Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia

Document prepared by

Bosques de la Primavera S.A.

Date of issue (*Version 1, 13/05/2025)*

Monitoring Report Template (Version 3.4)	
Name of project	***Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia***
BCR Project ID	*BCR-CO-261-14-001*
Registration date of the project activity	*11/05/2025*
Project holder	Bosques de la Primavera S.A
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Version number of the Project Document applicable to this monitoring report	*Version 1.0* *(11/05/2025)*
Applied methodology	AR-ACM003 Version 02.0

Monitoring Report Template (Version 3.4)	
Project location (Country, Region, City)	*Municipio: La Primavera,* *Departamento: Vichada* *País: Colombia*
Project starting date	*02/06/2005*
Quantification period of GHG reductions/removals	*30/06/2015 a 30/06/2045*
Monitoring period number	*3*
Monitoring period	(30/01/2023 to 31/03/2025)
Amount of emission reductions or removals achieved by the project in this monitoring period	1.234.074
Contribution to Sustainable Development Goals	*SGD 12 Responsible Consumption and production* *SGD 13 Climate Action* *SGD 15 Life on land*
Special category, related to co-benefits	*N.A*

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1 General description of project

The **Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia** seeks to establish in the municipality of La Primavera (Department of Vichada, in the Llanos Orientales of Colombia), a reforestation project with commercial forest species and at the same time promote the recovery and improvement of remaining natural forests and Riverside forests, under passive restoration actions, aimed, among other objectives, at fixing atmospheric carbon through the growth and development of plantations and natural forests. This environmental service contributes to the goals of reducing greenhouse gas emissions at a global level, gives dynamism to the international carbon market and the local market, driven by the policies of a carbon tax for consumption and burning of fossil fuels, and its potential non-causation when carbon credits are purchased to achieve carbon neutrality for companies required to pay the tax.

Purpose of the project activity and the measures taken for GHG emission reductions or net GHG removals by sinks; The Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia has as its objective to employ the international carbon market as a key incentive for investments in new commercial forest plantations and restoration of natural forests in the remote High Orinoco region of Colombia.

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

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

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

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

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

At the present verification, only **22.450,15** hectares were established in the different stand models (commercial stand models and natural regeneration systems) of the 29,019 hectares' eligibility.

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

Among the aspects to be highlighted during the current period is the ability to recover degraded soil, due to the unsustainable use of land for livestock production and the continuous burning to which they were subjected historically.

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

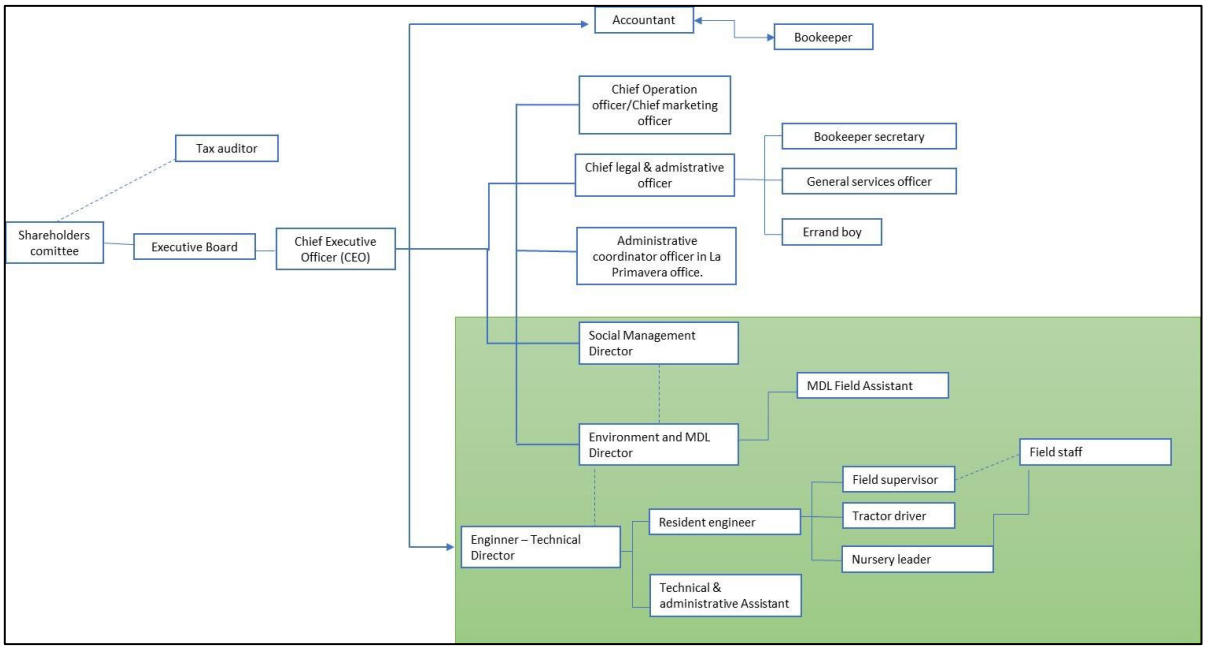


Diagram 1. Organization chart Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia.

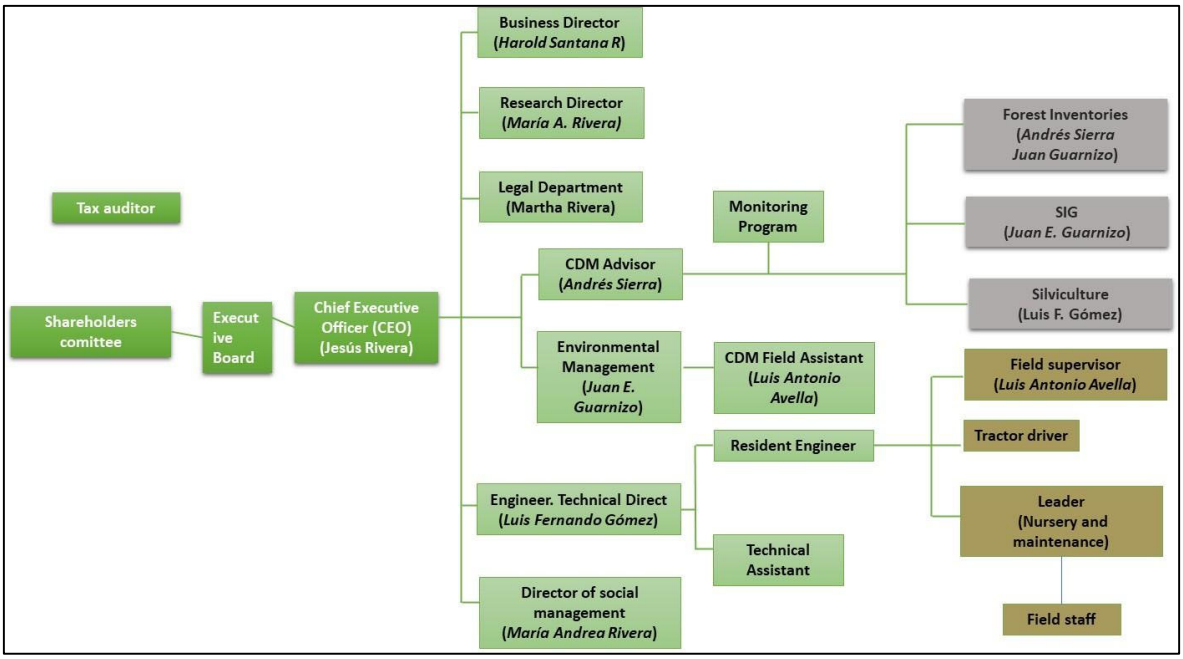


Diagram 2. Organization chart monitoring project.

Total removals estimations of atmospheric carbon by the project implementation accumulated 2005-2023 are 5,559,630, of which ***1.190.071*** tCO_2 eq correspond to the present monitoring period (2021-2023). This includes contributions from aboveground, belowground, shrubs, litter, dead wood, and carbon organic soil sink.

1.1 Sectoral scope and project type

Activities in the AFOLU sector, other than REDD+	X
REDD+ Activities	
Activities in the energy sector	
Activities in the transportation sector	
Activities related to Handling and disposing of waste	

The Proyecto is an initiative framed in the AFOLU sector. It is a project classified as ARR for reforestation with commercial forest species, which seeks to promote the recovery and improvement of remaining natural forests and riverside forests, under passive restoration actions.

1.2 Project start date

02/06/2025.

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 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 were approached by the Ministry of Agriculture during this period and they responded positively, deciding to carry out a Carbon forestry project, which began activities on June 2, 2005.

In 1999, the 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)[1]. 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."[2] That year, the Ministry of Agriculture and Rural Development commissioned a feasibility study to evaluate the Clean

[1] 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

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

Development Mechanism (CDM) as a new incentive for foresty: *"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 landowners 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.

Landowners and investors in Primavera Vichada were persuaded by the above-mentioned government programs and studies to invest in reforestation with carbon sequestration under Carbon project. 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 carbon project was celebrated with the support and presence of Dr. Roberto Camacho representing the CDM Initiative of the Ministry of Agriculture and Rural Development and the Director General of the Regional Environmental Authority of the Orinoco (CORPORINOQUIA), Dr. Orlando Piragauta (Image 1).

Image 1.. Planting the first tree in the –Carbon 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, and Dr. Orlando Piragauta, Director of the regional environmental authority CORPORINOQUIA.

1.3 Project quantification period

The period for the quantification of the removals and/or reductions of GHG emissions, for the Proyecto, which considers activities belonging to the AFOLU sector, is 60 years from June 02, 2025, to June 02, 2065.

The monitoring period for this verification is from 30/01/2023 to 31/03/2025: 2 years and 2 months.

1.4 Project location and project boundaries

1.4.1 Project location

a) Host Party

Colombia

b) Region/ State/ Province

Department of Vichada

c) City/ Town/ Community

La Primavera Municipality

1.4.2 Project Boundaries

The *Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia* is in the Municipality of La Primavera in the Department of Vichada (6º19'34'' y º53'58'' N y 67º25'1'' y 71º7'10'' W) in the extreme eastern plains of the Colombian High Orinoquia region (CORPORINOQUIA, 2008[3]). The Municipality of La Primavera is located approximately 400 km from Puerto Carreño, the capital of the department, and limits to the North with the Departments of Casanare and Arauca and the border of Venezuela. To the South, it is limited with the Municipality of Cumaribo, to the East with the Municipality of Puerto Carreño, and to the West with the Municipality of Santa Rosalía. The Municipality of La Primavera has an area of 21,420 km^2 which represents 22% of the total land area of Vichada (CORPOORINOQUIA 2008).

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

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

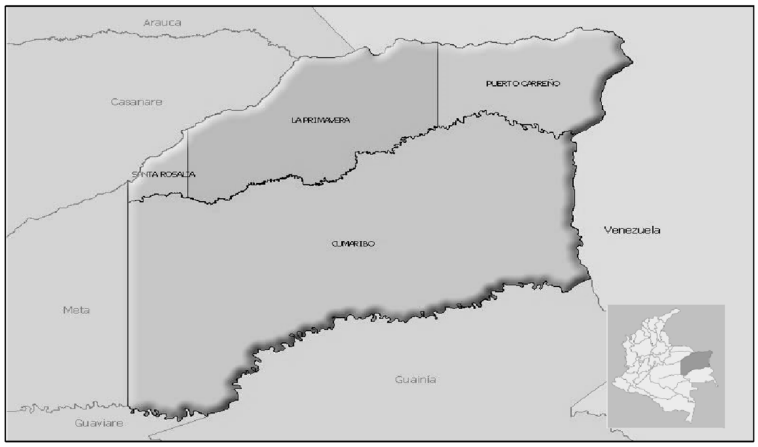


***Figure 1*. Location of the Municipality of La Primavera, department of Vichada.**

Location of the forest project nuclei that make up the Project

The Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia is divided into seven forest nucleus. The main features of each are presented below.

***Table. 1*. Location of each nucleus (central point).**

	Projected Coordinate system coordinates (Magna Colombia East)		Geographic coordinates	
Project	**X**	**Y**	**N**	**E**
Bosques de la Orinoquia	1168687	1094402	5° 26' 52,650" N	69° 33' 19,840" W
Compañía de María Padres Montfortianos	1112002	1084663	5° 21' 39,507" N	70° 4' 1,336" W
Bosques de la Primavera	1143404	1082147	5° 20' 15,701" N	69° 47' 1,765" W
Organización de la Primavera	1075832	1069974	5° 13' 42,975" N	70° 23' 36,550" W
Reforestadora los Cámbulos	1110748	1077895	5° 17' 59,279" N	70° 4' 42,417" W

Incomser	1120319	1081091	5° 19' 42,781" N	69° 59' 31,446" W
Reforestadora Guacamayas	1117826	1077782	5° 17' 55,218" N	70° 0' 52,586" W

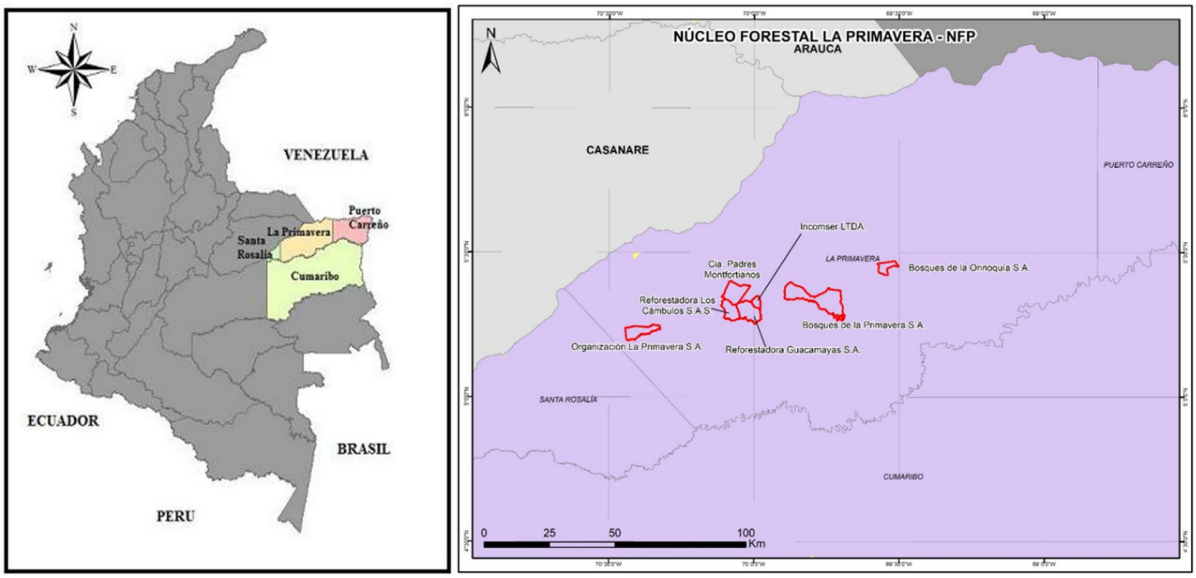
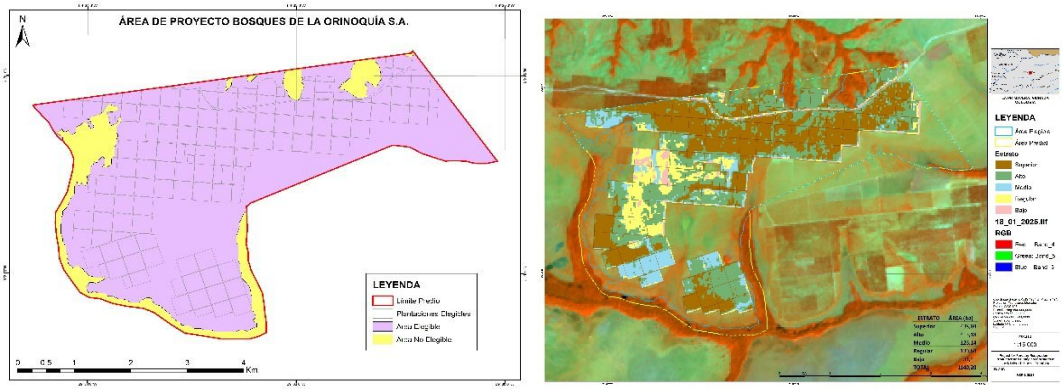


Figure 2. **Location of the seven forest nuclei in Municipality of La Primavera, Department of Vichada.**

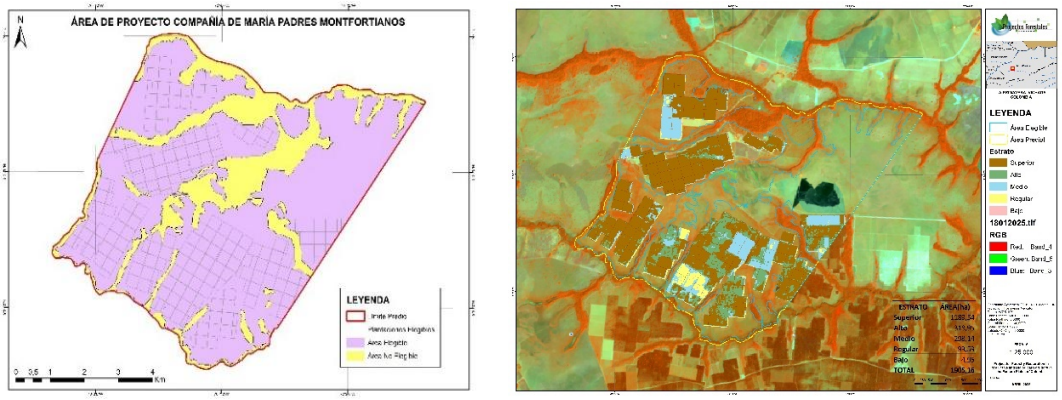
Bosques de la Orinoquia S.A.: This nucleus is in the village of Soledad, 120 kilometers from the municipal capital on the road that leads towards Marandua between the Terecay Stream and the Bita River. It includes the properties of Tranquilandia and La Pista.



A B

Figure 3. **Project boundary for Bosques de la Orinoquia. A, Project boundary; B, Planted area at 2025 year.**

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



A B

Figure 4. **Project boundary for Compañia de María Padres Monfortinos. A, Project boundary; B, Planted area at 2025 year.**

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

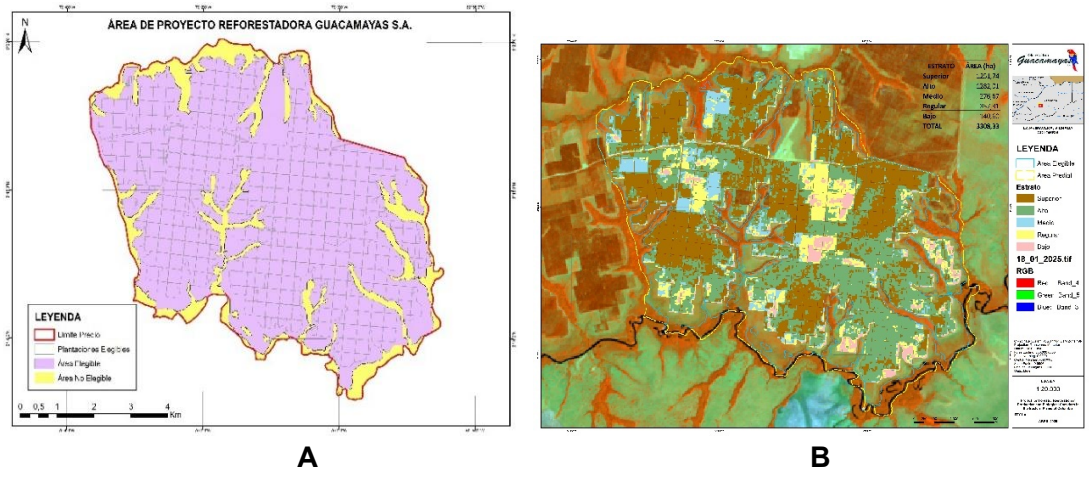


Figure 5. **Project boundary for Reforestadora Guacamayas. A, Project boundary; B, Planted area at 2025 year.**

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

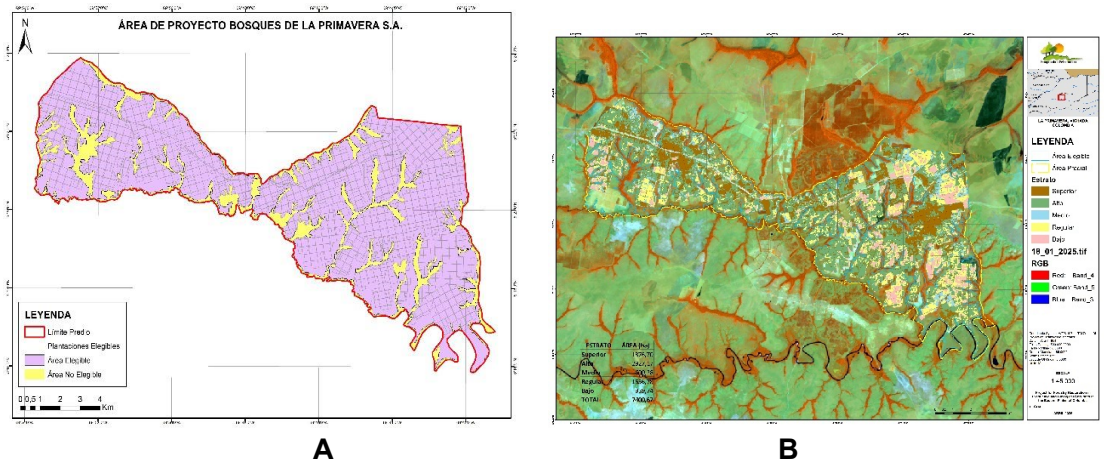
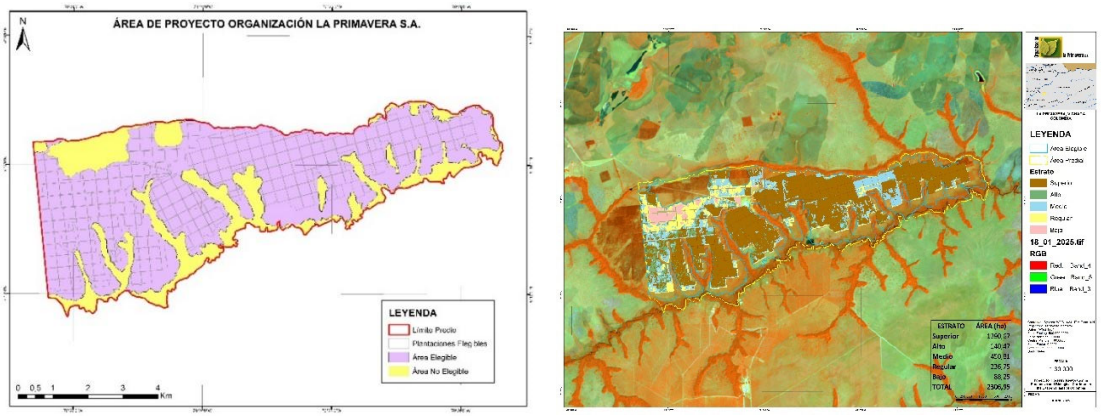


Figure 6. **Project boundary for Reforestadora Bosques de la Primavera. A, Project boundary; B, Planted area at 2025 year.**

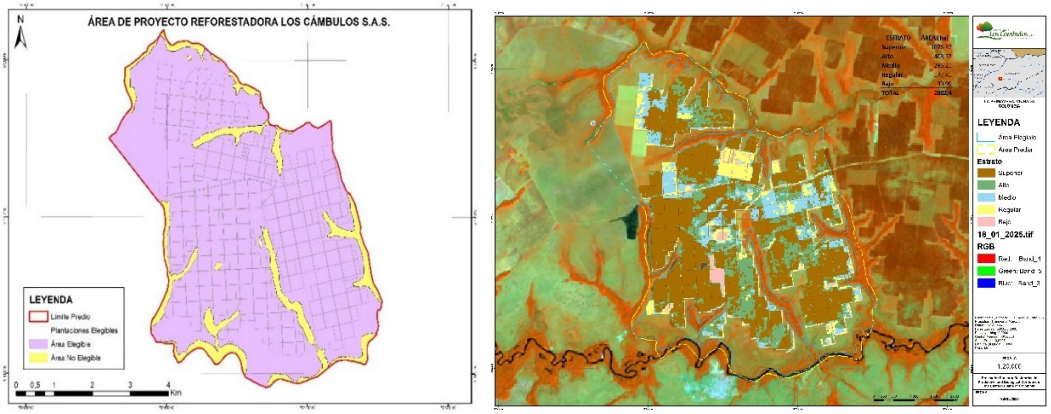
Organización La Primavera S.A.*:* this nucleus is located near the Altos de Meiva hamlet, 40 km from the municipal capital, bordering the El Lobo and Guacharacas streams and the junction with the La Evita River, a direct affluent of the Tomo River. It includes the properties of El Limonar, Mykonos II, Bosques de Vermont, Syros, Pasatiempo, and El Deseo.



