of the areas incorporated to the project. Thus, the maximum Carbon content peaks are hard to establish and possibly will not coincide with the monitoring periods.

Measurement and estimation of the Carbon content through time

The estimations for carbon removals is carried out with the equations proposed in the ex-ante phase or based on locally derived equations. The estimation of the change in the Carbon content present in the living biomass is considered for each sample plot, through the use of the BEF method.

Therefore, the variables of tree dimensions that must be measured in the monitoring plots are the breast Height Diameter (DBH, 1.3 m over the ground) and the total height (h). However, at the moment of the first verification, appropriateness of allometric and volume equations are assessed; and other variables should be considered in appropriate cases (e.g, basal area, crown diameter, etc.) if the initial equations are modified.

For determining the total biomass per individual, the aerial biomass expansion and the root-shaft relation proposed by the IPCC (2003) were used, as a first measure. Nevertheless, new values reported by published technical literature may be used as well as estimates under similar conditions and for similar species as those of the project.

New volume equations and appropriate estimations for the Project activity and the species considered ma y be assessed, from the information gathered in the first monitoring period. To convert the commercial volume into average Carbon contents in the aerial and subterranean biomass through the specific density of the dry wood, Ec. 67 and 68 of the AR-AM0004/Version 04 Methodology are applied. The value for the density will depend on the species to evaluate under each specific plot model and stratum. The total contents are obtained by multiplying the mean values of Carbon content per stratum, per area of each stratum.

The variations in the aerial and subterranean Carbon contents through time are estimated through Ec. 69 and 70 of AR-AM0004/Version 04. These consist in subtracting the Carbon contents at time t2 from those at t1 and dividing them by the amount of years elapsed.

Only the increase of aboveground (tree in all strata and shrubs in the RN) and belowground biomass in tree vegetation established in the Project is considered (accord to AR-TOOL 014 V0.4.2). Increases in biomass of disperse and preexisting trees are not accounted for, given that these individuals are part of the baseline. Therefore, only the individual growth of each tree in the sampling plots will be monitored. The increment in biomass in early successional stages of the NR strata, will be considered the biomass of shrubs and will be measured as the tool AR-TOOL 014 V0.4.2 [94], subsequently, measurements of the trees in the RN in addition to the shrubs will be included.

The shrubs biomass can be estimated accord *to AR-Tool 14, section 11*. Its estimation way does not imply any plots assembly in land:

[94] In the early stages of successional of RN, the biomass is superior to the baseline and is composed of seedlings and shrubs characteristic of the successional process in the natural regeneration of the forest. Therefore, its measurement is in accordance with the methodological recommendations of the UNFCCC.

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

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 $CC_{SHRUB,I}$ = 0.10); dimensionless.

The $CC_{SHRUB,I}$ can be evaluated following the recommendations of the tool.

"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"

This value will be estimated based on the increase in shaft size determined during each monitoring activity. The changes of carbon contained in other components of the aboveground biomass (branches and leaves) and belowground (roots) of the trees of each plot, will be estimated by the *Biomass Expansion Factor Method-BEF*. This process is accepted by the IPCC[95] and UNFCCC[96].

- **Process for trees with DBH less than that defined by the allometric equations for all species of the commercial stratum.**

On the other hand, for trees that do not comply with the minimum size of DBH for the application of allometric equations, the procedure to follow is the one recommended by the appendix 1, AR-AM Tool 0014 V.4.2. This appendix defines that:

[95] The Intergovernmental Panel on Climate Change (IPCC) 2003. IPCC Good Practice Guidance for LULUCF.

[96] AR-Tool 0014.V.4.2.

Where the number of saplings with diameter below the range of diameter applicable to the allometric equation is high, the mean biomass of the saplings in a sample plot can be estimated as follows: (1) Determine the diameter mid-way between the diameter of the smallest sapling existing and the smallest diameter allowed by the allometric equation. (2) Harvest from outside the plot area a few saplings having diameter close to the mid-way diameter and obtain the mean biomass per sapling; (3) Count all the saplings in the sample plot and multiply this number by the mean sapling biomass to obtain their contribution to the plot biomass.