A B

Figure 7. **Project boundary for Organización La Primavera. A, Project boundary; B, Planted area at 2023 year.**

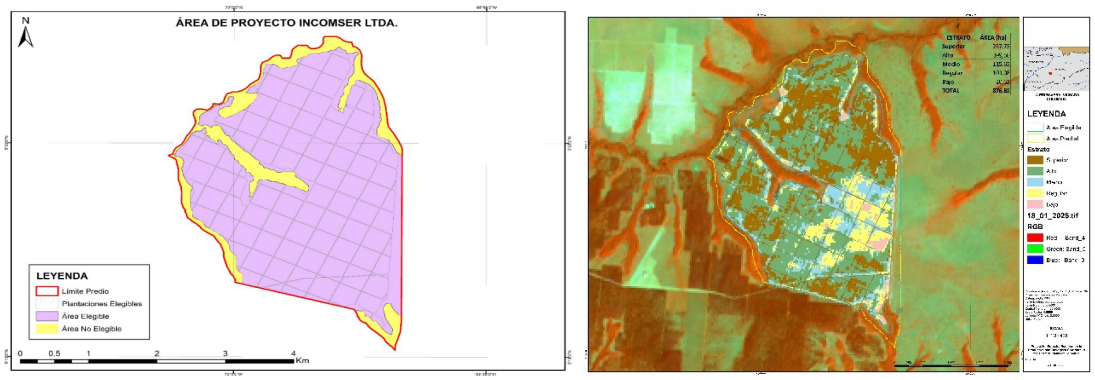
Reforestadora Los Cambulos S.A.S*:* This nucleus includes the properties Los Venados, Cámbulos and Chile. It is located on the road which leads from the Municipality of La Primavera to the city of Villavicencio (department of Meta) deviating at kilometer 19 and continuing 38 km East. The properties of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



A B

Figure 8. **Project boundary Reforestadora Los Cambulos. A, Project boundary; B, Planted area at 202*5* year.**

Incomser LTDA: This nucleus is adjacent to the Guacamayas project, on the northeastern side. At present it is owned by INCOMSER LTDA, a company specializing in forestry and engineering services, the property is known as La Lapa[4].



A B

Figure 9. **Project boundary Incomser. A, Project boundary; B, Planted area at 2025 year.**

Regarding the analysis of overlaps with other forest carbon initiatives developed in the region, three can be identified as the closest to the current project:

- El Dorado carbon Project: BCR-CO-956-14-001
- Proyecto Forestal Fundación Obra Social Redentorista Señor de los Milagros: PCR-CO-630-142-001
- Proyecto de carbono forestal organización la primavera: PCR-CO-697-142-001

[4] Referred to in the certificate of freedom as La Papa II.

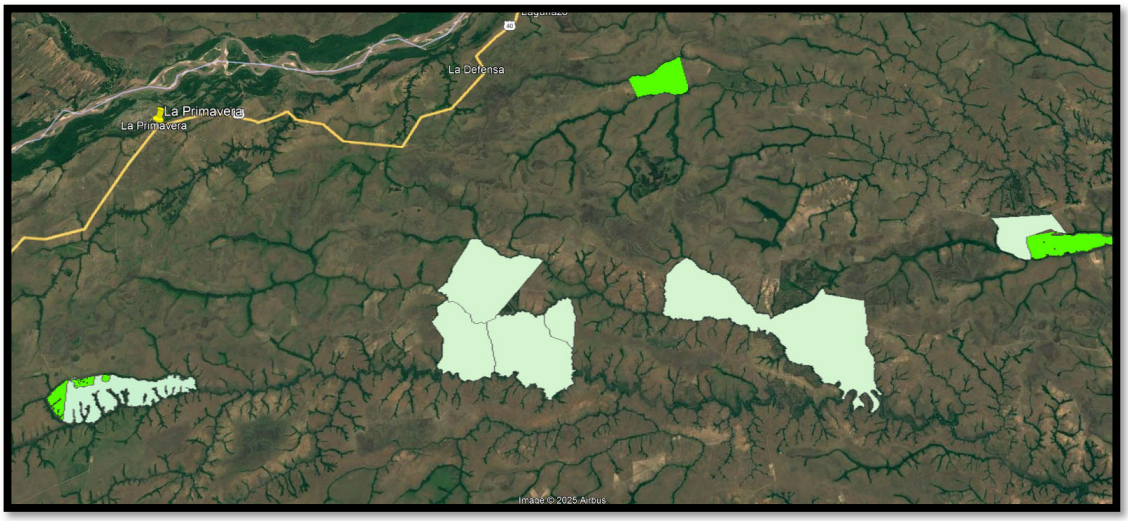


Figure 10. Not Overlapping with other GHG initiatives. The areas of the current Project are in light green, and other projects near the project area are in strong green.

1.5 Summary Description of the Implementation Status of the Project

Project operation starts date and period

The date of this report considers the development of activities from **January 30, 2023 – March 30, 2025.**

The project is a commercial forestry model, in abandoned and managed pasture areas, where extensive livestock farming activities were carried out.

The *Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia,* will consist of 29,019 ha eligible, for the current monitoring process, 18,940.3 ha are covered by the commercial model and 3,509.8 by natural regeneration Table 1.

***Table 1.* Stand model distribution (ha)**

Stand Model	Area (ha)
Commercial	18940.3
Natural regeneration (Passive)	3,509.8
Total	**22,450.15**

Some of the areas evaluated with a potential for commercial forestry that were within the eligible area's lists were not established due to low soil quality conditions, such as periodic flooding that impedes good seedling development. These areas have been left

for natural regeneration, to increase the estimated areas for this component in the project.

The distribution of models by project for the year 2025 is presented in the following table. **Project**	**Commercial (ha)**	**Natural regeneration (ha)**
Bosques de la Orinoquia	1.140,2	244,3
Bosques de la Primavera	7.400,7	591,4
Cámbulos	2.002,4	632,3
Guacamayas	3.308,3	452,6
P. Monfortianos	1.905,2	1.025,8
Organización La Primavera.	2.307,0	544,5
Incomser	876,6	19,0
Total	**18.940,3**	**3.509,8**
	22.450,2	

As for the establishments for the commercial model by nucleus, they were developed between 2005 and 2014, with the years 2008 to 2014 being the ones with the highest planting activity as shown in the following table.

Year	MON	BO	BP	CAM	GUA	INC	OLP	Total
2005							351	351
2006							490	490
2007		201					593	794
2008	223	330	483				327	1.363
2009	708	274	791		737			2.510
2010	157		1.596	619	721			3.094
2011	264		1.076	567	900		87	2.894
2012	502	311	905	234	324		128	2.405
2013	51	24	1.743	433	626		184	3.938
2014			805	149		877	147	1.101
Total	**1.905**	**1.140**	**7.401**	**2.002**	**3.308**	**877**	**2.307**	**18.940**

*MON: Monfortianos, BO: Bosques de la Orinoquia, BP: Bosques de la Primavera, CAM: Cambulos, GUA: Guacamayas, INC: Incomser, OLP: Organización La Primavera.

Assessment of the establishment of stands outside wetland areas.

According to the requirement AR-ACM0003 methodology, the actions of the project should not be in certain areas such as wetlands. Next, an analysis was developed, based

on the national layers of permanent wetland zones for the region, where it is shown that the plantations were not established in those areas, complying with the requirement of the methodology.

By 2025, the project has a total of **22.450,15**. The accumulated emission reduction from the established plantations and natural regeneration is estimated at **6,793,104 tCO2** since the start date. By 2025, accounting for verification in 2023, the net value will be **1,234,074 tCO2** for the period 2023-2025.

These plantations have had silvicultural management actions, such as weed control, fire control and prevention, pest control such as ants, as well as maintenance to improve the conditions of the stands, through fertilization, pruning, and thinning.

The project has received support from the government through the forest incentive certificate (CIF) and has permits from the corporation (COPORINOQUIA) for the environmental management measures established by this type of activity in the region.

See Appendix 10, Activity Monitoring, for support for these activities and the records of the work carried out. In general, management activities were developed periodically according to the requirements of the plantation and according to its development. The most recurrent activities focused on weed control, pests and fertilization, as they were carried out every year. Some activities such as thinking are not yet considered because the times for said activity are not met.

2 Title, reference and version of the baseline and monitoring methodology applied to the project

2.1 Methodology applied

The methodology applied to the project is AR-ACM003 Version 02.0 and **¡Error! No se encuentra el origen de la referencia.** summarizes the tools used in the development of the project for monitoring.

Table 2. Methodology and Tools used in baseline and monitoring

Title	Version
BCR0001	4.0
BCR Tool Permanence and risk Manegement	1.1

BCR Tool SDG	1.1
AR-Tool14 *"Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*",	04.1
A/R Methodological Tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"	01.1.0
AR- Tool12 A/R Methodological tool *"Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"*	03.0
BCR Tool *"Avoiding Double Counting (ADC)"*	2.0
SDSs Tool. Sustaniable Development Safeguards	1.1
Winrock Sample Plot Calculator use equations from: A/R Methodological Tool "Calculation of the number of sample plots for measurements within A/R CDM project activities"	02.1.0

3 Double Counting and participation under other GHG Programs.

The Project is not attached to other GHG programs or registries, see PDD. The project is duly registered on the RENARE platform to avoid double accounting in accordance with national norms.

4 Contribution to Sustainable Development Goals (SGD)

With 5 years to go until Colombia's 2030 agenda is met to achieve the Sustainable Development Goals, it can be highlighted that the implementation of the project for the period described in this monitoring report has managed to contribute especially to the reduction of areas degraded, has increased forest cover based on commercial stand models, has contributed to the protection of natural forests and waterways, and has reduced human-induced burning that affects ecosystems.

The **¡Error! No se encuentra el origen de la referencia.** describes the contributions of the project to the sustainable development indicators.

Table 3. Indicators that have contributed to the Sustainable Development Goals.

Objective	Contribution
	***12. Responsible consumption and production*** As a product of the thinning carried out in commercial stands and the release of defective trees, a part of this material has been used for fence posts and corrals, and other wood needs for maintaining the infrastructure of the farms. With this, the consumption of wood from forest species from natural forests has been reduced. This raw material reduces the need to use plastic wood or cement posts and has the characteristic of being biodegradable or a source of energy such as firewood in homes in the territory. The project has contributed to the protection of native forests an ecosystem characterized by riverside forests, and other hectares have been allocated for the protection of the water circuit and passive natural regeneration. The eligible area is **29,019** hectares. Of these, interventions have currently been developed for the establishment of new forests in 22,450.15 hectares, of which 3,509 are naturally regenerated forests, which contribute to the protection of natural ecosystems, the other areas will offer wood from planted forests, motivating the reduction of consumption of wood obtained illegally from natural forests.
	22,450.15 hectares of new forests have been established, in areas that were previously dedicated to extensive livestock farming without management and on degraded soils. These coverages have achieved the removal of 6.793.104 tons of CO_2eq (2005-2025, in 20 years implementations. For the current period, they will be added to the national accounting department under the mechanism of the RENARE platform, of which the project is already a part.
	The burnings to which the project areas were subjected are eliminated and protocols for the acquisition of equipment for fire control are established, allowing the prevalence of the flora and fauna species of the region that were previously threatened by conflagrations for grassland renewal (**22,450.15**ha of new forests) The areas of riverside forests identified in the baseline persist and increase in the water ring zones, according to the standards of the

	Corporación Autonoma Regional. Likewise, areas are left for natural regeneration. Although areas have been left for passive natural regeneration, this restoration is not quantified as new forest areas for the monitoring period, since the succession process is still in a very early stage.
Other transversal indicators of the project	**New Jobs:** 1191 monthly jobs have been generated and monitored in the monitoring period. All of these have all the conditions of social benefits, training and job security. **Women's Participation**: Women have been involved in nursery activities, accompaniment in the maintenance of camps and preparation of food for workers. **Trainings**: The training courses have developed the following topics. - Hazards in the workplace - Safety and coexistence rules - Safe handling of chemicals - Differences between poisonous and non-venomous snakes. - Standard Operating Procedure in case of ophitic accident. - Good practices to ensure the good use of the water resource. - Wildlife sighting. - Environmental management plan sheets. - Waste management - Prevention of Forest Fires The economic income of the staff has improved, guaranteeing more frequent and permanent jobs and income than those received in extensive livestock activities. The improvement in income helps to boost the economy in the municipal seat, which previously depended purely on income from livestock activity.

Table 1. Project contributions to the achievement of sustainable development goals

Number of SDGs to contribute	SDG	Activities that contribute	Consolidated Supports (Current Verification Period)

SDG 12	As a product of the thinning carried out in commercial stands and the release of defective trees, a part of this material has been used for fence posts corrals, and other wood needs for maintaining the infrastructure of the farms. With this, the consumption of wood from forest species from natural forests has been reduced. This raw material reduces the need to use plastic wood or cement posts and has the characteristic of being biodegradable or a source of energy such as firewood in homes. territory. It has contributed to the protection of the native forest ecosystem characterized by being a gallery forest, and other hectares have been allocated for the protection of the water circuit and passive natural regeneration.	Commercial wood production in sustainable models.	22.450.15 Hectares of crops that generate raw materials. Areas of commercial forests established with species adapted to environmental conditions and recommended for the region. GIS and Shapefile Bases
SDG 13	Hectares with change in land use, promoting new forests where historically they were not identified (ha). Reduction of greenhouse gas emissions derived from the environmental service of the capture of atmospheric CO_2 ($tCO_2eq.$) by trees in proposed stand models	Conservation of forests and protection from burning. / Monitoring and control of disasters in reforestation activity. / Reforestation to sequester atmospheric carbon	18,940.3 hectares of new commercial forests for ecosystem connectivity. GIS and Shape file databases and satellite images demonstrate the establishment of the rodales and withdrawal areas for projection.
SDG 15	Hectares of degraded soil that are protected and recovered by the implementation of new forested areas (ha). Expansion and protection of the water circuits and gallery forests of the territory. New areas (ha) of native forests or spaces suitable for due processes of natural succession and subsequent establishment of natural cover. Protection of natural ecosystems and biodiversity by reducing burning, soil degradation, and alteration of connectivity corridors between forest patches. (ha of protected natural forest).	Area of new forests / Area of withdrawals for causes / Increase forests for the supply of raw materials / By planting new forests, reduce the number of degraded soils.	Reduction of degraded soils with new commercial forests. GIS and Shape file databases and satellite imagery demonstrate the establishment of stands and setback areas for the project. These areas are consistent with those that were historically subjected to burns and degradation processes.

Additionally, the BCR SDG compliance tool was implemented, resulting in compliance with SDG indicators 12, 13 and 15.

4.1 See details in the application of the tool and its analysis (Annex 13). Compliance with safeguards for the Sustainable Development Goals.

In compliance with the application of the tools developed by BCR, the project updated the No Net Harm assessment to the Sustainable Development Safeguards V1.1 assessment. The results of the application of this tool allow the following indicators to be identified as potential indicators, which are presented as control or mitigation measures in the implementation of the project.

The other indicators are either not generated in the project or would not apply to it.

Land use: Resource Efficiency and Pollution Prevention and Management

Could the project/initiative activities potentially entail or result in:	**Response**	**Mitigation or preventive action**
Inadequate recycling and reuse of project-related resources, leading to unnecessary waste and environmental impact?	☐ Yes ☒ Potentially ☐ No	The Project complies with the measures of adequate management of the resulting wastes in forestry activities, within the framework of environmental regulation established by the corporation. Waste will be properly disposed of according to the corporation's standards. (See Anex_8)

Water

Could the project/initiative activities potentially entail or result in:	Response	Mitigation or preventive action
Exacerbating water scarcity or depleting water resources?	☐ Yes ☒ Potentially ☐ No	It has already been argued that the project does not take water directly from water sources; the permits applied for are for use in the housing units. On the contrary, it promotes the infiltration of water into the aquifers. The Project requests permission to use the water resources from the environmental corporation. These permits rest as evidence in the

		environmental permit portfolio and in the project's environmental management measures plan.

Biodiversity and ecosystems

Introducing invasive species, which could negatively affect native flora and fauna and disrupt local ecosystems? *	☐ Yes ■ Potentially ☐ No	Although the commercial forestry species established in the project are considered non-native, they do not affect fauna or flora because they are NOT classified as invasive. And they are accepted by national entities for forestry development. (CONIF, 1998[5])
Altering ecosystem dynamics, including changes in species composition, trophic interactions, or nutrient cycles on the environment?	☐ Yes ■ Potentially ☐ No	The project, being a land use change activity, may promote changes in the composition of the flora in the baseline, i.e. in the poorly managed pastures and flora, which alters the trophic networks that develop in this land use. However, new covers will bring and promote positive benefits by improving nutrient flow, bringing new habitats for fauna, and generating connectivity between forest relicts.
Chemical contamination or pollution negatively impacting biodiversity in soil, water, or air?	☐ Yes ■ Potentially ☐ No	Forestry activities, as mentioned above, will have activities for the efficient use of fertilizers and agrochemicals, avoiding the contamination of ecosystems. These actions will be monitored by the project's technical team and followed up by Corporinoquia Corporation. To mitigate this potential effect, the recommendations for the proper management of these wastes will be followed in accordance with the corporation's standards.

[5] https://www.itto.int/files/user/pdf/publications/PD39%2095/pd%2039-95-9%20rev%201%20%28F%29%20s.pdf

Inadequate monitoring and assessment of biodiversity within the project area, making it Challenging to identify and address changes over time?	☐ Yes ☒ Potentially ☐ No	The project does not consider developing a systematic long-term biodiversity monitoring process in the project area. However, changes that are perceived or determined by the environmental corporation will be reported in accordance with regional environmental regulations. Noting that new forests are promoting the connectivity of patches of natural forests and new wildlife refuges. These actions are within the environmental management measures of the project.

Labor and Working Conditions

Unsafe working conditions, exposing project stakeholders to potential hazards or accidents before, during and after the implementation of the activities?	☐ Yes ☒ Potentially ☐ No	Forestry activities entail certain risks to workers' safety. However, one mitigation measure is the application of all regulations related to the implementation of occupational safety, having workers linked to occupational risk services. Provide safety equipment and carry out follow-up and training. The project is periodically supervised in the implementation of occupational safety actions by third parties such as the labor risk management companies. (ARL, in spanish).

The SDS tool can be found in annex.

5 Compliance with Applicable Legislation

The activities carried out by the Forestry Project are governed by Colombian regulations at various levels: national, regional, departmental and municipal. These regulations cover environmental, economic and control aspects.

Forestry management was approved by FINAGRO during the process of reviewing and granting the CIF funds with which the project was initially financed; Environmental monitoring is carried out in accordance with the requirements of the Corporación Autónoma Regional de la Orinoquía -COPORINOQUIA- and is guaranteed through the

annual presentation of environmental compliance reports and subsequent monitoring and follow-up visits, which corroborate the integrity of the strategic ecosystem protection areas, waste disposal processes, and the responsible and concessioned use of natural resources established in Resolution 1130 of 2011.

The area where the forest plantation will be established is in line with the Municipality's Land Use Plan, which promotes forestry as one of the pillars of development.

These norms and their regulatory complements are presented in the table of legal regulations (Table 4), which is periodically reviewed and updated in the participatory spaces of each entity to ensure effective management of compliance and when there are new requirements or changes in the norms, the DOCUMENT CONTROL PROTOCOL and the PROTOCOL FOR INFORMATION COLLECTION AND RETURN are applied.

An example of compliance with these standards is compliance with the requirements of the local environmental corporation. The corporation conducts periodic on-site audits to evaluate compliance with environmental requirements. If there are requirements from the Corporation, they are systematically recorded in the project for each nucleus file which also contains the responses to them. This file is constantly updated and monitored by CORPORINOQUIA.

On the other hand, since they are registered in the ICA records, the entity in charge makes technical visits to the project to evaluate technical compliance. During these visits, the project proponent presents all the documents related to the management of the stands and to the management of pests and diseases.

Regarding the compliance with the forestry development policies, especially those related to the application of the Forestry Incentive Certificate (CIF), the project demonstrates its compliance with the agreements and manages an information base that lists the stands established, the management carried out and the verification carried out by the FINAGRO technicians who evaluate the compliance. All this information is kept in the project files.

5.1 Application of legal requirements

Listed below are some of the main legal requirements for the development of the Forestry project proposal.

Table 4. Legal requirements for the implementation of the Project

Normativity / Legal requirement	Characteristics	Compliment
Decree 1449 de 1977. Article 3.	It relates to the actions that seek the protection of water resources. Therefore, it defines measures for the withdrawal and protection areas. Establishing minimum margins of protection which are ratified by corporations in subsequent decrees.	The project defines the retirement areas in accordance with the regional standards of the Corporinoquia corporation. Likewise, for the Forest carbon component of the eligibility analyses, the areas that are within the protection and withdrawal strip were considered *NOT* eligible, even if these areas did not historically present forest cover.
Decree 1791-1996	The person who needs to take advantage of the natural resources of the Forests to satisfy basic needs, to market their products, to carry out scientific research or for the construction of works, must request the respective permit from the Corporation, in accordance with the required requirements.	The chapter XI of decree 1791 of '96 determines that: for commercial plantations it is sufficient to obtain registration with the Colombian Institute of Agriculture ICA (Instituto Colombiano de Agricultura[6]) and the forest establishment and management plan presented by the beneficiary of the CIF Forest Incentive Certificate. (Annex 9), which will serve as evidence for the autonomous corporations to grant registration to the plantation. Resolution 0687 of 1997 adopts this decree, which determines the actions by which the forest resource administration regime of the Corporación Autonoma Regional de la Orinoquia - Corporinoquia is issued.
RESOLUTION N.º 0687 OF DECEMBER 22, 1997	By which the forest resource administration regime of the Corporación Autónoma Regional de la Orinoquia - Corporinoquia is issued	The project complies with Chapter VIII related to the conditions of commercial forest plantations and has delivered the required documents (e.g. establishment and management plan), for the start of activities adjusted to regional standards.
DECREE NUMBER 4296 OF 2004	Regulations for controlled open burning (*quemas*) in rural areas.	The project complies with national and regional regulations and does not include in its management practices the leaving of waste in soil preparation

[6] https://www.funcionpublica.gov.co/eva/gestornormativo/norma.php?i=1296

		activities, or the burning of waste derived from maintenance.
Resolution 200.41-11-1130 of June 22, 2011. Update of 0687 of December 22, 1997. And Resolution 50041131571 of November 6, 2013.	By which the forest resource administration regime of the Corporación Autónoma Regional de la Orinoquia - Corporinoquia is issued. Corporinoquia, to guide regional productive development, adopts a tool that requires environmental management and technical procedures to develop in a sustainable way the activities that are immersed within agricultural, forestry and agro-industrial productive projects.	The project Forest Reforestation project has implemented the recommendations of the resolution and its updates, protecting water sources and remaining forests. The project has a registration file each nucleus and monitoring in the Corporation where monitoring and compliance with regulations is described. The environmental management policies are adopted and presented to the corporation periodically and the monitoring and follow-up are recorded and included in the project file folder that resides in the Corporation. In Annex (P) of the Biotic and Social Component, some sections of these evaluations are presented.
Decree 3930 of 2010.	By means of which Title I of Law 9 of 1979 is partially regulated, as well as Chapter 11 of Title VI-Part 11I- Book 11 of Decree - Law 2811 of 1974 regarding the uses of water and liquid waste and other provisions are dictated.	The project has the respective requests and approvals for the management of water resources and the potential polluting discharges that it may generate. Complies with the due withdrawals for the protection of water sources established in article 40 of this decree (see previous paragraphs).
LAW 139 of 1994.	By which the Forest Incentive Certificate is created, and other provisions are dictated.	The project complies with the conditions established by Law 139, meets the requirements and presents the documentation to access the CIF, having positive approval.
Document National Council of Economic and Social Policy (Consejo Nacional de Politica Económica y Social Conpes).	Distribution of resources for the forestry incentive certificate for commercial purposes (CIF for reforestation).	The project proposal, in compliance with Conpes, demonstrates the suitability of the territory for the distribution of resources, for projects, with prior approval of the compliance suitability. Furthermore, the selected species are within those required related to suitable forest species Forest species that have technical supports that demonstrate export potential, among others such as: Acacia (*Acacia mangium*), Melina (*Gmelina arbórea*), ***Pinus*** (*pátula,* ***caribea****, tecunumanii, oocarpa, maximinoii*), ***Eucalyptus***

		(*grandis, **pellita**, tereticornis*) y Teca (*Tectona grandis*), Caucho (*Hevea brasiliensis*) y Guadua (*Guadua angustifolia*).
Decree 2448 of 2012.	Partial modification of decree 1824 of 1994. Definition of: forest species, native forest species, introduced forest species, protective-producing forest plantation, forest establishment and management plan, eligibility, granting, payment, new plantation and forestry project.	The project is accepted at the time of approval and granting of the disbursements established by said decree, being consistent with Document Conpes 3724 that allocated the resources under the procedures described and defined prior to decree 2448 of 2012.
Resolution 1447 of 2018. RENARE	By which the monitoring, reporting and verification system of mitigation actions at the national level are regulated, established in the article 175 of Law 1753 of 2015 is regulated, and other provisions are dictated.	This resolution establishes the registration times for initiatives before RENARE. In compliance with the resolution, the project initiative submitted the formal registration to the Ministry of Environment and Sustainable Development. In response, it was argued that at the time, the RENARE registration platform had not been launched, so registration should be done when the platform was operating. All processes have been completed since the platform was put into operation.

5.2 Follow up to ensure that national regulations and laws applicable to the project are updated.

Due to the long duration of the accreditation period of the project, it is understandable that the rules and laws surrounding the forestry sector, environmental compliance, regulations for projects providing environmental services related to carbon change. For this reason, the nucleus has delegated the **Carbon Business Unit** and the **Legal Department of the Forestry Projects Unit** and directly responsible to for the continuous updating and compliance of regulations.

- In the case of monitoring in the context of forestry regulations, the emphasis is on the following:
- Regulations of the Ministry of Agriculture Regarding
    - Registration of forest plantations for commercial use.
    - Definition of species authorized for planting in Colombian territory.
    - Management of natural, protective and productive forest plantations.
    - Management and administration of commercial forest plantations.

- National Forest Politics.
  The monitoring of these updates is carried out on the platform of the National Forest Policy Guidelines[7].

- For the environmental elements of the forest plantations, the guidelines of the Regional Autonomous Corporation CORPORINOQUIA will be followed. The nucleus has a monitoring register in the Corporation with and periodically a record of compliance with the environmental regulations applicable to forestry activities in the region must be established.
- For the carbon-related environmental service elements, the project is subject to the norms established by the Ministry of the Environment and Sustainable Development. In this respect, it should be noted that the project is registered in the RENARE platform[8], which provides guidelines for the registration of the National Greenhouse Gases Emissions Reduction Register in compliance with resolution 1447 of 2018 and its amendments.

6 Climate change adaptation

New commercial stands have been established, a total of **22,450.15** hectares with species adapted to the environmental conditions of the territory and the qualities of degraded soil that the territory presents, derived from historical burning. These new forests will protect the soil, reduce its exposure to the prevailing climatic factors, recovering the physical and chemical conditions of the soil.

The Proyecto Forestal is aligned with the strategies proposed in the National Climate Change Policy[9], that seek to shape effective policy to influence decision-making to advance towards sustainable, climate-resilient and low-carbon development.

Within the framework of the action plan of the National Climate Change Policy, the forestry project is aligned with the territorial strategy for low-carbon and climate-resilient rural development, whose lines of action in which the project activities can be framed are:

[7] https://observatorio-economia-forestal-3-mads.hub.arcgis.com/pages/Normativa
[8] Registro Nacional de Reducción de emisiones de GEI. https://renare.ideam.gov.co/GPY2-web/#
[9] Política Nacional de Cambio Climático. Colombia. Ministerio de Ambiente y Desarrollo Sostenible, 2017

Table 5. Project activities related to the lines of action of the national climate change policy

Line of action	Project Activity
Line 1: Promote agricultural and fishery production systems that are better adapted to high temperatures, droughts or floods, to improve the competitiveness, income and food security of vulnerable populations.	The implementation of a commercial forest production system, with species approved by the Ministry of Agriculture (*Pinus caribaea*, *Eucalyptus pellita* and *Acacia mangium*), which have demonstrated great adaptability to the acidic soils of the Colombian Orinoquia region, as well as flexibility to the high temperatures characteristic of the region.
Line 3: Promote comprehensive actions on farms, in chagras or communities that help the efficient use of land, and where the conservation of existing natural covers on farms, the restoration of degraded areas, low-carbon livestock intensification, the implementation of agroforestry systems, family farming, the reduction of deforestation and the restoration of degraded areas, and technical assistance or agricultural technology transfer that increases competitiveness and decreases vulnerability to climate change	As a protection measure, the project maintains strict compliance with the areas of withdrawal from the water and forest strips established by Corporinoquia[10], in which no activities are carried out for commercial purposes, on the contrary, the natural regeneration of the transitional vegetation of the native gallery forests is protected and promoted, which are closely monitored in order to act in almost any natural or anthropic event that may occur in these areas
Line 7: Promote sustainable forest management, sustainable use of natural resources, conservation of forests and water margins, as well as restoration of degraded areas within farms	The project activities that add efforts related to line 7 of the National Climate Change Policy are associated with the protection and non-intervention (buffer non-eligible areas, see GIS Annex), corresponding to the protection margins of forests and water bodies, which implies that in the project area, deforestation and degradation of natural forests is zero since the beginning of the activities. Indirectly, the pressure on regional natural forests is

[10] Resolución 1130 de 2011. Corporinoquia. 2011.

	reduced by offering the local market wood of legal commercial origin and registered with the ICA with quality standards and transformation processes, which guarantee the duration of the wood products offered.
Line 9: Incorporate into the planning, improvement and rehabilitation of land adaptation infrastructure the assessment of the effects of climate change on water availability, as well as the implementation of options to address climate risks (such as floods or droughts), including those aimed at encouraging efficient use of water by users.	In the area of project development, it makes sustainable and responsible use of water resources, meeting the consumption goals proposed in the Efficient Use and Water Saving Program associated with the concession of use of groundwater (Example OLP[11]), proposed by the project and supervised by the Regional Autonomous Corporation of Orinoquia (CORPORINOQUIA), which establishes the commitment to reduce water consumption to 25% by 2030, with respect to historical consumption before the implementation of the plan. To meet this objective, the project will carry out the due diligences before the CORPORACIÓN to request permits for the use of water resources in the basic operations of the project (see Annex_8).

The Project demonstrates its commitment to contributing to GHG mitigation, also carries out actions related to climate change adaptation, derived from the implementation of project activities, adding to the lines of action of the National Climate Change Policy.

The Table 6, describes the actions carried out by the project, through the implementation of activities to contribute to climate change adaptation.

Table 6. Project actions that contribute to adaptation to climate change

BCR adaptation action	Project adaptation action

[11] Medidas de Manejo Ambiental, Organización La Primavera, expediente 800.33.1.10.0019. Annex_9

a) consider one or more of the strategic lines proposed in the National Climate Change Policies and/or focus aspects outlined in the regulations of the country where the project is implemented	Yes, the project activities fall under lines of action 1, 3, 7 and 9 of the 2017 National Climate Change Policy, as described in **¡Error! No se encuentra el origen de la referencia.**.
b) improve conditions for the conservation of biodiversity and its ecosystem services, in the areas of influence, outside the project boundaries, i.e., natural cover on environmentally key areas, biological corridors, water management in watersheds, among others	Yes, the project excludes the water rounds adjacent to the drainage: Elvita River and Caño Terecay, etc. thus contributing to the water management of the basins. This was demonstrated in the analysis of the eligible areas of the project.
c) implement activities that generate sustainable and low-carbon productive landscapes	Reforestation with commercial species *Pinus caribaea*, *Eucalyptus pellita* and *Acacia mangium*, have a positive impact on the sustainable productive landscape in the Orinoquía, since they have the technological packages approved by the national government, which are part of the zoning for forestry activities prepared by the UPRA (Unidad de Planificación Rural Agropecuaria)[12] [13].
d) propose restoration processes in areas of specific environmental importance.	The buffer strips of areas established by CORPORINOQUIA for the protection and conservation of natural resources and the environment have been preserved. The project promotes restoration activities through passive regeneration actions in areas that were previously non forest. (See Project Document)
e) Designs and implements adaptation strategies based on an ecosystem-based approach.	The project implements an ecosystem-based approach by preserving and restoring environmentally important areas, such as buffer strips and water bodies. Passive regeneration is promoted in previously degraded areas, and forest species adapted to local conditions are used to maintain the ecological and productive stability of the landscape. Additionally, the exclusion of water bodies

[12] https://upra.gov.co/en/Documents/01_Proyectos_Normativos/201802_lineamientos.pdf
[13] https://www.datos.gov.co/Agricultura-y-Desarrollo-Rural/Zonificaci-n-de-aptitud-para-plantaciones-forestal/u4aa-xujw/data?no_mobile=true

	protects the functionality of watersheds, enhancing the ecosystem's resilience to extreme climate events
f) It strengthens the local capacities of institutions and/or communities to make informed decisions that enable them to anticipate negative effects resulting from climate change (recognition of vulnerability conditions) and to seize opportunities arising from anticipated or observed changes.	The project strengthens local capacities through collaboration with entities such as CORPORINOQUIA, the La Primavera Fire Department, the La Primavera Mayor's Office, the Municipal Hospital, and residents, ensuring that reforestation and conservation activities align with national policies and the shared interests of the community. Additionally, training sessions are provided for workers, and joint efforts are carried out with the entities on sustainable forest management and soil and water conservation practices, promoting knowledge on climate resilience. These actions enable communities and authorities to make informed decisions regarding land use and the protection of strategic ecosystems in the region

Within the framework of afforestation projects, climate change adaptation is a fundamental axis to ensure the sustainability of initiatives and maximize environmental and socio-economic benefits. Given the vulnerability of the AFOLU sector (Agriculture, Forestry, and Other Land Uses) to climate change, various actions and strategies are implemented in line with best adaptation practices, ensuring that forest plantations not only capture carbon but are also resilient and contribute to the sustainable development of local communities.

The main adaptation measures include:

1. Forest production systems adapted to extreme climatic conditions. Management strategies and selection of tree species resistant to high temperatures, droughts, and floods (such as *Pinus caribaea*) are applied, improving plantation productivity and stability, ensuring competitiveness, and reducing risks associated with extreme climatic events.

2. Efficient land use and conservation of natural cover an integrated land-use approach is adopted, promoting the conservation of natural forests, the establishment of ecological corridors, and the restoration of degraded areas while respecting the buffer zones required by CORPORINOQUIA. Additionally, land use is ensured to be consistent with the territory's vocation and agroecological conditions, fostering sustainable agriculture and agricultural technology transfer to enhance the resilience of local communities.

3. Reduction of GHG emissions in agroforestry activities Advanced Forest crop management techniques are implemented, replacing conventional planting practices with methods that minimize soil disturbance and promote the efficient use of agricultural inputs. These actions not only reduce the carbon footprint but also increase the economic viability of forestry initiatives.

4. Specific measures for climate change adaptation. Improved seeds resistant to climate variations are used, and water management is optimized through rainwater harvesting, recycling, drainage, and efficient irrigation. Additionally, reforestation in areas near water bodies is promoted to prevent erosion, and soil management practices are applied to reduce compaction and optimize fertilizer use, minimizing environmental impact.

Collectively, these actions strengthen the resilience of forest plantations to climate change and generate positive impacts on food security, the local economy, and ecosystem conservation. Through an integrated and sustainability-based approach, afforestation projects actively contribute to climate change mitigation and adaptation, aligning with global commitments to sustainable development and environmental protection.

7 Carbon ownership and rights

7.1 Project Owner

Individual or Organization	**Bosques de la Primavera S.A.**
Contact Person	Jesus Rivera
Position	General Director
Adress	Carrera 14 # 78 - 30 Floor 3. Bogotá DC, Colombia
Phone Number	(+57) 601 257-9467
e-mail	jesusrivera@proyectosforestales.com

7.2 Land Tenure

Table 2. List of Land tenure.

Property
BOSQUES DE LA ORINOQUIA

BOSQUES DE LA PRIMAVERA S.A
REFORESTADORA LOS CAMBULOS S.A.
REFORESTADORA GUACAMAYAS S.A
INGIENERIA DE COMERCIALIZACION Y SERVICIOS INCONSER LTDA.
COMPAÑIA DE MARIA PADRES MONFORTIANOS
ORGANIZACION LA PRIMAVERA S.A.

The tenure certificates are presented to the auditor.

7.1 Responsible for the mitigation project

Table 3. Contact Information of project managers

Jesus Rivera	Project operations manager jesusrivera@proyectosforestales.com (+57) 601 257-9467 Carrera 14 # 78 - 30 Floor 3 Bogotá DC, Colombia
Andrés Sierra B.	Forest Carbon Consultant andsierrab@gmail.com (+57) 601 257-9467 Carrera 14 # 78 - 30 Floor 3 Bogotá DC, Colombia
Juan E. Guarnizo	GIS Manager mdl@proyectosforestales.com (+57) 601 257-9467 Carrera 14 # 78 - 30 Floor 3 Bogotá DC, Colombia

8 Environmental Aspects

The Department of Vichada is the second largest department in Colombia with a territorial area of 105.947 km^2, occupying 8,7% of the national territory. Located in the east of the country, in the Orinoquía region, made up of 4 Municipalities (Puerto Carreño, Cumaribo, Santa Rosalía and La Primavera) and 25 inspections. It limits to the north with the Meta River that separates it from the departments of Casanare, Arauca and the Republic of Venezuela. To the east, with the Orinoco River that separates it from the

Republic of Venezuela. To the south, with the Guaviare River that separates it from the departments of Guainía and Guaviare and to the west, with the departments of Meta and Casanare. The extensive plains of the Eastern Plains occupy a good part of the department's territory with some terraces such as the Vichada, Mono and Mataven hills (secretaria de Planeación y Desarrollo Territorial, 2016).

The capital of the department is Puerto Carreño, with an area of 12,409 km2 and an approximate population for the year 2013, of 15.258 inhabitants. The municipality of Cumaribo with an area of 65,674 km2 and a population of 35.146 inhabitants (approximately 50% of the population is indigenous), Santa Rosalía with an area of 2.018 km^2 and a population of 3,877 inhabitants and La Primavera with an area of 20.141 km2 and a population of 14,294 inhabitants. With an approximate population for 2017 of 75.468 inhabitants in the Department, being 0,14% of the Colombian population according to the DANE population projection (UNAL, Sede Orinoquía, 2018).

It has a participation in the national GDP of 0.12%; The economy of the department is mainly characterized by: 52.2% in agriculture, livestock, hunting, forestry and fishing; 15,2% in public administration and defense, education and social services; 13.1% for trade, repair, transportation and accommodation; 6.1% for electricity, gas and water; 4.7% for construction; 3.4% for real estate activities; 2.8% information and communications; 2.5% artistic, entertainment and recreational activities; This is according to a report from the Ministry of Commerce, Industry and Tourism, which specifies the distribution of the gross domestic product for the department of Vichada (UNAL, Orinoquía headquarters, 2018).

The economy of the Department is mainly constituted, 57%, in the agricultural sector, livestock, hunting, forestry and fishing. In livestock farming, the vaccine stands out, which is developed in natural savannahs, mainly in the municipality of La Primavera.

As evidence in the non-generation of impacts, the tool of safeguards to sustainable development goals is developed (annex 14)

8.1 Climate

The average altitude of the Municipality is 117 m high which, according to the classification of thermal floors proposed by Caldas for the American tropics, corresponds to the warm thermal floor. In the four municipalities that make up the department of Vichada, very special agroclimatic conditions occur in which, according to data collected at the IDEAM meteorological stations, it is said that in the department: it rains 166 days a year with an average annual precipitation of 2,255 mm , which indicates a very marked rainy season, followed by a dry season (see Figure 1); which end up becoming limiting factors for agricultural development due to excesses or deficits of water.

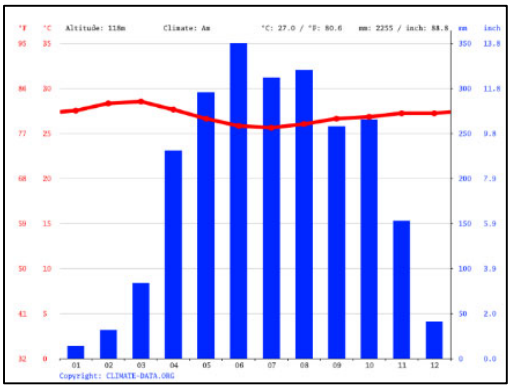


Figure 1. Distribution of precipitation throughout the year in the municipality of La Primavera Vichada. The driest month is January, with 13 mm. Most of the precipitation in the municipality falls in June (months on the horizontal axis), and the average is 336 mm, for an average annual precipitation of 2,225 mm. Source: Climate-Data.org

There is an average annual relative humidity of 70%, the average annual temperature is 28.2 °C; The potential evapotranspiration reaches 2,136 mm, showing an environment in which water is very easily lost from the soil due to evaporation, which conditions the development of different plant species.

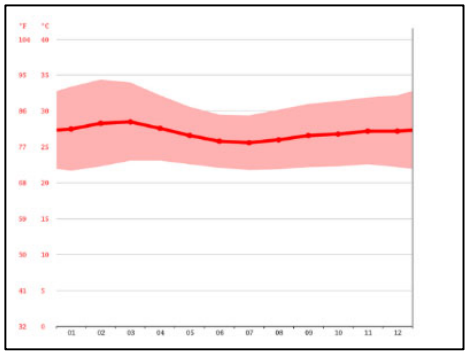


Figure 2. Behavior of the average temperature over a period of one year for the municipality of La Primavera Vichada. Its highest peak is located in March with 28.5 °C and the lowest in July with 25.6 °C, presenting a variation of 2.9 °C. Source: Climate-Data.org

8.2 Soils

The soils of the altillanura present an ochric horizon on the surface, which increases its content of organic materials as the transition is established to areas with greater precipitation or to those low and to the estuaries, places where the plant formation associated with the riverside forest provides biomass, significantly increases moisture content and the soils present humbric or tissue horizons. The type of humus is tropical acid *mull*, with average compositions of fulvic acids to humic acids greater than 1.2 and its humin content is less than 50%. The contribution of biomass is low (2.2 to 3.8 t ha^{-1}

año^{-1}) in herbaceous savannas but can increase to 28 or more t ha-1 year-1 under the covers depending on the rainfall regime, the length of the dry season and available nutrients (Lamotte cited by Malagón 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[14]). 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 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).

Soil degradation corresponds mainly to ferralization processes (formation of oxisols), through high transformation processes and loss of elements Ca, Mg, K, Na and Si, among others. The formation of Ultisols occurs in a lesser proportion. Additionally, there are some formations of Espodosols, Inceptisols, transitional to Oxisols. Indicators of these processes, in addition to the mineralogical ones, are those associated with the very low cation exchange capacity (CEC), values less than 4 meq/1000 g of the effective capacity. (Rippstein, et al, 2001).

[14] 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.

Image 2. Soils of the project area. The continuous burning of grasses on soils with oxisol characteristics causes a hard layer of ferrous material called plinthite to form[15].

The soil is 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 7.

Table 7. 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

15 When there is influence of groundwater in the O zone at 125 cm from the ground, a firm clay material with a high iron content (plintite) usually forms. When exposed to air or burning, it dries and becomes irreversibly hard (laterite or stone forms a layer or hard concretions. http://www.fao.org/tempref/fi/cdrom/fao_training/fao_training/general/x6706s/x6706s01.htm ferruginosa).

Description	Characteristics	Percentage (%)
Percentage of base saturation		4.70%
Phosphorus		None detected

These results are consistent with those reported by Rippstein et al (2001) for the Colombian altillanura, specifically for the undulating altillanura. See **¡Error! No se encuentra el origen de la referencia.** 8.