The contribution must be given in biomass dry weight, for which samples must be taken to the laboratory for their determination or make use of literature information.

This process is carried out in each of the verifications for the trees that do not meet the minimum diameter in the sampling plots and for each of the commercial species planted.

Quality control and assurance in the monitoring processes.

Procedures established by the project to guarantee the quality of information taken and its proper keeping will be followed. The procedures consist, initially, of training the staff in charge of reading, gathering and storing information. Secondly, the actual capacity of the staff in charge of analysing and making estimates from the information of the monitoring carried out will be analysed. In the same manner, there will be forest technicians that will support the execution activities of the specific plot establishment to comply with the described guidelines and project objectives.

Operational and management structure of the project. The organizational structure allows the visualization of a command and responsibility hierarchy to guarantee the control of the quality of information.

Monitoring of the CDM related parameters and data is the responsibility of the Environmental Group Director. Data is archived both in electronic and paper forms. All electronic data and reports shall also be copied on durable media such as CDs and copies of the CDs are stored in two locations (La Primavera and Bogota Offices). 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.

All this information be kept for at least two years after the end of the crediting period or the last issuance of CERs. For this project activity, whichever occurs later.

For the training of the personnel the project will provide protocols, formats, and forms, that allow the standardizing of the processes of monitoring plot establishment, taking information from the field (tree proportion variables), incorporating, analysing, handling and storing gathered information. According to the methodology, four fundamental stages are considered, to guarantee, in transparent and accurate manner, the GEI removal estimates of the Project:

Reliability of the field measurements.

The protocols designed for the training of the personnel in charge of establishing plots and of measuring the tree dimension variables (height, diameter at the chest height) guarantee the

standardization of procedures. The training of such personnel shall be under the responsibility of the field engineer and supported by technicians.

The need to carry out modifications to such protocols will be evaluated periodically, without generating alterations to the values of measurements carried out previously. The latter may occur for the purpose of adjusting the protocol to the conditions of the region and growing dynamics.

The time of training will be the necessary time to guarantee sufficient knowledge in handling measuring equipment and instruments. Therefore, training shall include theoretical and practical measuring procedures and avoid measuring and typing errors in the information.

The hiring of specialized firms for forestry measurements may be considered as an alternative, as long as these comply with trained protocols, high quality standards and have equipment and advanced technologies that minimize to a greater extent the possible errors in estimation.

Procedure for the identification of measurement errors.

This auditing procedure consists in executing a later verification of the data obtained from the forest inventory or monitoring and shall include the following characteristics and steps:

- It will be carried out by personnel that is different from those that executed the inventory. They should have ample experience in forest inventory procedures and wood volume estimation for different species. It is particularly important that the person in charge of this measurement should not know the results of the measurements to be audited.
- Between 10 and 20% of the total plots established under the forest inventory must be taken into account.
- The instruments used must have similar characteristics to those used in the initial inventory.
- The measuring procedures shall be adjusted according to the steps established under the measurement manuals or protocols with which the personnel were trained.
- Location of the plots.
- Establishment (sketching) of the plots Measurement of the Diameter al breast height (DBH) and total Heights (H).
- Comparing the information obtained with the original information taken by the forest inventory crews or teams.
- Error identification. This will be carried out by comparing both information (original inventory and audit inventory) in paired manner.
- If errors are identified, these are corrected and recorded, and expressed as a percentage of the total plots that were remedied, to promote an estimate of the measurement error[97]:

$$\text{Mistake measurement (\%)} = \frac{Biomass_1 - Biomass_2}{Biomass_2} \times 100\%$$

The permissible error must not be greater than 5%.

- Verification of the digitalization of the information and the analysis.

[97] Pearson, T., S. Walker and S. Brown S. 2006. Sourcebook for land use, land-use change and forestry projects. Winrock and Biocarbon fund. 57 p

The information digitalization phase: the transference of the data to digital spreadsheets shall be performed by the professionals qualified for such task and the personnel qualified in Carbon content of biomass estimation shall develop its analysis.