Table 8. Textural and chemical properties for soils from the undulating highlands in Colombia. (Taken and modified from Rippstein et al, 2001)

Element	Dry Savanna and undulating Altillanura
Clay (%)	30.4
Sand (%)	41.9
Silt (%)	27.5
M.O (%)	0.9
P (ppm)	0.9
pH	4.7
AL (meq/100 g)	1.4
Ca (meq/100 g)	0.1
Mg (meq/100 g)	0.1
K (meq/100 g)	0.1
S (pmm)	5.5
B (pmm)	0.2
Zn (pmm)	0.3
Mn (pmm)	0.4
Cu (pmm)	0.2
Fe (pmm)	52.8

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[16]).

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 forests 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.

According to the study of soils and land zoning of Vichada prepared by the Agustín Codazzi Geographic Institute, 36% of the department (3.6 million hectares) has areas suitable for agricultural, livestock and forestry production; This potential can be exploited if appropriate agronomic practices are carried out to improve soil conditions, where there are low contents of organic matter, high acidity and in some sectors toxic levels due to aluminum; This large amount of land has the potential to expand areas of soybean, corn and rice crops for agroindustrial development and extensive livestock farming as the main livestock production (National University of Colombia, Orinoquía headquarters, 2018).

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

The department of Vichada has an area of 100,242 km2, of which 6,123,261.2 ha correspond to areas with a forestry vocation, where forestry and agro-industrial projects are currently being developed for commercial purposes, emphasizing exotic species that stand out for their technological packages and capacity. adaptation to the environmental offer of the territory. Noteworthy are the species *Acacia mangium, Pinus Caribaea, Eucaliptus grandis, Eucalipto pellita, Eucalipto tereticornis* and *Pino oocarpa*, among others.

8.3 Hydrography

The department of Vichada belongs to the great basin of the Orinoco River. The Municipality of La Primavera has the particularity that several water sources arise and die in its territory. The lands of the Municipality are deeply irrigated, as they are crossed by numerous rivers, pipes, streams and other minor streams, among which the Meta River stands out due to its flow and importance, which serves as a natural boundary with the departments of Arauca and Casanare. The main basins of the municipality belonging to the Great Basin of the Orinoco River correspond to the sub-basins of the Tomo and Bita rivers that belong to the Great Basin of the Orinoco River, with a percentage of area in the territory of the municipality of La Primavera of 43.5% and 52.5%. %, respectively. At the same time, the subbasins of Caño La Balsa, Caño Aguas Claras, Laguna de La Primavera, Caño Aguaverde and Caño La Culebra are also found as sub-basins that make up the Meta River in the town of La Primavera, as the most important (CORPORINOQUIA, 2008)

One of the main drainages in the municipality of La Primavera is the Bita River, which crosses the department from west to east, until it flows into the Orinoco River on the border with Venezuela. The project area is located in the upper part to the east of the Bita River, near where this river originates and close to the Caño Lobo and the Elbita River which flows into the Tomo River.

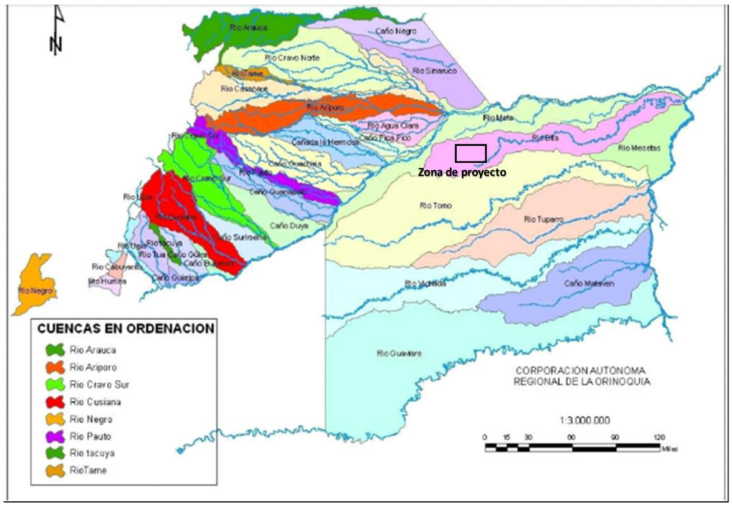


Figure 11. Hydrographic basins of the jurisdiction area of Corporinoquía. Source: CORPORINOQUÍA, 2013. Plan de Gestión Regional Ambiental 2013-2025

The Bita River is an important tributary that has its origin in several streams that originate in the high plains to the west of the municipality of Puerto Carreño. In its route from west to east, more than 200 km is navigable in winter, by small boats. As tributaries it has numerous channels, including: El Bravo, Pendare, Cabrillas, Avión and Tres Matas (Gobernación del Vichada, 2011[17]). The richness of biodiversity in the sub-basin characterizes it as a location of vital importance for natural conservation within the rural area of the municipality, therefore, expanding the conservation and reserve zones will result not only in an environmentally strategic area, but also a point of local development, which can integrate sustainable activities such as ecotourism (Secretaria de Planeación y Desarrollo Territorial, 2016).

The Tomo River rises in front of the Carimagua Lagoon in the Department of Meta, and runs through the area from west to east; It is navigable by boats of up to 10 tons from La Palmita to Caño Guaripa and from this point to its mouth in the Orinoco River, by boats of up to 150 tons, over a distance of 280 km. Among its tributaries are: Caño Urimica, Guaira pali, El Boral and El Negro (Gobernación del Vichada, 2011).

The Guaviare River, located in the south of the department, is another fluvial limit of the Orinoquia. Its origin is in the Cordillera Oriental, west of the department of Meta. It is one of the largest in the region, but with rugged navigability due to the rapids formed in some

[17] Gobernación del Vichada, 2011. Plan vial departamental del Vichada 2011-2019, Puerto Carreño.

sectors of its course. **¡Error! No se encuentra el origen de la referencia.** shows the density of the Vichada water network. (Ecofondo, 2005[18]).

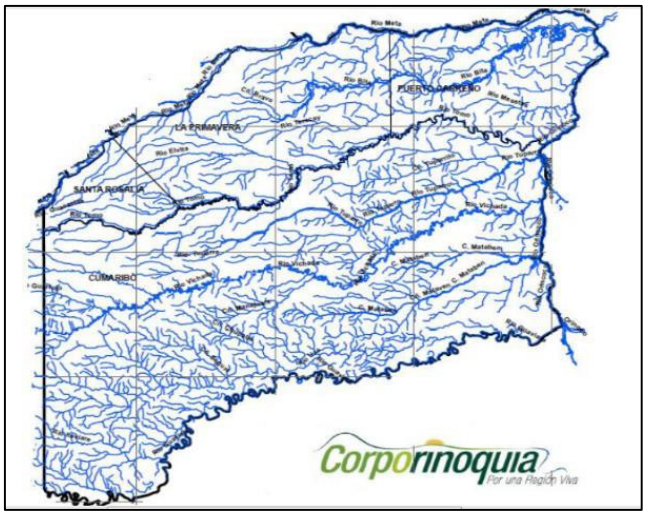


Figure 12. Main water currents of Vichada. Source: CORPORINOQUÍA, 2013. Plan de Gestion Regional Ambiental 2013-2025

However, the great surface and underground water wealth widespread in the Orinoquia region is not distributed spatially and temporally homogeneously. Additionally, there is a marked deficiency in the availability of information on the regional water supply and the quality of the resource, because of the lack of an adequate hydroclimatic monitoring network and the difficulty in operating it regularly. From the few data available on historical flows in some streams, the growing loss of the regulation capacity of hydrographic basins can be deduced, as a great difference is observed between the extreme flows recorded. (CORPORINOQUIA 2006).

8.4 Physiography, topography and geology

According to the physiographic and landscape analyzes in the Region, it is inferred that the municipalities of La Primavera, Puerto Carreño, Santa Rosalía and approximately 50% of the territory north of the municipality of Cumaribo are part of a plain physiographic subprovince. high, which is between 90 and 120 meters above sea level, and has a very

[18] Ecofondo, 2005. El agua en la Orinoquia.

gentle inclination towards the east of the country, it is also known as the overflow plain of the rivers coming from the cordillera Oriental (CORPORINOQUIA, 2013).

This system is characterized by the presence of inherited forms such as alluvial dikes (spaces that are not flooded during winter), flood basins and partially filled drainage axes known as estuaries (CORPORINOQUIA, 2017). Likewise, within the high plain the great landscapes listed below are contemplated:

- The Altillanura structural erosion that consists of an almost flat undulating terrain with some terraces
- Residual high plain of the shield, which consists of the flat plain with artificial soils (alluvial colluvium)
- Depositional - erosional high plain that is composed of deposits of sand, silt, clay and gravel, are strips of variable width next to the main rivers.

Approximately 50% of the territory south of the municipality of Cumaribo contains the Physiographic subprovince of the Orinoquia-Amazon Transition Forest. It is an extensive low-lying jungle strip, mixed with open Amazonian savanna vegetation. The strip is characterized by presenting a highland landscape in which there are gently undulating areas and others with a broken relief; Its well-developed and nutrient-poor soils have deposits of fine sediments, basically in riverbeds. (CORPORINOQUIA, 2013).

Topography

The geoforms are mostly savannas, strips of slope forest and gallery. There are low areas that flood during the winter when numerous rivers and pipes overflow. The territory of the department of Vichada corresponds to the region of the Eastern Plains and in it four physiographic groups are distinguished: the poorly drained Orinoquia Alluvial Plain, the well-drained Orinoquia Altillanura, the Alluvial Strip of the large rivers and the Guiana Shield. The first is formed by low beaches located to the north in the municipalities of Puerto Carreño and La Primavera, covered by savannah vegetation and temporarily floodable. The Altillanura, with different degrees of dissection, occupies the largest area of the department between the Meta and Vichada rivers; It is covered by savanna vegetation alternating with gallery forests, and in its interior, by tropical jungle forest between the Tuparro and Vichada rivers. The Aluvion Strip extends parallel to the Meta, Tomo, Bita, Tuparro and Orinoco rivers, covered by intervened gallery forests. Finally, the Guayanés Shield is located in isolated sectors in the east of the department and is characterized by the presence of rocky outcrops and plateaus dissected in white sediments. The main cover is made up of mosaics of forest, shrub and degraded savanna vegetation. There are some orographic features such as the Mono and Mateavení hills and the Casuarito hills. (CORPORINOQUIA 2008). In the case of the

study area where the forestry project will be carried out, the geomorphology corresponds to the physiographic unit of Altillanura

Geology

In the Orinoquia, the typology of soils and their evolution are linked to the origin of the sedimentary megabasin located between the Guayana Shield and the Eastern Flank of the eastern mountain range. Quaternary deposits of fluvial origin predominate, Tertiary sedimentary rocks (sandstones, mudstones and limestones) resting on sediments from the Cretaceous, Paleozoic and felsic crystalline rocks from the Precambrian. On these materials, piedmont landscapes are developed, extensive Pliopleistocene plateaus, with variable dissection, alluvial and aeolian plains partially dissected and cut by long and narrow recent and current alluvial valleys, associated with large rivers. The Faults over which the Meta River runs establish two clearly differentiated subregions, the Altillanura (plain) and the so-called Orinoquia Floodplain. (Mendivelso 2003, mentioned by Malagón 2004).

In addition to the characteristics, there are frequent burnings, which are carried out in the project areas to promote the regeneration of pastures for livestock. Burning generates progressive degradation that affects soil fertility. On the other hand, the most common land use in the area has been extensive livestock farming, which has caused soil erosion and compaction processes. On the other hand, the introduction of non-native grasses for cattle grazing has generated changes in biodiversity and soil degradation. Therefore, if livestock activities had continued in the project area, the soils would not have the capacity to develop regeneration processes of the native flora.

8.5 Ecosystems

The Eastern Plains of Colombia are an extensive savannah that goes from the foothills with the cordillera oriental, reaches the Orinoco River in the east and extends in a north-south direction from the Arauca River to the Guaviare River; It has an approximate area of 266,300 km2, in which three large landscapes can be identified. (CORPORINOQUIA, 2013):

- The *piedemonte llanero*
- The floodplain
- And flat and undulating altillanura

The first corresponds to a narrow strip located between 700 and 500 meters above sea level, which has a typically plain climate, with average temperatures of 23 to 30 ºC and a biseasonal rainfall regime with 3.000 to 4000 mm of annual precipitation. The second landscape is the region located west of the Meta River, known as the Casanare and Arauca savannahs and is probably the largest area of land in the north of the South

American continent, which is below 200 m in altitude. The last corresponds to the area located between the Meta and Guaviare rivers where the foothills of the Cordillera Oriental begin, between the Humadea river and the Sierra de La Macarena that reaches the Orinoco river. The lowest and eastern part, known as the Orinoqués platform, is a territory with gentle slopes approximately 100 kilometers wide, which runs parallel to the Orinoco River and connects with the floodable alluvial valleys of the Vichada, Tuparro, Tomo and Bita rivers, among others.

More than 90% of the region is part of the tropical savannah ecosystem. These are open formations without a uniform tree canopy, where a perennial herbaceous matrix extends continuously and sometimes appears covered by low-growing woody plants or scattered palms. The main genera of grasses found in them are: *Andropogon, Aristida, Axonopus, Leptocoryphium, Panicum and Trachypogon*. One of the most outstanding features of this biome is its tolerance to natural fires, adaptation to conditions of intense drought and flooding according to the variable patterns of precipitation, as well as the generalized low fertility of soils and winds. powerful. These ecological factors have conditioned and helped the evolution of species through morphological, phenological and functional adaptations. The relationship of fire in the evolution of these savannahs can be verified by the existence of woody species of a pyrophilous nature (*Curatella Americana, Byrsonima crassifolia, Bowdichia virgiliodes, Xylopia aromatica, Miconia sp*.) (Alvarado et al. 1991, Bosques de La Primavera 2006).

Below is a general description of the ecosystems present in the region:

Image 3. Images of the land uses and ecosystems that determine land uses in the Colombian highlands and in the project area

The formation of "pyrophilic edges" is especially noticeable in the contact areas between the highland forests and the savannahs. In general terms, the dominant species are herbaceous, grasses and some sedge, juncaceae and xyrydaceae, among which the following stand out: *Aristida sp., Axonopus purpusii, Axonopus fissifolius, Digitaria decumbens, Eragrostis maypurensis, Panicum sp., Paspalum sp., Trachypogon plumosus*, among others. Along the main rivers and canals of the region, riverside or riparian forests develop. These formations are important from an ecological point of view as they serve as corridors for the dispersal of wild fauna and flora. They are characterized by the presence of palms in the canopy and co-dominant strata. Some characteristic species are: *Socratea exorrhiza, Astrocaryum vulgare, Oenocarpus minor, Attalea maripa, Euterpe precatoria, Iriartea deltoidea, Bactris gasipaes, Mauritiella armata.* Las pricipales especies arbóreas presentes son*: Terminalia amazonica, Tabebuia serratifolia, Ceiba pentandra, Jacaranda copaia, Hymenaea courbaril, Enterolobium schomburgkii, Parkia pendula, Callophyllum sp., Inga sp., Spondias mombin, Guatteria sp., Bombacopsis quinatum*, entre otras (Alvarado et al. 1991).

Life Zones

In the department of Vichada, the tropical humid forest (bh-T) life zone predominates according to the Holdridge classification system. This area is located from sea level to 1.000 m altitude and is characterized by temperatures between 24 and 35 °C and rainfall between 2.000 and 4.000 mm. (Holdridge, 1978).

Below is a general description of the ecosystems present in the region:

Savannah

It is an ecosystem created through anthropic transformation due to the deforestation of the Orinoquía jungle, which is mainly due to the slashing, slashing and burning process for the establishment of pastures for livestock and crop areas. These practices result in eroded and impoverished soils which, after being abandoned, are colonized by fast-growing pioneer species such as the balso, a tree with extraordinarily light wood, and the yarumo. Deforestation occurs on two fronts: that which descends from the mountains and that which ascends from the plain; Among these are the last remnants of humid forest. There are many places where this type of forest has completely disappeared, thus breaking the connectivity between the Andean jungle, the foothill jungle and the riverside forest that goes deep into the sheets.

Periodic fires, loss of soil nutrients and intensive grazing keep the landscape transformed for a long time. The elimination of this habitat is undoubtedly one of the

main threats to the primates of the piedemonte llanero, such as **the titi, the choyo monkey and the marimondas**, which are among the most endangered in the entire region.

Flood Planins

These plains, subject to flooding for approximately seven to eight months a year, have a rainy period between March and November and a short summer from December to February; To the east, its limit is defined by a geological fault that develops in a southwest-northeast direction. The Meta River follows the course of this fault and undermines the walls of the eastern block and the plateau, which is almost 40 to 50 m higher. In the flood plain, the ecological processes, soils, flora, fauna and land use are determined by the behavior of floods and make up groups that involve several ecosystems, which is why they are considered macrosystems, in which There are permanent, temporary aquatic environments and dry land savanna, but the largest area corresponds to temporary aquatic environments.

Within this landscape of savannah covers, there are humid or hyperseasonal sheets, aeolian or semiseasonal sheets, zurals, estuaries, morichales and flooded forests.

Within the existing coverage for the jurisdiction of Corporinoquia, there are almost all types of coverage and land use, due to the extension of the region and the wide range of heights ranging from 0 meters above sea level in the municipalities of Orocué, San Luis de Palenque and Maní in Casanare and Arauca, Puerto Rondón, and Arauquita in Arauca, among others and up to 3500 meters above sea level in the municipalities of Sácama and La Salina in the north-west of the department of Casanare and Labranzagrande, Paya and Pisba in the moor in the department of Boyacá.

Zurales

They form in depressions with very gentle slopes, remain flooded most of the year for up to nine months and have dark-colored soils, rich in organic matter. From the air, a reticulated pattern can be seen, made up of mounds of different sizes called zuros; The lowest ones, 30 to 50 cm, are found on the edge of the zural and termite mounds grow on them; Those of greater height, one to two meters and more widely spaced, develop towards the interior of the zural.

Some zurales reach surfaces of 5 km^2 and densities of 900 to 1000 mounds per hectare; Each mound has its own humidity gradient that determines the colonization of different species, among which grasses predominate, although rare families such as Eriocauláceas and Burmaniaceas and common ones such as Cyperaceae, Melastomataceae and legumes grow; occasionally on top of a mound crowned by termite mounds, which remains dry longer, some bushes develop. The water that

circulates between the zurales is transparent, poor in nutrients and its drainage system forms a closed microbasin, which is sometimes interconnected with estuaries and morichales. (Banco de Occidente, 2005[19]).

Morichales

Some rivers and canals in the floodplain have, along their course, narrow strips of riverside forests dominated by the moriche palm (*Mauritia flexuosa*), which has fan-shaped leaves and grown associated with timber trees of the family of the Anonaceae, such as the plank and with myristicaceae, such as the palo sangre. These forests, where there is also an abundance of shrubby melastomataceae and other palms such as the one known as milpesos, a very promising oil species, are important for the maintenance of a varied fauna, in which large wild mammals such as peccaries and tapirs stand out[20].

Image 4. Morichales ecosystem, the high presence of palms from flood-prone areas stands out

The ground water table determines the structure and composition of floodplain gallery forests; Compared to those of the high plains, they are less diverse and structured and their herbaceous and shrubby strata are poorer and with few species tolerant to flooding. The soil, from which the dense tangle of fine roots and pneumatophores of palms and trees emerge, structures specialized in gas exchange, is almost bare, muddy and with little leaf litter; Towards the outer edges there is a narrow strip of dense forest of low height, 10 to 15 m, which abruptly cuts the open vegetation of the savanna.

[19] La Orinoquia de Colombia. https://www.imeditores.com/banocc/orinoquia/creditos.htm
[20] Banco de Occidente, Op Cit.

The moriche palm is perhaps the most widely distributed and possibly the most abundant in the Amazon and Orinoco basins; Its optimal habitat is in flooded lands or with very poor drainage, below 900 m altitude. The indigenous people call it “the tree of life” because its uses are very numerous: the orange pulp of the fruits is highly nutritious due to its high protein and oil content; Excellent quality fiber is extracted from the young leaves and the adult leaves are used as roofs for homes; Mojojoyes, cockroach larvae, are raised in the fallen trunks and are used as a complement to the protein diet; dead logs serve as nesting sites for very valuable birds such as macaws and parrots; During high waters, the fruits are dispersed by water currents and are part of the diet of large fish that feed on seeds and fruits such as the yamú or bocón[21].

Flood Forest

Some of the last relicts of the flood forests are found in the flood plains of the Meta, Cusiana, Pauto and Casanare rivers, on a landscape enriched by alluvial sediments of Andean origin, deposited during the last floods.

Image 5. General appearance of the flooded forest

A determining factor in flooded forests is the duration of the flood; In the highest places, called benches or high meadows, the waters drain quickly and in a few days the land is fertilized with fertile silt; There the jungle presents a complex and diverse structure, with large trees such as the caimitos, the chivechas or rubbers, the ceibas, the jobos, the maracos with their clusters of enormous fruits on the stem and the mortecinos,

[21] Banco de Occidente, Op Cit.

Lecitidaceae that produce pestilent flowers. The abundance of palms such as the royal, the milpesos, the moriche and many others.

In the lowlands, lows or shoals; The water remains for seven to nine months, most of the rainy season. The most common species in the lowlands are the swamp búcaro and the totumo[22].

Wetland areas

For the eligible areas of the project, the data is combined with the zoned areas of permanent wetlands for Colombia, provided by the Ministerio del Medio Ambiente y Desarrollo Sostenible. As a result of the step, it is evident that in the wetland areas, there is no establishment of forest plantations for commercial purposes, it can be stated that almost all the areas delimited as wetlands are outside the eligible areas of the project. The minimum overlaps occur due to the difference in survey scales of the wetland layer (scale 1:100,000, and information obtained from primary data type Raster vs. Project information scale 1:10,000 and primary data obtained from the field with GPS of property limits)

In the following series of maps, the wetlands areas are presented in green polygons, the eligible areas in blue, the property area in yellow, and the establishment of the commercial model in solid black points (see wetlands_annex).

[22] Banco de Occidente, Op Cit.

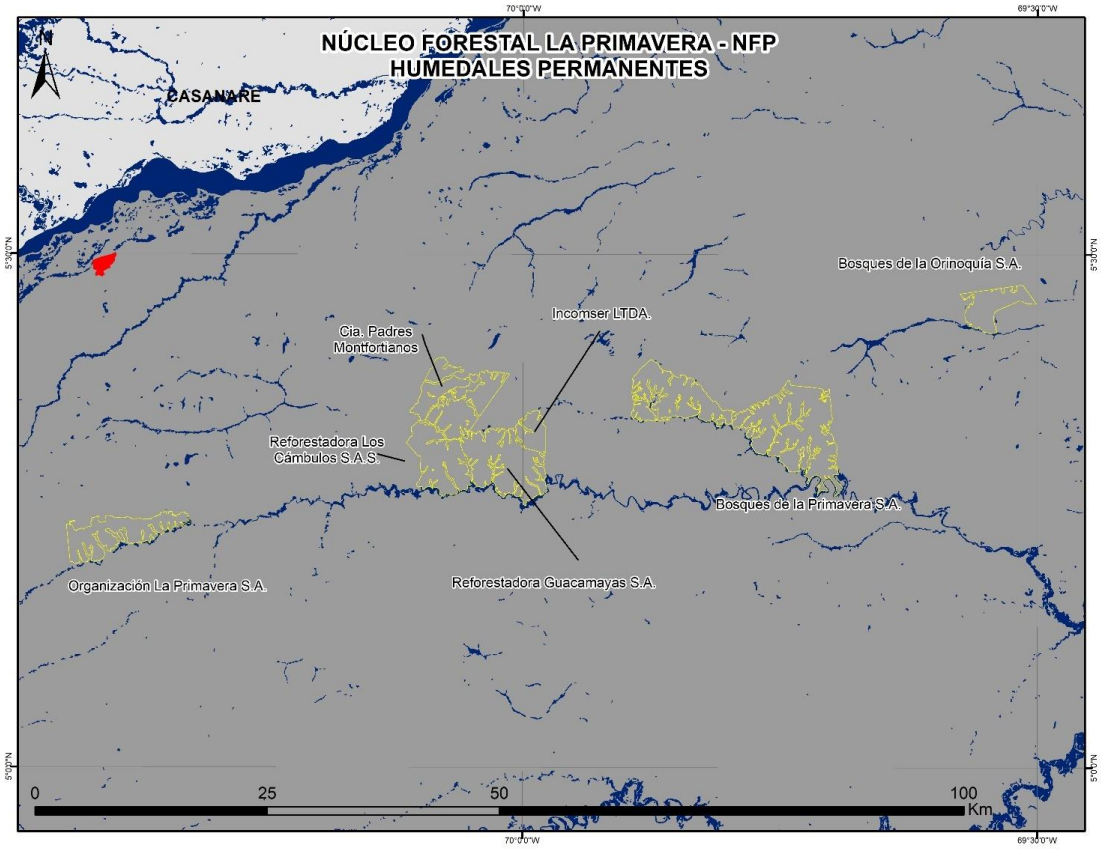


Figure 13. Eligible areas and areas determined as permanent wetlands in the project region

Land Use and Land Cover

In the department of Vichada it is possible to differentiate five types of vegetation: savannah covers, gallery forests, transitional jungle, planted forests and flora associated with wetlands and bodies of water. The vegetation cover represents 42% of the total area of the department, with forests being the predominant land use coverage, concentrated mainly in the south of the department, in an almost continuous region of tropical forest. In a lower percentage are the gallery forests located in the north of the department and the pastures covering 39% of the departmental total.

Table 9. Land Use and Land coverage identified for the Department of Vichada, identified from satellite images (clouds correspond to unidentified areas). Source: CORPORINOQUÍA, 2013. Plan de Gestión Regional Ambiental 2013-2025

Land Use and Land Coverage	Area (ha)	Percentage (%)

Forest	4,249,583.35	42.55
Water	48,744.35	0.49
Crops	995,830.06	9.97
Clouds	138,864.67	1.39
Grasslands	3,935,092.05	39.4
Rastrojos	283,819.08	2.84
Rivers	142,934.28	1.43
Shadows	51,574.25	0.52
wastelands	140,495.17	1.41
Urban	1,192.95	0.01
Total	**9,988,130.22**	**100**

Land Use

In the municipality of La Primavera, land uses vary between urban and rural areas. In the urban area, the predominant uses are for industry and commerce. For the rural area, the gallery forests and the flood zone are used in the summer to plant temporary crops of corn, banana and cotton. They are also used to support livestock farming and small dairy industries. Approximately 90% of the rural lands of the Municipality are used for large livestock (cattle and horses) and small livestock (sheep and pigs), most of the economy depends on activities related to livestock, and only approximately 2% , is used in pancoger agriculture. Generally, these crops are located in small plots called conucos on the banks of the canals and small areas of forest are cut down for these crops. Another 2% is used to improve pastures on larger livestock farms with artificial grass crops such as *Brachiaria humidícola* and Llanero grass and, finally, 6% is used for logging in areas such as Santa Cecilia, Marandúa y Urillano (Esquema de Ordenamiento Territorial, EOT 2000).

Controlled burning is common to promote the renewal of pastures, which improves their adaptation for livestock grazing. During the summer, the pastures are very dry and due to their texture, the cattle cannot digest it easily. Therefore, the popular practice is to burn it once or twice a year to obtain the regrowth of the grass so that it can be better assimilated by the livestock. On the other hand, during intense summers, natural fires are common, generated by high temperatures or by the transport of ashes resulting from burning to regenerate pastures, in nearby places. Fires, both those carried out for the regeneration of pastures and natural fires, cause degradation in the soil, since they cause loss of minerals and a decrease in porosity, generating larger flooding areas in winter and less natural recovery capacity of native flora. On the other hand, gallery forests are affected by common fires since on some occasions they are impacted by flames and lose their density.

Fauna and Flora

Colombia, with more than 24,500 species of vascular plants, ranks second, after Brazil, in the ranking of countries with the greatest plant diversity on the planet. (Espinosa *et al.* 2008[23], Bernal *et al.* 2016[24]). New taxa for science and new records of species from poorly inventoried areas are frequently documented in the country, such as the Orinoquia region.

For the Colombian Orinoco River basin, more than 26000 systematized records of plants are known in the main herbaria of the country, representing around 4,900 species (Cárdenas et al. 2017 in prep.). In general, studies to understand the biological diversity of this basin have been directed 60% at estimating the composition and 40% at determining the way in which these biological components are organized (structure) (Correa et al. 2005). Within these estimated percentages, the contribution of the Vichada department has been low, which is why it occupies third place in the entire basin, in relation to studies carried out on both flora and fauna. However, due to its richness in different species and ecosystems, the Orinoquia is one of the most biologically diverse regions in the world. (Lasso *et al.* 2010[25]).

This is how the Andén Orinoqués, in the department of Vichada, which represents one of the most complex landscapes of the Orinoquia due to the great variety of ecosystems and the presence of unique species, is a unique remnant of biodiversity, however, the flora present in this landscape has been little studied (Castro-Lima, 2010[26]).

In the northern part of the Orinoqués Anden, the presence of flat savannahs with some sporadic outcrops of the Guayanés Shield stands out; while in the southern area, Amazonian-type jungles predominate with sporadic or continuous outcrops locally called

[23] Espinosa, D. y S. Ocegueda C. (Eds.) 2008. El conocimiento biogeográfico de las especies y su regionalización natural, en Capital natural de México, Pp. 33-65, vol. I: Conocimiento actual de la biodiversidad. Conabio, México,

24 Bernal. R., S. Gradstein y M. Celis. 2016. Catálogo de Plantas y Líquenes de Colombia Volumen I. Primera edición. Bogotá. D.C. Universidad Nacional de Colombia (Sede Bogotá). Facultad de Ciencias. Instituto de Ciencias Naturales. Volúmenes I y II. 1500 p.

25 Lasso, C. A., J. S. Usma, F. Trujillo y A. Rial (Eds.). 2010. Biodiversidad de la cuenca del Orinoco: Bases científicas para la identificación de áreas prioritarias para la conservación y uso sostenible de la biodiversidad. Instituto de Investigación de Recursos Biológicos A. von Humboldt, WWF-Colombia, Fundación Omacha, Fundación La Salle e Instituto de Estudios de la Orinoquia (Universidad Nacional de Colombia). Bogotá, D.C., Colombia, 609 p.

[26] Castro-Lima, F. 2010. Avance del conocimiento de la flora del Andén Orinoqués en el departamento del Vichada, Colombia. Revista ORINOQUIA - Universidad de los Llanos - Villavicencio, Meta. Colombia. Volumen 14 - Sup (1): 58 – 67 p.

Tepuyes, these correspond to ancient rock formations dating from the Precambrian, their age ranges between 500-1600 million years. (Etter 2001[27]).

This landscape presents high floristic diversity due to the presence of numerous ecosystems such as: Los Tepuyes with three unique plant formations, the forests at the base of Tepuy, forests at the top of Tepuy and chasmophyte vegetation; Low and high savannas, gallery forests, morichales, mountain forests, saladilsales and floodplain forests of the Orinoco River. The rocky outcrops are scattered throughout the area, bordering the Orinoco River. From north to south are Cerro Banderas and Cerro el Bita in Puerto Carreño; in the Bojonawi reserve, the lagoon stone, Caricare, Morrocoy hill and Campana; in the Guacamaya reservation, the Canavallo, Guacamaya and El Tigre hills. In the Ventanas reserve, the Ventanas hills follow the hills of Guáripa, Dagua, Casuarito, Mesetas, Tuparro, Santa Rita and Mataven. (Castro-Lima, 2010).

In research carried out by Castro-Lima (2010), in the Andén Orinoqués, in a floristic inventory, 1010 species were identified, belonging to 123 families and 473 genera. Passiflora sclerophylla Harms and Combretum cf. llewelynii Macbr, can be considered as new records for Colombia and the genus Cavanillesia is a new record for the Orinoquia. In **¡Error! No se encuentra el origen de la referencia.**, families with more than 10 species are recorded; The Fabaceae family has the highest number of species, 147, followed by Rubiaceae with 64 and Myrtaceae 40 species.

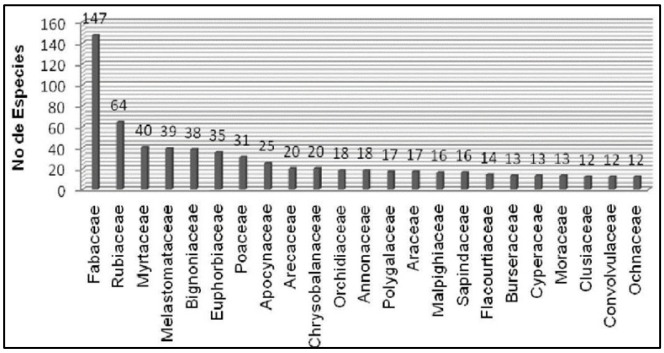


Figure 14. Registry of families with more than 10 species reported in the Orinoqués Anden

[27] Etter A. El Escudo de Guayana, en A. Etter (ed.) Puinawai y Nukak. Caracterización Ecológica General de dos Reservas Nacionales Naturales de la Amazonía Colombiana. Serie Investigación 2. Instituto de Estudios Ambientales para el Desarrollo – IDEADE. Bogotá. 2001pp. 31-42.

Once the floristic inventories have been carried out in the different ecosystems of the Orinoqués Anden, it is observed that some species can occupy one or more ecosystems, such is the case of *Copaifera pubiflora*, which is present in the floodplain forests of the Orinoco and in the forests of the top of the Tepuyes; *Calophyllum brasiliense* is found in riverside forests and mixed morichales; *Attalea maripa* and *Syagrus inajai* are found only in the forests associated with rocky outcrops, while the presence of *Cavanillesia sp* is exclusive in the forests at the base of the Tepuy. The most common species is *Tapirira guianensis*, as it is found in sheets, gallery forests and bushes, even on the edges of the moriches. In **¡Error! No se encuentra el origen de la referencia.**, the highest number of species grow in well-drained areas (460), followed by semi-aquatic areas with 409 species, as these environments occupy the largest area of the landscape. (Castro-Lima, 2010).

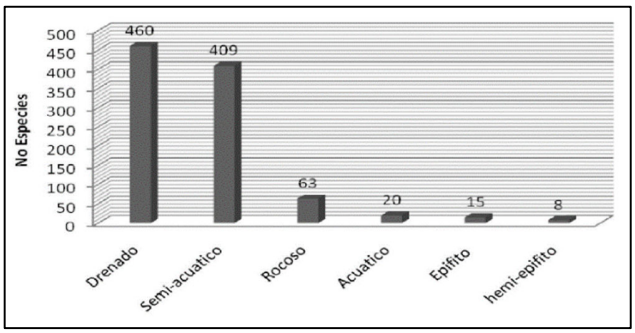


Figure 15. Number of flora species by growth environment in the Anden Orinoqués in Vichada, Colombia

Of the flora species found, 845 are of importance for the diet of wildlife, such as birds, mammals, fish and reptiles (**¡Error! No se encuentra el origen de la referencia.**).

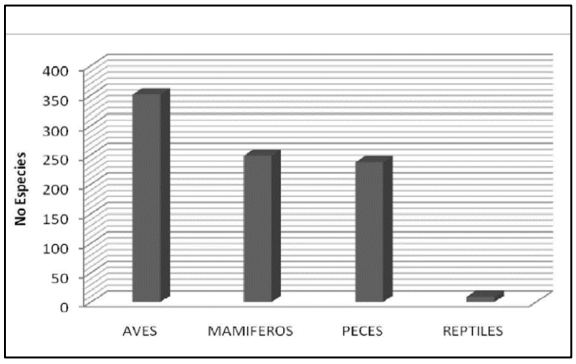


Figure 16. Flora species associated with fauna feeding in the Orinoqués Andén

Likewise, a study carried out by Mosquera *et al*., 2017[28] in the Bita River stands out, where the floristic inventory recorded a possible new species of the genus Perama (Rubiaceae) and four new records for the country: *Genlisea sanariapoana* (Lentibulariaceae), *Polygala microspora* (Polygalaceae) y *Borreria pygmaea* (Rubiaceae).

Table 10. Taxonomic and chorological news reported during the study in the Bita River

Taxón	Colección de referencia	Importancia
Perama sp.	MFG 3192, MFG 3202, MFG 3211	Posiblemente es una nueva especie, se revisaron todas las especies de *Perama* del neotrópico y no coincide con ninguna.
Genlisea sanariapoana	MFG 2997	Nuevo registro para el país, solo había sido reportada en Venezuela.
Sauvagesia sp.	MFG 3210	Nuevo registro para el país. Podría ser una nueva especie, aún no se han revisado todas las especies de *Sauvagesia* del neotrópico.
Polygala microspora	MFG 3209	Nuevo registro para el país, solo había sido reportada en Venezuela.
Borreria pygmaea	MFG 3212	Nuevo registro para el país, solo había sido reportada en Venezuela.

It is important to mention that 23 new records were found for the flora of Vichada, which are not included in the list of species in the Colombian Plant Catalog, among which the species *Drosera biflora* (Droseraceae), a carnivorous herb that has been reported for the Amazon, Guayana, the Macarena mountain range and the Magdalena Valley, in an altitudinal range of 50 to 640 m; a small fern of the genus Ophioglossum (Ophioglossaceae), of which three species have been reported for the country with distribution in the Andes, Guayana, Sierra la Macarena, Pacific and Sierra Nevada de Santa Marta; and *Brachystele guayanensis* (Orchidaceae), one of the two species of the genus reported in Colombia (Bernal *et al.* 2016).

Also noteworthy is the study carried out by Mijares, et al., 2017[29] where 18 taxa were determined, which constitute new records for the vascular flora of Colombia. The specimens are deposited in the Orinocense Herbarium (HORI) at the National University of Colombia (Orinoquia Headquarters), the National Herbarium of Colombia (COL) and the ICESI Herbarium in Cali (**¡Error! No se encuentra el origen de la referencia.**). The 18 species recorded in this contribution constitute new records for the vascular flora of

[28] Mosquera, H. R., M. F. González, H. Mendoza, O. Díaz-Vasco y C. Gutiérrez. 2017. Flora. Pp. 47-87. En: Trujillo, F. y C. A. Lasso (Eds.). IV. Biodiversidad del río Bita, Vichada, Colombia. Serie Editorial Fauna Silvestre Neotropical. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt (IAvH). Bogotá, D.C., Colombia.

[29] Mijares, F.; Aymard G. & Pérez-Buitrago, N. 2017. Nuevos registros para la flora vascular de Colombia presentes en la Orinoquia y reseña histórica de las expediciones botánicas a la región. Biota Colombiana 18 (2) – 2017. 72 – 87 p.

Colombia, highlighting: *Nectandra bartlettiana Lasser* (Lauraceae), *Muellera crucisrubierae* (Pittier) M. Sousa, *Enterolobium barinense* L. Cárdenas & Rodr.- Carr. (Fabaceae), *Duguetia riberensis* Aristeg. Ex Maas & Boon (Annonaceae), *Dulacia cyanocarpa* Sleumer (Olacaceae) and *Gouania wurdackii* Steyerm., taxa that were considered endemic to the flora of Venezuela

Regarding the fauna of the Orinoquía, it is represented in literature and tradition by the animals that have been most evident to the human eye or ear, or those that most frequently appear in the stories, legends and fears of the people or those that are the most frequent target of hunting for consumption. The best known and most easily observed in the Eastern Plains include the sabanero deer (*Odocoileus virginianus*), the chigüiro (*Hydróchaeris hydrochaeris*), and the red corocora (*Eudocimus ruber*).

The Orinoco fauna also includes one of the animals with the most powerful vocalization in the animal kingdom, such as the araguato or big-necked monkey (*Alouatta seniculus*), which can be heard several kilometers away, or the various species of macaws (Am spp.), whose flocks break the silence of the morning when they go to their usual feeding places or at dusk when they return to their roosts. It also includes several animals that are considered dangerous to humans, such as the panther (*Panthera onca*), the black güío or anaconda (*Eunectes murinus*), the Orinoco caiman (*Crocodylus intermedius*) and the caiman cuatronarices (*Bothrops atrox*).

This is the natural region that contains a higher percentage of the national birdlife; Among the best-known groups are the waders or ciconiiformes, whose order includes all the herons, egrets or greatcoats and within which are the largest birds in the country; Other members of this order are the corocoras, which stand out for their beautiful colors, as well as for their massive movements from their feeding areas to their roosts or herons. Another group of great showiness and relevance is that of ducks or anseriformes, particularly the pisingos (*genus Dendocygna*), which present massive local migrations from the plains to the foothills, which add to the transcontinental migrations. (Defler & Ródriguez[30]).

[30] DEFLER, T. & RODRÍGUEZ, J.V. S.F. LA FAUNA DE LA ORINOQUIA. Fundación Natura y Conservación Internacional de Colombia.

Image 6. Photographs of the new records for the vascular flora of Colombia, collected in Orinoquía, department of Arauca. A) D. riberensis, B) T. duckei, C) T. medinae, D) M. burchellii, E) Murdannia aff. M. triquetra, F) M. tovarense, G) M. crucisrubierae, H) E. barinense, I) C. aromatica, J) P. corymbosa var. brasiliensis K) C. africana, L) P. microphyllus, M) D. cyanocarpa N) N. bartlettiana, O) J. orinocensis. Photographs m y o F. Castro-Lima.

However, there are hundreds of other lesser-known animal species that make up. This rich fauna. Although the species for which there is more information in the country are found in the Eastern Plains, the fauna of Orinoco has been little studied and its diversity is much higher as we approach the jungle area south of sheets. The extremes in topographic variability and abundance of vegetation generate diverse horizontal levels of species richness, thus diversity is lowest in the plains, but increases as one moves towards the southwest. Additionally, the multiplicity of some groups of vertebrates increases from the level of the savannahs towards the foothills and decreases from the foothills towards the heights of the páramos.

In the Orinoco macro-basin, 318 species have been recorded, of which 196 are associated with the terrestrial and aquatic ecosystems of the ecoregion of the Colombian Eastern Plains, reporting 12 orders, 127 genera and 35 families, the most diverse orders being Chiroptera (105 species), Rodentia (29 species) and Carnivora (17 species) (Pardo-Martínez y Rangel-Ch. 2014, Solari et al. 2013, Trujillo et al. 2010, Ferrer et al. 2009a). The Orinoco mastofauna is made up of Andean, Amazonian and Escudo Guyanese elements. (Correa et al. 2006); en ella se encuentran las mayores concentraciones poblacionales de este grupo faunístico en el país (Rodríguez-Mahecha et al. 2006a), pero es la región que presenta la menor diversidad específica de mamíferos en el país (Ferrer *et al*. 2009) y un nivel de endemismo bastante bajo (Rodríguez-Mahecha et al. 2006a).

In the department of Vichada, few investigations have been carried out regarding the structure, composition and diversity of the mastofauna; the studies have been concentrated mainly in the El Tuparro National Natural Park (Defler 1982, Defler 1986, Gómez-Camelo et al. 2009, Patiño et al. 2005, Trujillo et al. 2008), near the municipality of Puerto Carreño (Botello-Castillo 2001, Gómez-Camelo 2004, Parra 2006, Velasco-Gómez 2004 and Trujillo and Mosquera 2016) and in the Orinoco basin (Bermúdez-Romero et al. 2004, Carrasquilla 2002, Carrasquilla and Trujillo 2004, Castelblanco et al. 2009, Muñoz-Saba et al. 20015, Trujillo et al. et al. 2017). Some image records of mammals from the region are presented. See **¡Error! No se encuentra el origen de la referencia.**

In the Orinoquia region, a total of 783 of the 1,889 bird species reported for Colombia (Donegan et al. 2011) have been recorded, representing about 40% of the total number of species in the country. It is estimated that about half of the birds reported for the Orinoquia are found in the department of Vichada (Figure 17). According to Acevedo-Charry et al. (2014), 368 species have some kind of record in this department, while the Colombian Biodiversity Information System (SIB Colombia 2015) includes records of specimens of 350 bird species for Vichada represented in the country's biological

collections, most of which come from the Matavén forest and the Tuparro National Natural Park. For the Bita River, there is a document that lists 155 bird species present in the basin (Corporinoquia 2015). However, it is believed that there are many more records, but there are gaps in knowledge about biodiversity (Arbeláez-Cortés 2013), for example for Vichada, a situation that occurs in other departments of the Orinoquia.

Image 7. Images obtained on the day with camera traps: a) Cebus albifrons, b) Hydrochoerus hydrochaeris, c) Leopardus pardalis, d) Puma concolor, e) Puma yaguaroundi, f) Myrmecophaga tridactyla. Source: Taken from the reports and studies mentioned.

Image 8. Photographic record of birdlife in the Region. Source: Taken from the referenced studies.

Knowledge about the biological diversity of the Bajo Orinoco geographic region is limited (Rosales et al. 2010), and for the department of Vichada the figure for amphibian and reptile diversity is still far from being known. In the national context, of the 806 species of amphibians reported, only 29 are registered for Vichada (Acosta-Galvis 2017) and 25 of these are associated with the Bajo Orinoco corridor, thus positioning the fauna of this department as one of the most unknown. from the country. Reptile records are still uncertain and according to published studies, a total of 72 species are recognized for this corridor (Acosta-Galvis et al. 2010). Below are some photographic records of amphibians and reptiles of the Region. See **¡Error! No se encuentra el origen de la referencia.**.