To detect errors in data entry in the digital spreadsheets, a person other than the one in charge of initially entering the information will type between 10 to 15% of the field forms in an additional spreadsheet. The results of the two calculations (original and auditing) shall be compared to detect errors. Any error observed will be corrected in the original file.

Estimation of the typing errors:

The typing errors are given by:

$$\text{Mistake (\%)} = \frac{\text{Number of mistakes found in the sample}}{\text{Total of the sample}} \cdot 100\%$$

If an error of over 10% is detected, the data of the field forms must be re-entered in digital form.

The estimates carried out with data that is of external nature regarding the Project but with similar activity conditions will be compared (information in literature, forest inventories of adjacent zones, etc.), to verify the presence of errors or strange data.

Care and storing of information

The information will be stored in original and digital form with sufficient copies and a fixed means will be secured to avoid its loss.

In accordance with AR-AM0004/V.04, the verification checklist will be followed (Table 2) to maintain consistency, quality and control in data taking and in performing calculations. The engineer in charge of forest inventory will execute the checking and control activities.

Data analysis.

In order to guarantee that the steps for the estimation of the net removals generated by the project are properly developed in the monitoring phase, the latest version of the TARAM tool is being used. This tool provides consistency for estimations from information gathered through monitoring.

Table 2. Verification checklist (original) recommended by AR-AM0004/V.04, to guarantee quality and control of the information and its management

QC activity	Procedures
Check that assumptions and criteria for the selection of activity data and other estimation parameters are documented	• Cross-check descriptions of activity data and other estimation parameters with information on source and sink categories and ensure that these are properly recorded and archived.
Check for transcription errors in data input and reference.	• Confirm that bibliographical data references are properly cited in the internal documentation • Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors.

Check that removals are calculated correctly.	• Reproduce a representative sample of removal calculations. • Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy.
Check that parameter and units are correctly recorded and that appropriate conversion factors are used.	• Check that units are properly labelled in calculation sheets. • Check that units are correctly carried through from beginning to end of calculations. • Check that conversion factors are correct. • Check that temporal and spatial adjustment factors are used correctly.
Check the integrity of database files.	• Confirm that the appropriate data processing steps are correctly represented in the database. • Confirm that data relationships are correctly represented in the database. • Ensure that data fields are properly labeled and have the correct design specifications. • Ensure that adequate documentation of database and model structure and operation are archived.
Check for consistency in data between categories.	• Identify parameters (e.g., activity data, and constants) that are common to multiple categories of sources and sinks, and confirm that there is consistency in the values used for these parameters in the emissions calculations.
Check that the movement of inventory data among processing steps is correct	• Check that removal data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries. • Check that emission and removal data are correctly transcribed between different intermediate products.
Check that uncertainties in removals are estimated or calculated correctly.	• Check that qualifications of individuals providing expert judgment for uncertainty estimates are appropriate. • Check that qualifications, assumptions and expert judgments are recorded. Check that calculated uncertainties are complete and calculated correctly. • If necessary, duplicate error calculations on a small sample of the probability distributions used by Monte Carlo analyses.
Undertake review of internal documentation	• Check that there is detailed internal documentation to support the estimates and enable reproduction of the emission and removal and uncertainty estimates. • Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. • Check integrity of any data archiving arrangements of outside organizations involved in inventory preparation.
Check time series consistency.	• Check for temporal consistency in time series input data for each category of sources and sinks. • Check for consistency in the algorithm/method used for calculations throughout the time series.

Undertake completeness checks	• Confirm that estimates are reported for all categories of sour ces and sinks and for all years. • Check that known data gaps that may result in incomplete emissions estimates are documented and treated in a conservative way.
Compare estimates to previous estimates.	• For each category, current inventory estimates should be compared to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain the difference.

All the information that corresponds to management of the forest project itself will be handled through the SILVIA[98] software or a similar database.

Appendix 7. Summary report of comments received from local stakeholders

See section F.

[98] http://web.catie.ac.cr/Silvia_ML/Espanol/Marco%20principal_esp/contenido_esp.htm

Appendix 8. Summary of post-registration changes

All the adjustments and changes follow the recommendations of the applied methodology, as well as the guidelines *CDM project standard for project activities*, describing real conditions of the development of the project activity without affecting conditions eligibility, additionality, baseline and levels of precision in the estimates.

Change	Comment	Observation	Type change
Re stratification. New stratum: - **Commercial.** ***Sub-strata*** -Low -Steady -Middle -High - Upper - **Assisted Natural regeneration.** **- Protected Natural regeneration**	The re-stratification was developed because of the differences identified in the developed pre-sampling process assessments with information systems and geographic.	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 additionality. - Not affect the scale project. Since the project area is not reduced and the annual average removals remain high.	Change in project design and affected monitoring plan design.
The AR-TOOL 014 V0.4.2 tool is applied. Changes in parameters, equations, or methods used in tree biomass estimation. Changes in methods of estimation of changes in any carbon pool.	- Procedures were added for sampling in shrubs as part of the natural regeneration process. - Default values recommended in the TOOL are used.	This is the last version of tool from biomass estimate. Conservative estimates are assumed, based on the default values of TOOL, and national report in relation to contents of total forest biomass in the project region, for the estimation of early stage biomass of natural regeneration. - Not affect the applicability condition the methodology and Base line -Maintains the accuracy requirements in the estimates accord the methodology applied and Good Practice Guide recommendations (IPCC, 2003). - Not affect the additionality. - Not affect the scale project.	Change registered monitoring plan.

	- Procedures were added for sampling in tree whose DBH are less than those defined by volumetric or allometric equations applied, or for trees that have not yet reached a height greater than the DBH (*total height <1.3m)*.	For trees smaller than ranges established by the applied equations in the commercial stratum, the harvesting procedure is implemented to estimate the average biomass of these tree, following the AR-TOOL 014 V0.4.2, appendix 1. - Not affect the applicability condition the methodology and Base line -Maintains the accuracy requirements in the estimates accord the methodology applied and Good Practice Guide recommendations (IPCC, 2003). - Not affect the additionality. - Not affect the scale project.	
Tool for demonstration of applicability of allometric equations and volume equations in A/R CDM project activities is applied.	The equations of the allometric or volume type were defined for ex post estimates of net removals in the species of commercial stratum. These equations were not considered in the registered PDD	This in line with the procedures proposed in the PDD register. Meets the requirements of the tool, so its application is adequate. - Not affect the applicability condition the methodology and Base line - Maintains the accuracy requirements in the estimates accord the methodology applied and Good Practice Guide recommendations (IPCC, 2003). - Not affect the additionality. - Not affect the scale project.	Change to the Project design
Inclusion of species *Pinus oocarpa*	The seed of this species was mixed with a lot of acquired seeds. Given its similarity to *P. caribaea,* it was only until adulthood that it was identified as *P. oocarpa.* This species was planted as a whole than the *p. caribaea,* is a species not genetically modified and complies with the same conditions of adaptation to the *p. caribeae.*	The species complies with the conditions of applicability of the methodology, does not require flood irrigation, and its establishment and management is very similar to the *P. caribeae.* - Not affect the applicability condition the methodology and Base line. -Maintains the accuracy requirements in the estimates accord the methodology applied. - Not affect the additionality, it stays the same as it would be for *P. caribaea.* - Not affect scale project and the purpose of the project registered.	Change to the Project design