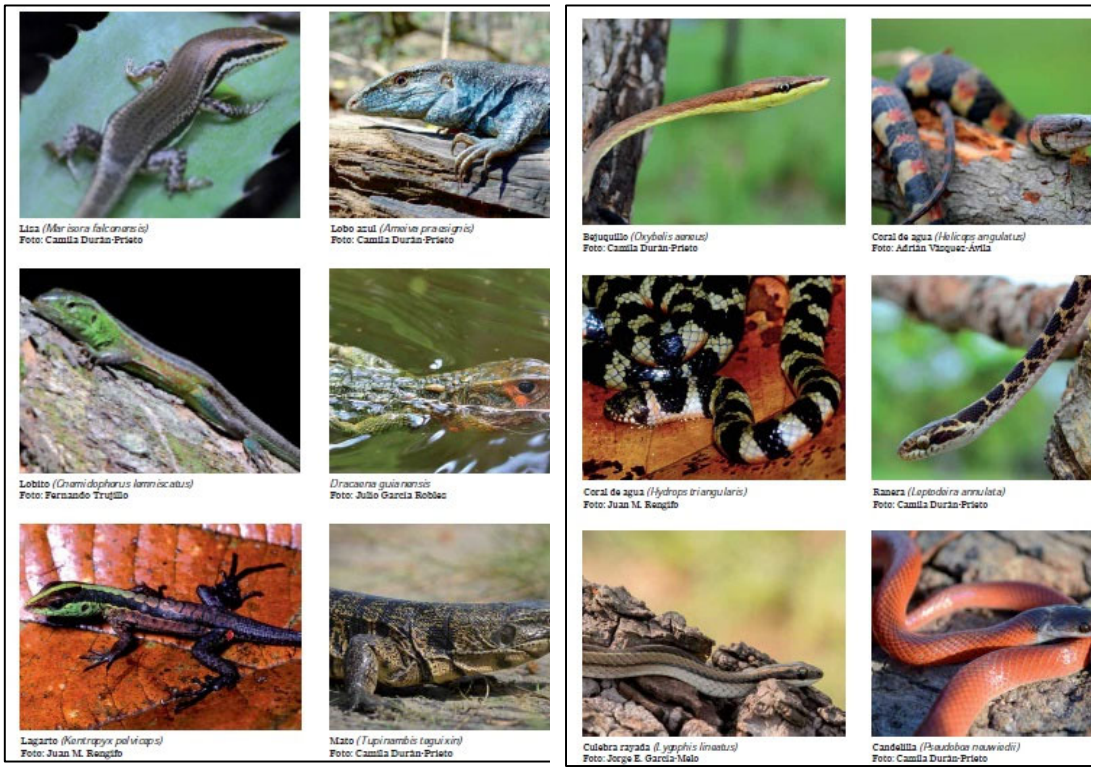


Image 9. Photographic record of some species of amphibians and reptiles of the Orinoquia Region

In Colombia, the Orinoco River basin concentrates 57.6% (995 spp.) of the national ichthyological wealth (Maldonado-Ocampo et al. 2008; Álvarez-León et al. 2013), which places it as the first with greatest fish diversity in the country (**¡Error! No se encuentra el origen de la referencia.**). The fish diversity of the Orinoquia has been studied in the sub-basins of the Meta rivers (Eigenmann 1914, 1919, 1921, 1922, Myers 1930, Cala 1977, Galvis et al. 1989, Sánchez et al. 1999, 2003, Usma et al. 2016), Tuparro (Maldonado-Ocampo and Gregory 2007), Tomo (Maldonado-Ocampo et al. 2006) and Ariporo (Villa et al. 2015); at the confluences of the Guaviare, Inírida, Atabapo and Orinoco rivers (Lasso et al. 2009); in the foothills of the Casanare department (Urbano-Bonilla et al. 2009), in the Casanare rivers (Villa et al. 2011, Maldonado-Ocampo et al. 2013), in the Casanare basin in Arauca, in the Lipa rivers , Tame and Tocoragua (Mesa et al. 2015); and for the entire basin (Lasso et al. 2004, Galvis et al. 2007).

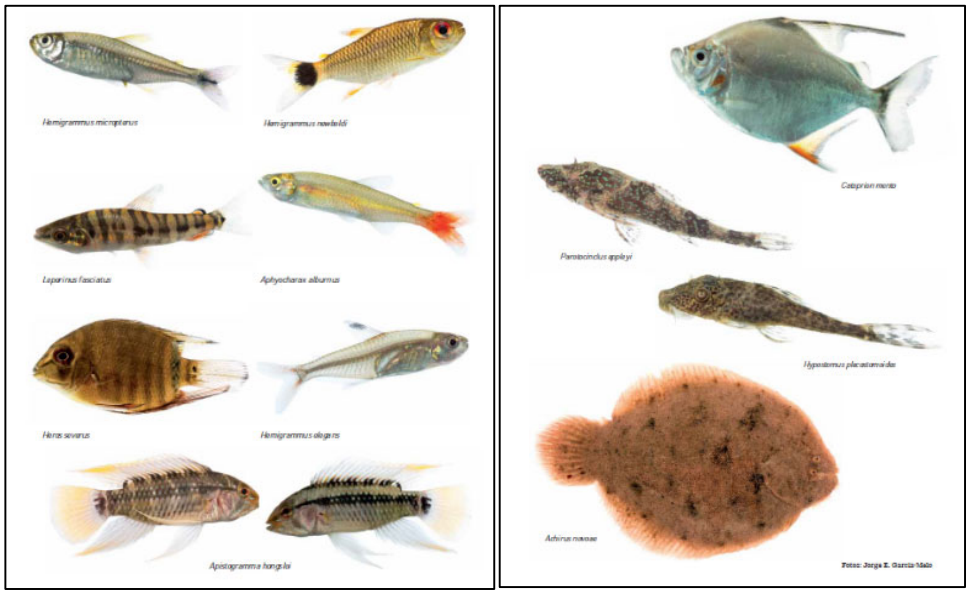


Image 10. Photographic record of some species of fish in the Region

Endangered Species

The chigüiro (*Hydrochaeris hydrochaeris*) is an important rodent in the area and is threatened because of the indiscriminate hunting to which it is subjected due to the high demand for its meat and skin. The freshwater dolphin (*Inia geoffrensis*), the Antillean manatee (*Trichechus manatus manatus*) and the giant otter (*Pteronura brasiliensis*) are aquatic mammals that are equally threatened. Among mammals, pressures on their habitat represent the most important threat to species such as the leopard (Leopardus pardalis) and the Cebus apella. The plains caiman (*Caiman intermedius*) is one of the most studied crocodiles in the basin, since it is an emblematic species of the area, of commercial importance, endemic and in a critical state of conservation. The morrocoy and charapa turtles (*Geochelone denticulata and Podocnemis expansa*) are also in danger of extinction; Of these species, local inhabitants consume the eggs and meat or are hunted very small for export as aquarium pets. (Gobernación de Vichada 2008, CORPORINOQUIA 2004).

¡Error! No se encuentra el origen de la referencia., shows the list of species reported as threatened in the Eastern Plains Region and the Transitions of the Colombian Amazon. **¡Error! No se encuentra el origen de la referencia.**, shows some of the emblematic species of the Colombian plain that are under some degree of threat. The listings and monitoring are supported by research carried out by some entities such as

the Omacha Foundation,[31] which issues periodic reports on the status of species and activities for their conservation. The data are those used by the project to guide actions that improve their habitat in the project area. Many of these species depend on the high plains, specifically in the areas of the Orinoquia savanna, for their survival, an area where the Forest Project will be developed. But it is crucial to conserve the gallery forests, increase their areas and have means of connectivity between forest relics (such as forest plantations) for the movement of fauna between the forests, which will be preserved, improved and protected with the implementation of the project. This will conserve habitats and allow gene flow between populations.

[31] https://omacha.org/

 *Leopardus pardalis* https://omacha.org/especies-amenazadas-felinos/	 *Cebus apella* Mico Maicero Foto: Cristian Castro Morales
 *Hydrochoerus hydrochaeris* https://colombia.inaturalist.org/photos/34844190	 *Caiman intermedius* (Caiman llanero) https://sostenibilidad.semana.com/medio-ambiente/
 *Chelonoidis carbonarius* Morrocoy Sabanero (c)ivanlau https://colombia.inaturalist.org/taxa/539039-Chelonoidis-carbonarius	 *Inia geoffrensis* https://omacha.org/

Image 11. Some endangered animal species in the Orinoco region.

Table 11. Threatened fauna species in the Orinoquia region. EN: endemic, VU: vulnerable, NT: near threatened, LR: low risk, DD: insufficient data.

Scientific Name	Common Name	Category
Fishes		
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*
Cacajao melanocephalus		*VU*
Mammals		
Leopardus pardalis	Leopardo	
Cerdocyon thous	Zorra	
Hydrochaeris hydrochaeris ithsmius	Chigüiro	
Myrmecophaga tridactyla	Oso hormiguero, oso palmero	*VU*
Reptiles		
Crocodylus intermedius	Caimán del Orinoco, llanero	
Podocnemis expansa	Tortuga charapa	
Geochelone denticulata	Tortuga morrocoy	
Birds		
Neochen jubata	Pato Carretero	*NT*
Falco deiroleucus	Halcón colorado	*DD*
Pauxi pauxi	Paujil Copete de Piedra	*VU*
Polystictus pectoralis	*Tachurí Barbado*	*NT*

Source: Mojica (2002), Renjifo (2002), Corporinoquía (2004)[32]

[32] 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.
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.

8.6 Environmental Benefits

The project obtained the permits established by the regional environmental authority Corporinoquia (CORPORINOQUIA is an environmental services government agency in the Colombian Orinoquia region).

The environmental corporation holds the environmental compliance and monitoring files of each of the forest nuclei that are part of the projectEnvironmental management plans have been implemented and applications for environmental permits have been made.

Awareness-raising actions have also been carried out for the protection of wildlife inside and outside the projects. Among these are the signage and messages alluding to the protection of the environment, in addition to the good management of waste within the project.

Image 12. Signs referring to wildlife conservation.

It is important to mention that the project has been developed on land dedicated to livestock farming. These soils have historically been affected by annual burns, resulting in the degradation of the physical and chemical properties of the soil.

Likewise, burning has led to the destruction of habitats and fragmentation of ecosystems, isolating fauna and eliminating the possibility of genetic exchange between forest patches. The project has contributed to the connectivity of these forest relicts. The forest cover reduces the loss of water in the soil by evaporation and the roots of the trees

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

promote the rupture of hardened soils, aerating the innermost parts of the soil and allowing the infiltration of water to deeper areas.

The project reduces surface runoff, which leads to soil degradation and loss of fertility by washing away nutrients, and with its cover, generates a regulating effect on soil humidity and provides significant quantities of organic matter necessary for the recovery of fertility.

In this way, the project, by promoting new forests in areas vulnerable to soil degradation, contributes positively to the care and conservation of flora and fauna, reduces burning, and contributes to making the territory more resilient to climate change conditions. The processes of environmental management measures that allow mitigating the potential negative effects and that are applied to the project can be seen in annex_8_compromiosos _ambientales.

9 Socioeconomic Aspects

9.1 Population

Prior to the implementation of the project, it was estimated that the department of Vichada had a total population of 55,872 inhabitants, that is, 0.53 inhabitants per km^2. With a balanced distribution between men and women, where a little more than 40% of the population was distributed in the population under 14 years of age. The working population (adult population) for the region is assumed to be in the range of 15-65 years and covers about 55% (Figure 13).

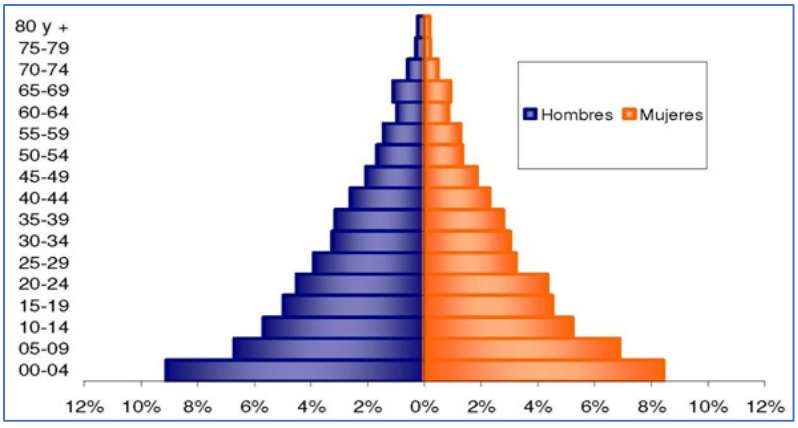


Figure 17. Population distribution years prior to the start of project activities. Source DANE, 2010. https://www.dane.gov.co/files/censo2005/PERFIL_PDF_CG2005/99000T7T000.PDF

According to the pyramidal shape of the population graph, it is assumed that the population of the department is progressive, that is, where the young population strongly dominates over other groups.

In 2016, the year of the project's implementation, the population was estimated at 73,702 people, that is, an increase of 31% in a period of six years, with an estimated 0.73 people per km2, which is low for the size of the territory.

Population in the Vichada department.

- N°. People in Cabeceras: 30,660
- N°. People in Rural Areas: 43,042
- **Total: 73,702**

Of these inhabitants, the percentage of the working population remains unchanged. This is related to the highest proportion of the young population registered before 2010. However, as seen in **¡Error! No se encuentra el origen de la referencia.**, the young population has decreased, and the adult population has increased. It can be inferred that in the future, the working population will begin to reduce, if the age trend continues, which could imply possible difficulties in finding labor in the territory. However, it should be noted that the majority of the population (58%) is concentrated in the rural area, therefore the contribution to the generation of employment in the rural sector is a contribution of the project to the development of the territory.

Table 12. Age distribution for the department of Vichada, year 2016[33].

Age range	>1 year	1-4	5-14	15-44	45-59	>60
Total number, by age group	2094	8115	18554	31621	8228	5090
(%)	2.84	11.01	25.17	42.90	11.16	6.91

A detailed view of the municipality of La Primavera, where the project activities are located, shows that despite being the second largest municipality in Colombia (larger even than other departments in the country), it only has 21.5% of the population of

[33] http://www.vichada.gov.co/indicadores/poblacion-2016

Vichada, with a total of 15,886 inhabitants (**¡Error! No se encuentra el origen de la referencia.**), of which it is estimated that 16% is indigenous population. The average number of people per square kilometer is 0.74, which is consistent with the departmental average.

Table 13. Populational distribution for the different municipalities of Vichada

People by department										
Municipalities	**Distribution by age ranges**						**Distribution by sex**		**Total**	**% on Municipal total**
	<1 year	**1-4**	**5-14**	**15-44**	**45-59**	**>60**	**Men**	**Women**		
Municipality - Puerto Carreño	382	1,580	3,792	7,890	1,650	706	8,420	7,580	16,000	21.71
%	2.39	9.88	23.70	49.31	10.31	4.41	52.63	47.38	100	
Municipality - Santa Rosalía	132	498	1,048	1,664	503	231	2,076	2,000	4,076	5.53
%	3.24	12.22	25.71	40.82	12.34	5.67	50.93	49.07	100	
Municipality - Primavera	411	1,642	3,774	6,715	2,253	1,091	7,979	7,907	15,886	21,55
%	2.59	10.34	23.76	42.27	14.18	6.87	50.23	49.77	100	
Municipality - Cumaribo	1,169	4,395	9,940	15,352	3,822	3,062	18,862	18,878	37,740	51.21
%	3.10	11.65	26.34	40.68	10.13	8.11	49.98	50.02	100	

9.2 Population distribution

According to DANE (INCODER, 2012), for the entire department of Vichada there are 31 registered indigenous reservations occupying a total area of 3,557,432.82 hectares, housing a total of 3,947 families.

Human settlements are made up of colonizing population, immigrants from the rest of the country and ethnic groups. According to data from the National Department of Statistics (DANE, 2012) cited in the *Geographiando 2.0* portal, the total projection of the indigenous population for the department of Vichada in 2012 is 27,596 people, concentrated especially in the Municipalities of Santa Rosalía, Carreño and Cumaribo, where the largest extensions of natural tropical forest of Vichada are present in the Orinoquia-Amazon transition. In the municipality of La Primavera, for the years prior to the start of activities, there was a small indigenous population, corresponding to three indigenous reservations (Campo Alegre and Ripialito, La Pascua and La Llanura), the three corresponding to the Guahibo people and covering only 4.7% of the territory of the municipality of La Primavera.

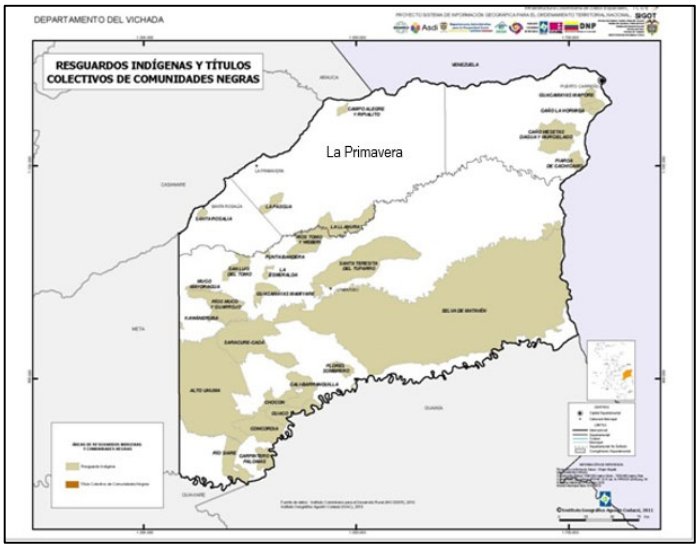


Figure 18. Distribution of the indigenous population in the Department of Vichada. Source: Geographic Information System for Planning and Territorial Ordering – (SIG-OT), 2010)[34].

9.3 Society and economic

Livestock is the first link in the economy of the municipality of La Primavera, it is estimated that more than 50% of the department's livestock is in the Municipality. For 2014, a few 125,750 heads of cattle were estimated. An extensive activity where it is estimated that only 3% of the properties dedicated to livestock farming have implemented pasture improvement[35]. The main economic activity of the Municipality is livestock farming developed extensively in herds - farms - farms, with low production costs because it is carried out in a traditional way, using native pastures, with little technology and low efficiency.

La Primavera - Vichada, has 90% (21,415.78 km2) of rural land dedicated to livestock, especially breeding and rearing (weaning and growing calves). The livestock carrying capacity is estimated at 0,06 head of livestock per hectare in the municipality, a value that supports being called extensive, and which is significantly below the national average which is estimated at 0,65 large livestock unit per hectare (Viloria, 2003[36]) contributing only 1% of the country's bovine heads. Although livestock activity is the main

[34] http://sigotvg.igac.gov.co:8080/

[35] Plan de desarrollo La Primavera 206-2019. http://laprimaveravichada.micolombiadigital.gov.co/sites/laprimaveravichada/content/files/000110/5457_pddlpv.pdf

[36] Viloria, J. 2003. La ganadería bovina en las llanuras del Caribe colombiano. BANCO DE LA REPUBLICA. https://www.banrep.gov.co/sites/default/files/publicaciones/archivos/DTSER-40.pdf

source of income for the municipality, it requires little labor, since large herds can be managed by very few people under traditional ways of production.

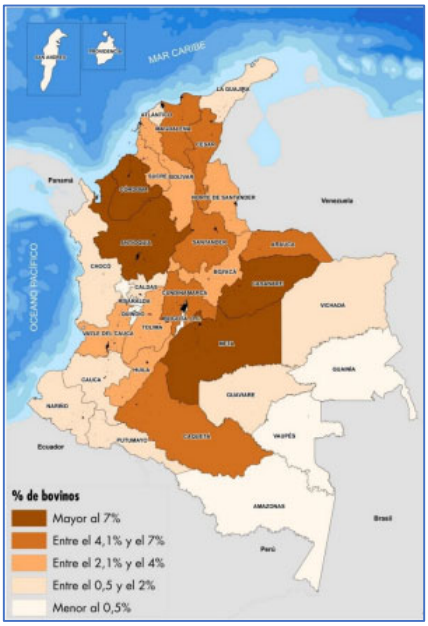


Figure 19. Contribution of bovine heads by department to the national inventory (2014). Source: National Agricultural Census 2014[37].

Other sources of income are related to the production of cotton, corn, and bananas, whose production is achieved with traditional systems and little technology, in the plains of the Meta, Orinoco and Guaviare rivers. Agriculture, incipient, is destined only for self-consumption due to the suitability of the soil, limited labor force and high production and transportation costs.

Regarding unsatisfied basic needs (UNB) in the department of Vichada, for the years prior to the implementation of the project activities, they ranged from 66% to 100% for the period 2005-2010[38], slightly improving the UBN conditions. for the other municipalities and maintained high NBI values for La Primavera at the end of the period. Hence, the project proposal is expected to contribute significantly to the generation of

[37] https://www.dane.gov.co/files/CensoAgropecuario/avanceCNA/PPT_9.pdf

[38] https://sigot.igac.gov.co/sites/sigot.igac.gov.co/files/sigot/Mapas%20Tematicos/Departamentales/Vichada/Vichada_NBI_2005_V2_2012_01_18.pdf
http://www.odc.gov.co/portals/1/regionalizacion/caracterizacion/RE082015-caracterizacion-regional-problematica-asociada-drogas-ilicitas-vichada.pdf

employment, the improvement in the living conditions of the population and the economy of the territory. Reference indicators on which the forestry project initiative hopes to contribute.

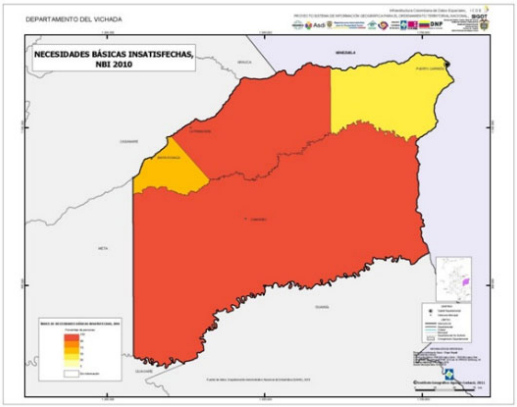


Figure 20. Unsatisfied basic needs department of Vichada year 2010: Source: https://sigot.igac.gov.co/sites/sigot.igac.gov.co/files/sigot/Mapas%20Tematicos/Departamentales/Vichada/Vichada_NBI_2005_V2_2012_01_18.pdf

9.4 Index of Living Conditions for Vichada

According to the National Planning Department (DNP) with data from 2005 cited by (Geographic Information System for Planning and Territorial Ordering (SIG-OT), 2010), only Puerto Carreño has a higher Living Conditions Index (LCI). at 70, the rest of the department presents values between 25 and 70. As can be seen, the municipalities, being further from the border with Venezuela and distant from the interior of the country, their quality-of-life conditions are reduced by aspects related to deficiencies in communication routes that improve commerce, sources of employment, income precipitates in the economically active population and state investment. This makes the department and the municipality of La Primavera a territory rich in land, but poor in state investment.

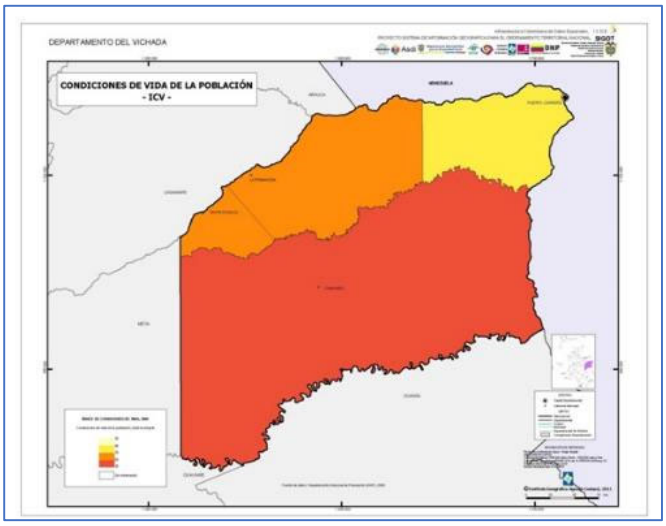


Figure 21. Living conditions of the population of Vichada. In yellow the best conditions and in red and their transitions the worst living conditions. Source: https://sigot.igac.gov.co/sites/sigot.igac.gov.co/files/sigot/Mapas%20Tematicos/Departamentales/Vichada/Vichada_ICV_Total_V2_2012_01_18.pdf

9.5 Social benefits expected

Among the social benefits are the generation of direct and indirect employment, the modernization of the workforce, the development of productive and social infrastructure that can serve other projects, demonstrating at the local level how reforestation activities can contribute to the economy and sustainable development of the region, to the generation of productive alternatives and sources of employment (one hectare of reforestation uses more labor than extensive livestock farming). The future wood transformation chain associated with the project's forestry production cycle will need trained and qualified personnel, promoting new labor skills in the community.

The project proposal has contributed to the generation of new jobs in the region, which have been provided with the legal employment contracts and benefits that by law must be granted to workers in Colombia, such as health and pension benefits and training for the development of their work. For this monitoring period, approximately 1,191 jobs have

9.6 Identification of ethnic communities in the territory

As described in previous sections, the department of Vichada has the presence of indigenous communities. Considering the location of the indigenous reservations, the spatial identification analysis of ethnic communities was developed, near or within the areas of intervention of the project. As can be seen in the image, the populations of black, peasant or indigenous communities with territory legally recognized by the

national government are distant from the project area. Demonstrating that the project does not affect these territories or communities.

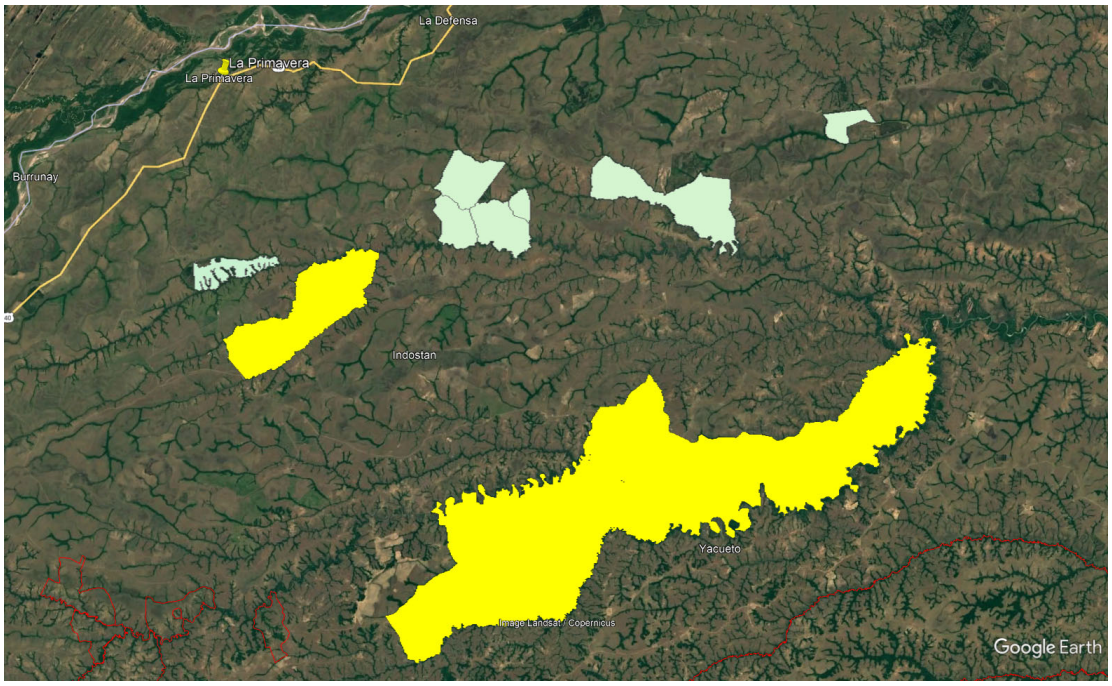


Image 13. No overlap with ethnic communities

10 Stakeholders' Consultation

The project was socialized with the regional autonomous corporation (Corporinoquía), to obtain the necessary permits for the development of the project. There was also communication with local entities, such as the mayor's office, among others. At the national level, there was communication with the Ministry of Agriculture and FINAGRO as executors of resources and to obtain the forestry incentive certificate.

Among the interested parties, government entities such as the municipal mayor's office stand out. The project is articulated with the entity to fulfill the objectives of the territorial development scheme, in the specific lines of productive alternatives for the region and the generation of employment.

This articulation is done through the participation in sectoral meetings held by the mayor's office, fairs, and reporting of activities to the extension agents of the secretaries. Much of this interaction is done verbally.

Another interested party is the **Corporinoquia Environmental Corporation**, which, as detailed above, is the one who ensures due compliance with environmental regulations for forestry activity in the region. With the entity and as evidenced in the annexes, the activities carried out in compliance with the regulations are recorded and minutes are drawn up relating compliance with these.

For the current monitoring period, a notification process was developed for external neighbors of the project cores regarding the monitoring and verification process for the 2023-2025 period. No complaints or comments regarding the project's progress were received from these notifications.

Finally, through the training process, the project is socialized in a comprehensive way with workers and operational personnel through annual training, periodic meetings and compliance processes with external entities. These activities are not limited to technical training and risk prevention but also include a detailed explanation of the economic and operational dynamics of the project. In this way, it ensures that all staff are informed and aligned both in terms of safety and efficiency, as well as in understanding the financial and functional objectives of the project.

11 REDD+ Safeguards

N.A

12 Special categories, related to co-benefits

N.A

13 Implementation of the project

Date of start of the project and period of operation

The period for this report considers the development of activities from **January 30, 2023 – March 30, 2025**

13.1 Implementation status of the project

At present, **22,450.15** hectares have been established in commercial stand and natural regeneration systems. The total area for the project eligible areas is 29,019 ha, of which most of the species are *Pinus caribaea*, a species with good development in acid, mineralized, and degraded soils of the region.

At present, the project has established the next stands:

- Commercial
- Protection of deforested areas adjacent to gallery forests[39] to allow protected natural regeneration (PNR) of forest cover

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*
- *Acacia mangium*
- *Eucalyptus pellita*

The commercial species were stratified according to their biomass content, as presented in Table 14.

***Table 14.* Distribution of commercial strata in *eligible areas*.**

Strata	Area (ha)
Low	1.398,7
Steady	2.691,5
Middle	1.632,8
High	5.952,7
Upper	7.264,7
Natural Regeneration	3.509,8
Total	**22.450,15**

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

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

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

anthropogenic activities are physical isolation for the protection of deforested areas and the elimination of livestock, fires, and hunting.

Table 15, presents the area in the project by nucleus and strata (2023-2025).

***Table 15*. Distribution of forest establishments by nucleus and stratum.**

Stratum	Bosques de la Orinoquia (ha)	Bosques de la Primavera (ha)	R. Cambulos (ha)	Guacamayas (ha)	P. Monfortianos (ha)	Organización La Primavera. (ha)	Incomser (ha)	TOTAL (ha)
Low growth	30,190	981,44	49,840	181,380	21,520	103,910	30,370	**1.398,7**
Steady growth	151,410	1.538,34	183,570	347,390	120,610	238,220	111,940	**2.691,5**
Middle growth	125,520	508,78	281,310	225,540	149,600	227,570	114,480	**1.632,8**
High growth	402,810	2.948,20	409,450	1.257,320	230,140	248,270	456,490	**5.952,7**
Upper	430,270	1.423,91	1.078,230	1.296,700	1.383,290	1.488,980	163,330	**7.264,7**
Protected Natural regeneration	244,300	591,350	632,260	452,64	1.025,820	544,470	18,990	**3.509,8**
Sub-totals	**1.384,500**	**7.992,020**	**2.634,660**	**3.760,970**	**2.930,980**	**2.851,420**	**895,600**	**22.450,2**

The records of the activities developed in the period of the present monitoring session are kept in physical documents in the installations of the project. (**Figure 22**), shows the structure for the development of the establishment and implementation of forestry and environmental technology.

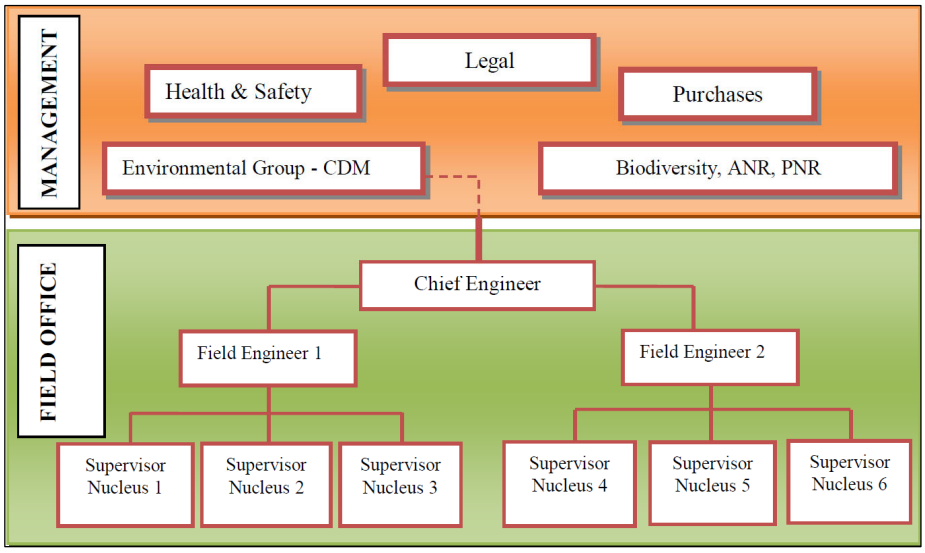


Figure 22. Operational and Management Structure of the Project Activity

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

The Field office manages forestry operations and technical direction, which is composed of the supervisors, resident forestry engineers and the chief forestry engineer. These operatives manage all the silvicultural activities of the project activity. Each one of the seven nuclei that conform to the project activity is under the direction of a field supervisor, who reports 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-forest nucleus. Each nucleus has a resident forestry engineer who files regular reports to the chief engineer, who then reports to and interfaces with the general manager of the project.

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

- Registers and logbooks of activities including soil preparation, planting, application of soil correctives, fertilizers, weeding, pruning, thinning, and harvests among others.
- Copies of all original field measurement data, data analyses and spreadsheets.

- Estimates of the carbon stock changes in all aboveground and belowground biomass and corresponding calculation spreadsheets.
- GIS products.
- Copies of the measuring and monitoring reports.

For the development of the actions and fulfillment of the project objectives, training has been developed during the verification period. In this way, the project contributes to the development of the region and the country, by training qualified laborers for forestry activities in the territory. The training related to preventive management of fuel spills and preventive management of burning was developed.

The training developed during the period covered topics such as (see Annex 3):

- Forestry maintenance.
- Fire control.
- Forest harvesting.
- Solid waste management.
- Efficient use of water.
- Occupational health and safety (use of safety equipment, industrial hygiene, ergonomic risks, ophidian accidents, among others).

EMPLOYMENT CREATION

1,251 jobs have been created, through a monthly renewed employment contract, linking women (79) and men (1,172) to project activities, during the current monitoring period. This labor dynamic is important for the area, since in this region job opportunities and stable employment relationships are low.

Table 16. **Day's wage and employment generated (202*3-2025*). See social component annex**

Nucleus	Womens	Mens	Total
BOSQUES DE LA PRIMAVERA	25	239	264
CAMBULOS	0	127	127
P. MONFORIANOS	0	228	228
ORGANIZACIÓN LA PRIMAVERA	31	281	312
INCOMSER	23	164	187
BOSQUES DE LA ORINOQUIA	0	73	73
GUACAMAYAS	0	60	60
	79	**1172**	**1251**

Post-registration changes

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

N.A

13.2 Changes after the GHG project registration

N/A

14 Grouped Project

N/A

15 Monitoring system

15.1 Description of the monitoring plan

To obtain verification of reduced emissions for the project, activities are developed to determine reduced emissions, through the establishment of forest plantations and the development of natural regeneration (stand models) within the eligible areas.

For the implementation of the project, the methodology used has established a series of procedures to ensure clear accounting of the greenhouse gases that would be mitigated, in this case the CO_2 captured and fixed in the growing forest cover. Therefore, once the project has been approved, monitoring includes the evaluation of the state of the forest stands on the ground and the spatial monitoring of the areas using cartography.

15.1.1 Project boundary monitoring

Spatial Analysis

The process of quantifying areas and determining development states of plantations can be summarized in five steps, as described in the following diagram (see annex 2. GIS process).

Figure 23. process flow diagram for area quantification

Identification of the study area

Spatial analysis begins with the identification of the study area. In this case, joint analyses were carried out for four nuclei that are part of the forest carbon initiative, considered as a regional umbrella project. Each nucleus shares aspects related to forest management by having the same technical assistance as the forest nucleus. The nuclei that are part of the project have developed their own project documents and monitoring reports separately, but with unified analyses for all, to facilitate and standardize processes.

In this way, the project area is defined as the properties that make up each of the projects and that meet the eligibility conditions in their validation process.

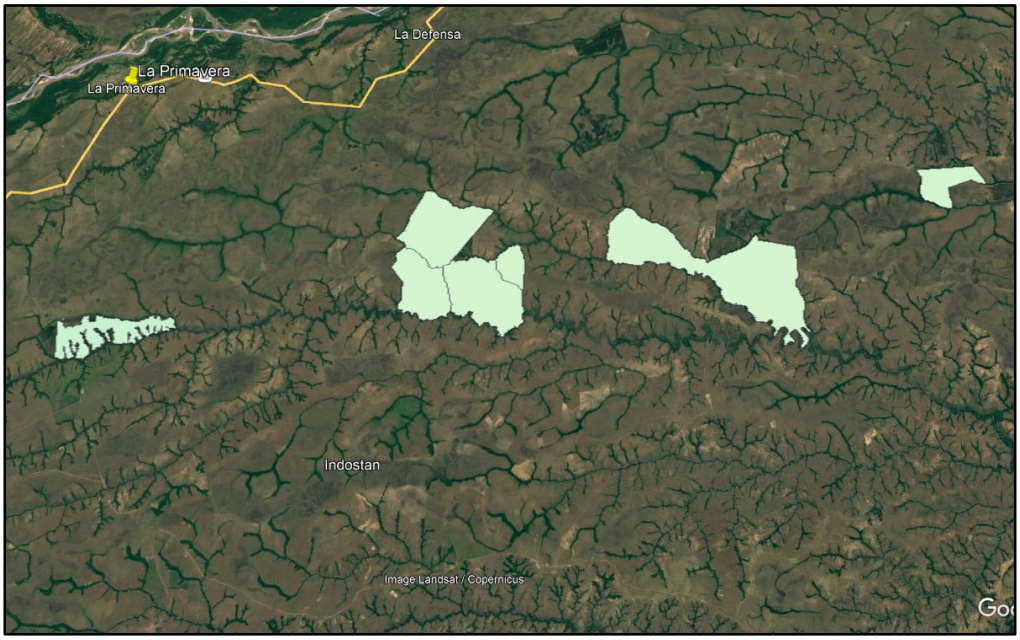


Image 14. General location of the carbon project

Field Monitoring

Monitoring of physical limits of the project

These include the areas that are part of the project. They must include those that have been planted and will be planted, and that are under control. Likewise, many areas may not be planted due to soil conditions, and flooding, among others, and it is intended that they be included in the accounting for passive natural regeneration. Another aspect is to control areas where anomalies occur that affect the accumulation and conservation of captured CO_2, such as fires, pests, etc. Finally, it must be taken into account that the control areas are those planted, that is, areas that do not have forest covers such as firebreak corridors or roads, should not be considered in the accounting, even if they are part of the project, in addition to those areas that are planted and that are outside the eligibility analysis developed in the ante-ante phase

15.1.2 Monitoring of forest establishment

Here we want to guarantee the quality of the stands that are planted, realizing that they comply with the procedures detailed in the proposed project. This monitoring must be carried out at least during the first three years after establishing each lot and with longer periods, especially when pruning, thinning, and final harvesting activities are carried out for each lot.

The components to consider are:

Species planted: In many cases, despite the species having the appropriate technological packages, their development for the project region is not as expected, leading to high mortality and poor development of the stands, affecting the projections of CO_2 capture, for which the change of species is necessary to provide continuity to the commercial forestry project.

Monitoring mortality and replanting. It is important in the first year of establishment to maintain homogeneity of the stands at optimal densities per hectare. This monitoring allows for replanting promptly, since late replanting within the same plot, in many cases, generates asynchrony in the development of the trees and would require different management plans in those spaces with replanting.

Forest Management Monitoring

These activities undoubtedly also affect the greenhouse gas balances that are to be mitigated, given that poor standing development affects their growth and atmospheric carbon capture. The aspects to be monitored are associated with activities carried out by species, lot, intervened area, and farm. These are Cleaning of plots after sowing (biomass removed and left within the plots), pruning (intensity, biomass, or volume removed), or thinning, harvesting (intensity, biomass, or volume removed), replanting of stands that are of several rotations over the duration of the project, monitor disturbances such as burning, diseases and biomass loss because of said condition. Finally, the development of the trees is evaluated through growth monitoring plots.

To monitor the development of the project, the stratification of the stands is necessary.

Stand stratification: Stratification is the key when carrying out reduced emissions assessments. It is recommended to develop stratifications based on aspects such as species, sewing date, and silvicultural management, among others, since it is presumed that these aspects will allow unifying lots that present similar removal conditions and carbon content. However, it is highlighted that stratification seeks to unify areas with similar carbon content, regardless of management or species, since these can have effects such as pests, fires, and site qualities, among others that make stratification reformulate.

For the current project proposal, stratification will be developed, initially discriminating against two types of stands:

Commercial stand model: composed of a species of commercial interest that will be subjected to silvicultural management.

Passive natural regeneration: areas that were intended for protection, where productive interventions are not carried out and their recovery process will be carried out through natural succession processes without anthropogenic intervention. These areas correspond to areas of withdrawal from water sources, protection places, or areas not suitable for the cultivation of forest species.

These two stand models will have stratifications based on their development and accumulation of biomass-carbon, which will be initially evaluated with satellite image processes, using indicators such as the Normalized Difference Vegetation Index (NDVI), which allows estimating the quantity, quality, and development of vegetation based on the measurement of the intensity of radiation of certain bands of the electromagnetic spectrum from certain satellite images (see section 16).

For this stratification, four levels are proposed in each type of stand:

- Low
- Steady
- Middle
- High
- Upper

Below is the list of the most important variables to monitor and that will be applied in the forestry project, in the three aspects indicated above.

Data/Parameters:	$A_{PLOT,}$
Data unit:	ha
Description:	Sampled plot area; Strata area
Data source:	Field measurement
Measurement procedures (if any):	The measurement protocol developed for the project is followed.
Monitoring Frequency	At each check
QA/QC procedures	Rectification of plot areas in the field. Quality control of measurement equipment.

Data/Parameters:	A_i
Data unit:	ha
Description:	Area of Strata *i*
Data source:	Measurement using remote sensors.

Measurement procedures (if any):	Standard operating procedures prescribed in the national forest inventory apply. In the absence of these, the manual published by SOPs, or that of IPCC GPG LULUCF 2003, will apply.
Monitoring Frequency	Each verification (minimum every 2 years, maximum 5 years)
QA/QC procedures	Control is carried out with forest establishment and management data.
Comments:	-

Data/Parameters:	***APLOT,$_i$***
Data unit:	ha
Description:	The total area of the sampling plots in Strata i
Data source:	Field measurement. Digital hypsometers
Measurement procedures (if any):	The protocol developed for the project is applied.
Monitoring Frequency	Each verification (minimum every 2 years, maximum 5 years)
QA/QC procedures	Hot control is applied, that is, directly when sampling is carried out, with the same measurement equipment. Reference equipment is properly stored in the office.
Comments:	-

Data/Parameters:	$CC_{SHRUB,\ i}$
Data unit:	dimensionless
Description:	Shrub cover in Strata I of the shrub biomass
Data source:	Field measurement. Or default data. It can be visual
Measurement procedures (if any):	Considering that the biomass in shrubs is smaller than the biomass in trees, a simplified method could be used to estimate the canopy cover in shrubs. A visual estimate of cover could be carried out by any method such as the transect method or using the relascope method.
Monitoring Frequency	Each verification (minimum every 2 years, maximum 5 years)
QA/QC procedures	

Comments:	When the land is subject to a periodic cycle (for example, slash and burn or clearing - regeneration) the shrub cover oscillates between maximum and minimum values in the baseline, on average the shrub cover is equal to 0.5 of the estimated biomasses unless the information provided is verifiable and transparent to justify a different value.

Data/Parameters:	DAP
Data unit:	cm.
Description:	Diameter at the breast height of a tree.
Data source:	Field measurement in sampling plots. Diametric tapes.
Measurement procedures (if any):	The protocol procedures developed for the project are applied.
Monitoring Frequency	Each verification (minimum every 2 years, maximum 5 years)
QA/QC procedures	We try to have new diameter tapes in each monitoring. Metallic diameter tape is recommended to avoid material elongation due to humidity, which happens when they are made of fiberglass or other plastic material.
Comments:	-

Data/Parameters:	*H*
Data unit:	Meters (m)
Description:	Tree height
Data source:	Field measurement in sampling plots Digital hypsometers
Measurement procedures (if any):	The protocol developed for the project is applied.
Monitoring Frequency	Each verification (minimum every 2 years, maximum 5 years)
QA/QC procedures	Quality control is carried out in the field, through the remeasurement of some individuals. A hypsometer is reserved in the office for quality control
Comments:	-

Data/Parameters:	*T*

Data unit:	Year
Description:	The period between successive carbon storage estimates.
Data source:	Recorded time
Measurement procedures (if any):	N/A
Monitoring Frequency	-
QA/QC procedures	-
Comments:	If two of the successive estimates of carbon storage are taken to different points in time in a year t_2 and t_1 (for example, in the month of April in year t_1 and in the month of September in year t_2), then, a fraction of value could be assigned to *T*

15.1.3 *Monitoring of the forest management*

The monitoring of this component is carried out through temporary or permanent plots, in which the dynamic growth process of the plantation is evaluated, to estimate the carbon content present in the aboveground and belowground tree biomass of the project.