Changes in distribution of the areas for each of the stand models, particularly for the commercial stand model.	The registered PDD proposed 25,629 ha with commercial species, due to deprived conditions in soil quality for planting commercial species; this stratum is reduced by 19,181.09,573.1 ha. The areas that are not planted with commercial species, increase the areas of the PNR model, which was initially proposed in 3,000 ha and becomes 9,447.78 ha	It is clear that the total area of the project is not reduce, it remains the same and only changes the distribution, without affecting the conditions of eligibility, methodological applicability or baseline. - Not affect the applicability condition the methodology and Base line. - it is readjusted to develop more precise estimates to the reality of the project. - Not affect the additionality. - Not affect scale project and the purpose of the project registered.	Change to the Project design
Change in CF_{tree}	In accordance with national regulations and methodological recommendations, the carbon factor for commercial species was adjusted. Step from 0.49 to 0.47.	It allows to maintain conservative estimates in anthropogenic net removals, it conforms to national standards such as resolution 1447 of 2018 (RENARE), to the AR-ACM0003 methodology and to methodological tools such as the Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A / R CDM project activities	Change to the Project design
Change Root-shoot ratio	The values were adjusted to the ranges established by the IPCC 2003, according to the species and their biomass content.	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.	Change to the Project design

Adjustment to the AR-ACM0003 V02 Methodology that replaced the AR-AM0004 V04	This adjustment to the AR-ACM0003 methodology is adjusted to the conditions of applicability of the project, including sinks that are important in the net anthropogenic removals in the project, such as soil, litter, shrubs within the plantations and soil organic carbon (SOC).	As described, project areas were historically subject to slash and burn of pasture, causing critically low or zero carbon conditions in baseline carbon sinks. At the time of designing the project and starting the audit process for validation and registration, the AR-AM0004 methodology was the one that best suited the project conditions. This methodology only considered aerial and underground biomass as the main carbon sinks, and did not link others such as litter, shrubs, dead wood on the ground and the SOC. For the project proposal, these sinks are of vital importance, since they significantly improve the carbon contents in them when comparing with the baseline, especially in the soil component, which as demonstrated are degraded soils and that were subjected for more 50 years to periodic burning.. The project adjusts the project to the most up-to-date version of the methodology, that is, the AR-ACM0003 v02 that replaced the AR-AM00004 V04, meeting all the applicability requirements. Not affect the applicability condition the methodology and Base line, as it meets all the conditions established by AR-AM0004 V04 and AR-ACM0003 V02.	Change to the Project design

Appendix 9. Declaration on small-scale afforestation and reforestation project activity

N.A

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Document information

Version	*Date*	*Description*
11.0	31 May 2019	Revision to: • Ensure consistency with version 02.0 of the "CDM project standard for project activities" (CDM-EB93-A04-STAN); • Make editorial improvements.
10.0	28 June 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale afforestation and reforestation CDM project activities" (CDM-SSC-AR-PDD-FORM); • Make editorial improvement.
09.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
08.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.
07.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for afforestation and reforestation CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for afforestation and reforestation CDM project activities " (Version 01.1)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.8.4 and Appendix 1; • Change the reference number from F-CDM-AR-PDD to CDM-AR-PDD-FORM; • Make editorial improvement.
06.0	13 March 2012	EB 66, Annex 10 Revision required to ensure consistency with the "Guidelines for completing the project design document form for afforestation and reforestation CDM project activities".
05.0	30 July 2010	EB 55, Annex 22 Restructuring to reflect changes applied in the design of approved A/R CDM baseline and monitoring methodologies. Due to the overall modification of the document, no highlights of the changes are provided.

Version	*Date*	*Description*
04.0	19 October 2007	EB 35, Annex 20 • Restructuring of section A; • Section "Monitoring of forest establishment and management" replaces sections: "Monitoring of the project boundary", and "Monitoring of forest management"; • Introduced a new section allowing for explicit description of SOPs and quality control/quality assurance (QA/QC) procedures if required by the selected approved methodology; • Change in design of the section "Monitoring of the baseline net GHG removals by sinks" allowing for more efficient presentation of data.
03.0	29 September 2006	EB 26, Annex 19 Revisions in different sections to reflect equivalent forms used by the Meth Panel and facilitating the transparent selection of an approved methodology for the proposed A/R CDM project activity.
02.0	24 February 2006	EB 23, Annex 15a Inclusion of a section on the assessment of the eligibility of land and the Sampling design and stratification during monitoring.
01.0	03 September 2004	EB15, Annex 6 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: afforestation reforestation, project design document