The inventory of the plots allows evaluation of the correspondence of the species planted with those proposed in the project, in addition to the planting densities.

The protocol for establishing plots and measuring dendrometric variables will be followed to estimate the volumetric increases in each stand. This information will serve as an input to validate the volumetric equations by species, or to reformulate new equations that allow the volume to be modelled more realistically. achieved by the species planted for the project area.

Below are some of the most important parameters to monitor:

Stratification.

The defined strata will be monitored in a database where species, area, lot, planting date, etc. appear. which will be stored in physical and digital format. Said database will be additionally supported with the respective cartography. The updating of areas that are incorporated into the project is suggested to be done quarterly, allowing permanent control and monitoring of the areas by Strata.

Monitoring changes in carbon content

Mapping

Maps of different scales may be used, however, large-scale maps such as 1:10,000 are recommended to facilitate the distinction between models and lots. It is advisable to have a series of maps of this type by strata and the generation of a single map for field monitoring will be avoided. In this way, the groups in charge of the inventory will have facilities to make tours and locate distinguishable sites in the field to access in subsequent monitoring or to facilitate access for the group intervening in the monitoring. This cartography will document altimetric references, geographical features (such as drainage), road infrastructure (here primary and secondary roads are included, characterizing their type, that is, paved or not), possible division of the lots, characterizing the location of the stand with dissimilar colors from each other. There will be a general map of the lots and models that summarize the maps generated for field monitoring. This can be of a higher scale (1:50,000, 1:100,000) and will serve as support for monitoring planning. For each monitoring period, the project map base will be updated, and data on areas planted and under control for said period will be included. As support for cartography, aerial photographs may be used for plot location procedures.

Sample size.

A series of sampling plots will be established to identify the changes and evolution of carbon accumulation in the stands. These plots will be established having cost-effectiveness critter, maintaining a level of precision of ±10% of the mean, with a confidence level of 95%.

The procedure to calculate the sample size follows method *I* of the methodological tool for calculating sample size[40]:

Steps:

- Identify the parameters according to the project proposal, to estimate the amount of sample needed.

Parameters:

A: Total project area; ha

i: Strata

[40]Calculation of the number of sample plots for measurements within A/R CDM Project activities. see 02. (EB 46 Report Annex 19).

Ai: Area of each Strata *i*; ha

AP: Monitoring plot area; ha

st_i: standard deviation of the estimate by *strata i*

Calculate all plots of the defined size for the entire project area:

$$N = \frac{A}{AP}; \quad N_i = \frac{A_i}{AP}, \qquad \textit{(Equation 1 from the tool)}$$

where:

N: *maximum number of possible plots in the project area*

N_i: *maximum number of possible plots in strata i.*

Estimate the allowable error, based on the desired precision levels and by estimating the average volume (or biomass).

$$E_1 = Q_1 * p \qquad \textit{(Equation 2 from the tool)}$$

Where:

Q1: Estimated average value for volume or biomass in the project. Q, tha^{-1}, $m^3\,ha^{-1}$.

P: Precision level (e.g. 10%)

E1: *Allowable error (±10% of the average)*

Estimate the number of plots for the entire project assuming equal costs of establishing the plots, using the following equation:

$$n = \frac{\left(\sum_{i=1}^{m_{PS}} N_i \cdot st_i\right)^2}{\left(N \cdot \frac{E}{z_{\alpha/2}}\right) + \left(\sum_{i=1}^{m_{PS}} N_i \cdot (st_i)^2\right)} \qquad \textit{(Equation 5 from the tool)}$$

Where:

n: *total number of plots in all strata of the project*

$z_{\alpha/2}$: *the value of the statistic z, for α = 0.05 (indicated for a 95% confidence level), zα/2 = 1.9599*

The number of plots per Strata for the project can be determined using the tool generated by Winrock International[41].

Type of plots

The shape of the monitoring plots is rectangular with a size of 500 m^2 of area (20 x25m) on all systems (Figure 3). In the event of situations in which a plot of these dimensions cannot be established, the shape of the plot will be adjusted to ensure that the plot area is maintained 500 m^2.

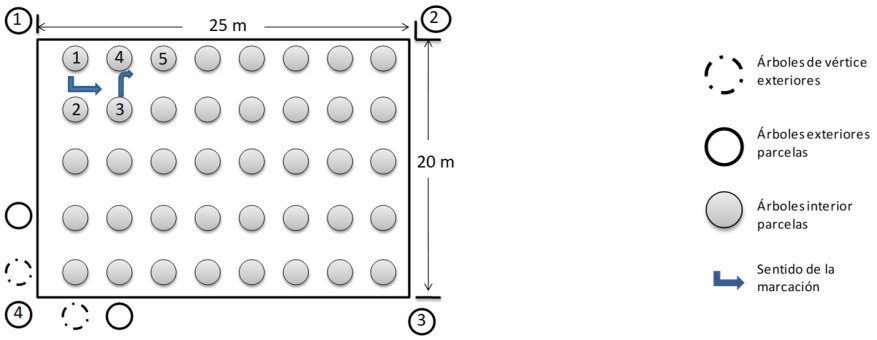


Figure 3. Survey of monitoring plots. The dimensions correspond to 25m x 20m, for an area of 500 m2.

Location and survey of the plots

After having carried out the distribution of the plot systematically on a map of the established coverage, with the geographical coordinates, the center point of the plot is in the field with GPS. The entry route to the plot must be marked to facilitate its subsequent location in other monitoring or audit processes. This point will be called vertex one and in a clockwise direction, the initial lateral corridor of 25 m is established, until vertex 2 is located and so on (see Figure 3). Then the three exterior trees that determine each of the vertices are marked (with the respective vertex number). In this way, the plot is delimited. Then we proceed to mark each of the trees with successive numbering. You should try to have permanent markings, with plates that do not damage the tree and paint. Finally, information is placed on tree 1 with paint detailing the plot code and planting date. These procedures are shown in more detail in the protocols designed for this purpose.

[41]Winrock Terrestrial Sampling Calculator.www.winrock.org/ecosystems/files/Winrock_Sampling_Calculator.xls

Measurement and estimation of carbon content over time

The estimates of the removals will be made using the equations available in the scientific literature for environmental conditions like those of the project, equations proposed by the IPCC good practice guides for stand models and their species, and some of the recommendations from the tool “Demonstrating appropriateness of allometric Equations for estimation of aboveground tree biomass in A/R CDM project activities” to define equations to apply ex-post. Finally, if possible, equations will be built with primary information about the project.

Therefore, from the monitoring plots the dendrometric variables are breast height diameter (*dbh*, at 1.3 m above ground level) and total height (*h*).

The expansion factors of the aboveground biomass are those suggested by the Good Practices Guide, in addition to the root–stem relationships for estimating belowground biomass. However, new values reported by the literature or estimated under conditions and species like those of the project may be used, giving priority to national information.

From the information collected in the first monitoring period, new volume equations can be adjusted, and appropriate estimates made for the proposed project and the species considered.

The detailed procedures for this purpose are detailed in the field sampling plan protocol.

Quality assurance and control in monitoring procedures.

The procedures established by the project will be followed, guaranteeing the quality of the information collected and its proper filing.

The procedures initially consist of training the personnel in charge of taking, collecting, and filing information. As a second instance, the real capacity of the personnel in charge of making analyses and estimates will be evaluated, based on the monitoring information carried out. Likewise, there will be forestry technicians who will support the execution activities of establishing the stands, so that they are by the approaches described and the objectives set by the project.

A management structure is established that allows viewing a scale of command and those responsible to guarantee control over the quality of the information.

For the training of personnel, there will be a series of protocols, formats, and forms that allow standardizing the processes of establishing monitoring plots, collecting information in the field (dendrometric variables), incorporating the collected information, analysis, etc. Therefore. According to the methodology, four fundamental stages are considered to ensure transparent and accurate estimates of GHG removals provided by the project:

- **Reliability in field measurements.**

The protocols designed for the training of personnel in charge of establishing plots and in charge of measuring dendrometric variables (height, diameters, circumference at chest height), guarantee the standardization of procedures. A forestry engineer will supervise the training, with technicians directing the monitoring teams.

The need to adjust said protocols will be periodically evaluated, without generating alterations in the values of measurements made previously. Adapt the protocol to the region's conditions, planting dynamics, and controlled areas involved in the project.

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

Procedure for identifying measurement errors.

This audit procedure consists of carrying out a subsequent verification of the data obtained from the forest inventory or monitoring and will have the following characteristics and steps:

- It will be carried out by personnel different from those who carried out the inventory and who will be characterized by having extensive experience in forest inventory procedures and estimates of wood volumes for various species. Of special consideration, the person in charge of this measurement must be unaware of the results of the measurements to be audited.
- Between 10 and 20% of the total plots established in the forest inventory should be taken.
- The instruments used must present similar characteristics to those used in the initial inventory.
- The measurement procedures will be adjusted according to the established manual steps or measurement protocols with which the staff was trained.
    - Location of the plots
    - Survey of plots
    - Measurement of diameters at chest height (*dbh*) and total heights.
- Compare the information obtained with the original information taken by the forest inventory crews.
- Identification of errors. This is done by comparing both information (original inventory and audit) in a paired manner.
- If errors are identified, they are corrected and recorded, expressed as a percentage of all plots that were remeasured, to provide an estimate of measurement error. The estimation error is given by:

$$\text{Error of measurement } (\%) = \frac{Data_1 - Data_2}{Data_2} \cdot 100\%$$

The allowable error should not exceed *5%.*

Verification of input data and analysis

The information entry phase, to bring the information into digital spreadsheets, will be carried out by qualified personnel for this work and its analysis will be carried out by personnel trained in the estimation of carbon content in biomass.

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

Estimation of typing error:

$$\text{Error of measurement}(\%) = \frac{(Number\ of\ errors\ identified)}{Total\ number} \times 100$$

When errors are identified due to adjustments to integer values in decimal measurements, these should be adjusted to the lowest order integer to guarantee conservative evaluations of the measurements.

Safeguarding of information

The data obtained in the field will be kept at least for the subsequent monitoring period. The forms must be scanned and saved in digital formats, along with the digitized files. Likewise, the tracking and monitoring of the other variables must be preserved digitally, in various media such as files in the cloud, hard drives, and USB flash drives. A fixed and secure means will be implemented to archive the information and prevent its loss.

Data and parameters to quantify emissions reduction.

To implement the project, the methodology implemented has established a series of procedures to guarantee a clear accounting of the greenhouse gases that would be mitigated, in this case, the CO_2 captured and fixed forest cover that is growing.

Data and complementary information to determine the baseline or reference scenario.

Environmental effects.

Biodiversity: This monitoring is articulated to the demands developed by the regional autonomous corporation, which within its policies establishes monitoring and control of the impacts that the project activity may generate on the biotic component, especially biodiversity and specifically to the vulnerable species, or Conservation Target Values (VOC). Under this component, the list of species present in the region and their conservation status will be updated based on updated regional studies and complemented by monitoring carried out by the project.

Finally, it is planned to develop processes related to the quality of information. This provides for the optimization of control and quality of the information collected. The process focuses on a control plan in the collection of information, archiving, verification, and internal audit of the resulting information, guaranteeing the integrity of the data accumulated for each monitoring period and throughout the execution of the proposed project activity.

Social Effects

The social impact of the project is reflected in the generation of jobs, complying with national regulations and provisions for hiring, and training for the qualification of personnel. Likewise, it does not affect territories with the presence of ethnic communities.

For this component, monitoring the employment indicators per year becomes the most important, since, as noted in previous paragraphs, the non-presence of ethnic communities in the project areas was demonstrated.

15.2 Variables to monitoring.

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

Data / Parameter	$CC_{SHRUB, i}$
Data unit	Dimensionless
Description	Shrub canopy cover in shrub biomass Strata i
Measured /Calculated /Default:	Default

Source of data used	National source, national forest inventory, IPCC, UNFCCC, or Field measurement
Value (s)	*0.5*
Indicate what the data is used for (Baseline/Project/Leak Emissions Calculations)	Applied in the carbon shrub biomass *Strata i. Project Emissions Calculations.*
Justification of choice of data or description of measurement methods and procedures applied	Taking into account that biomass in shrubs is lower than biomass in trees, a simplified measurement method can be used to estimate shrub canopy cover. An ocular estimate of the crown cover can be made.
Additional comments	AR-Tool 14. When land is subjected to periodic cycles (e.g. slash-and-burn or clear-regrowth cycles) such that shrub crown cover oscillates between minimum and maximum values at the baseline, An average shrub canopy covers equal to 0.5 is used unless transparent and verifiable information can be provided to justify a different value.

Data / Parameter	***CF***
Data unit	*tC td.m-1*
Description	*Carbon fraction of dry matter for species of type j*
Source of data used	*IPCC 2003*
Value (s)	*0.47*
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Baseline, Project emission calculation. *Actual net GHG removals by each species in the project activity.* *Applied in the eq. 68 of the methodology AR-AM0004 v.04 and AR-Tool 0014, in section 11 for the biomass and carbon shrubs. Applied in the eq. 68 of the methodology AR-AM0004 v.04 and AR-Tool 0014 V.4.2 in section 11 for the biomass and carbon shrubs.*
Justification of choice of data or description of measurement methods and procedures applied	Default value

Additional comments	It was applied to each stand model.

Data / Parameter	*R j*
Data unit	Dimensionless
Description	Root-shoot ratio is appropriate for biomass stock. for species *j*
Source of data used	Table 3A.1.8 of IPCC GPG LULUCF, 2003
Value (s)	**Fact.** / ***P. caribaea*** / ***E. pellita -A, mangium*** Biomass <50tha-1 / 0.46 / 0.45 50-150 tha-1 / 0.32 / 0.35 >150 / 0.23 / 0.2
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	*Baseline, Project emission calculation.* *Actual net GHG removals by each species in the project activity.* *Applied in the eq. 68 of the methodology AR-AM0004 v.04 and AR-Tool 0014, in section 11 for the biomass and carbon shrubs. Applied in the eq. 68 of the methodology AR-AM0004 v.04 and AR-Tool 0014 V.4.2.*
Justification of choice of data or description of measurement methods and procedures applied	Calculation of actual net GHG removals by sinks
Additional comments	Conservative choice of default values: 1. If in the sources of data mentioned above. data are available for conditions that are like 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*
Data unit	dimensionless
Description	Root-shoot ratio for shrubs
Source of data used	IPCC and UNFCCC AR Tool 0014 V4.2.
Value (s)	0.4
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Actual net GHG removals in project and baseline.
Justification of choice of data or description of measurement methods and procedures applied	Value applied and accepted by default for carbon estimates in shrubs. Data are provided by IPCC procedures 2003-2006.
Additional comments	This process is applied to the shrub's biomass

Data / Parameter	BDR_{sf}
Data unit	dimensionless
Description	The ratio of shrub biomass per hectare in land has a shrub crown.
Source of data used	AR Tool 0014 V 04.2
Value (s)	0.10

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Actual net GHG removals in project and baseline.
Justification of choice of data or description of measurement methods and procedures applied	Value applied and accepted by default for carbon estimates in shrubs. Data are provided by IPCC procedures 2003-2006.
Additional comments	This process is applied to the shrub's biomass

Data / Parameter	b_{FOREST}
Data 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 used	National source, national forest inventory. the tropical humid forest in Colombia. Phillips, et al, IDEAM 2014.
Value (s)	231.7 t d.m. ha^{-1}
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Applied in the biomass and carbon shrubs in the regeneration stratum.
Justification of choice of data or description of measurement methods and procedures applied	Value applied and accepted by default for carbon estimates in shrubs. Data are provided by IPCC procedures 2003-2006.
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***
Data unit	%
Description	Desired level of precision
Source of data used	-
Value (s)	10%

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	(ii) Calculation of actual net GHG removals by sinks
Justification of choice of data or description of measurement methods and procedures applied	Value applied and accepted by default for carbon standard.
Additional comments	Required for the calculation of the number of plots ex-post

Data / Parameter	$z_{\alpha/2}$
Data unit	Dimensionless
Description	Value of the statistic z (normal probability density function)
Source of data used	*Excel program*
Value (s)	1.97
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Measured, according to the confidence level
Justification of choice of data or description of measurement methods and procedures applied	(ii) Calculation of actual net GHG removals by sinks
Additional comments	Required for the calculation of the number of plots ex-post

Data and parameters monitored

Data / Parameter	A_{PLOT}, *i*, $A_{SHRUB,i}$, *Ai*
Data unit	*Hectares*
Description	*Sampled plot area; stratum area*
Measured /Calculated /Default:	*Standard operating procedures prescribed in the national forest inventory apply. In the absence of these, the manual published by SOPs, or that of IPCC GPG LULUCF 2003, will apply.*

Source of data used	*Field measurement*
Value (s)	*500 m2*
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	*Estimation of biomass content at the plot level during sampling.*
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	*30m measuring tapes.*
Measurement/reading/recording frequency	
Calculation method (If applicable)	
QA/QC procedures applied	*Prescribed quality control/quality assurance (QA/QC) procedures on the national forest inventory are applied. In the absence of these, the published manual of quality control/quality assurance procedures, or the IPCC GPG LULUCF 2003, may be applied.*

Data / Parameter	*Ai*
Data unit	*Hectares*
Description	*Stratum area*
Measured /Calculated /Default:	*Standard operating procedures prescribed in the national forest inventory apply. In the absence of these, the manual published by SOPs, or that of IPCC GPG LULUCF 2003, will apply.*
Source of data used	*Remote Sensing*
Value (s)	

Strata	AREA (ha)
Low	***1.398,7***
Steady	***2.691,5***
Middle	***1.632,8***
Higth	***5.952,7***
Upper	***7.264,7***
Total	**18940.3**

Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	*Estimation of biomass content at stratum level.*
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	*GIS processes*
Measurement/reading/recording frequency	*Each verification (minimum every 2 years, maximum 5 years)*
Calculation method (If applicable)	*Measured*
QA/QC procedures applied	*Prescribed quality control/quality assurance (QA/QC) procedures on the national forest inventory are applied. In the absence of these, the published manual of quality control/quality assurance procedures, or the IPCC GPG LULUCF 2003, may be applied.*

Data / Parameter	*nPlots,i*
Data unit	*plots*
Description	*Total of sampling plots in stratum i Total area of sampling plots in stratum i*
Measured /Calculated /Default:	*Standard operating procedures prescribed in the national forest inventory apply. In the absence of these, the manual published by SOPs, or that of IPCC GPG LULUCF 2003, will apply.*
Source of data used	*Field measurement*
Value (s)	**Strata** / **n**: Low 34; Steady 60; Middle 48; Higth 52; Upper 23; **General Total** 217
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	*Determine adjustments to biomass estimates at the stratum level.*

Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	
Measurement/reading/recording frequency	*Each verification (minimum every 2 years, maximum 5 years)*
Calculation method (If applicable)	
QA/QC procedures applied	*The sampling protocol was applied, and training of field personnel was developed. The developed procedure and the information obtained are then evaluated.* *Development of error control according to PD* *In each verification process, new measuring tapes will be available to ensure correct operation and accuracy of measurements.*

Data / Parameter	*DAP*
Data unit	*cm or any length unit as specified*
Description	*Diameter at breast height of a tree. To determine it, equations (1) and (2) are proposed, DBH could be any diameter or dimension measurement (for example, basal diameter, root collar diameter, basal area, etc.) used as a data source for the model.*
Measured /Calculated /Default:	*Measured*
Source of data used	*Field measurement in sampling plots*
Value (s)	
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	*Applied in allometric or volume equations, for each species.*
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	*Diametric tapes (±1mm error)*
Measurement/reading/recording frequency	*Each verification (minimum every 2 years, maximum 5 years)*
Calculation method (If applicable)	

QA/QC procedures applied	*Data cross-checking is performed on the sampling plots. New diameter tapes were used during the development of the inventory.* *The staff was trained in the correct way to measure and use the equipment.* *An audit process was carried out, and under cross-verification the data was corroborated in a sample of more than 10% of the established plots.* *This process was performed with metallic diametral tapes, which show fewer variations in precision.*

Data / Parameter	*H*
Data unit	Meters (m)
Description	Tree height
Measured /Calculated /Default:	Measured.
Source of data used	Field measurement in sample plots.
Value (s)	
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	Applied in allometric or volume equations, for each species.
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	*Forestry laser II*
Measurement/reading/recording frequency	*Each verification (minimum every 2 years, maximum 5 years)*
Calculation method (If applicable)	
QA/QC procedures applied	
Comentarios	Height measurements were taken on all plots in the commercial stands and on all trees in the plots. This was in line with the recommendations of the monitoring plan and PDD, as it was suggested to sample only a proportion of the trees and to develop allometric equations to estimate the heights of the unmeasured trees.

	The field team received additional training on the correct establishment of plots, including equipment management, reading and maintenance. To verify that the plots had the correct areas, more than 10% of the established plots were remeasured.

Data / Parameter	*T*
Data unit	*Año*
Description	*Time period between successive carbon stocks estimates.*
Measured /Calculated /Default:	*N.A*
Source of data used	*Measured*
Value (s)	*2.2 years*
Indicate what the data are used for (Baseline/ Project/ Leakage emission calculations)	*Estimate the reduced emissions for the monitoring period.*
Monitoring equipment (type, accuracy class, serial number, calibration frequency, date of last calibration, validity)	
Measurement/reading/recording frequency	
Calculation method (If applicable)	
QA/QC procedures applied	
Commentaries	

15.3 Information related to the evaluation of the environmental impact of GHG project activities

The projects follow the standards established by the regional environmental corporation Corporinoquia, to avoid any environmental impact on regional ecosystems. Although forest plantations do not require an environmental impact analysis for their development, they must meet the requirements established by corporations, such as environmental management plans or measures.

16 Quantification of GHG emission reduction / removals

16.1 Baseline emissions

Reference emissions are considered zero.

Source	Gas	Selection	Considerations for the project.
Burning of woody biomass.	CO_2	No	Emissions from burning biomass are counted as a change in carbon content.
	CH_4	Yes	The methodology allows the burning of woody biomass as part of site preparation and as part of forest management.
	N_2O	Yes	The methodology allows the burning of woody biomass as part of site preparation and as part of forest management.

Although the methodology allows the burning of woody biomass as part of forest management, the project complies with national regulations that restrict the use of controlled burning as part of agricultural soil management (DECREE NUMBER 4296 OF 2004). According to the said decree, this activity is sanctioned by the regional autonomous corporations. Therefore, burning and its potential emissions are NOT considered in the project activity.

16.2 Project emissions/removals

16.2.1 Identification of the sampling area.

The project area is defined by those zones in the area under project control that met the definition of eligibility at the time of validation (see PDD), as explained and shown above. On these areas the spatial analysis processes are developed in which the areas established by the stand models are identified. It is important to note that only the areas that are effectively covered by plantations or natural regeneration are counted, and all those areas within the core properties that correspond to roads, firebreak zones or areas devoid of forest cover or in forest successional processes are discounted.

Stratification

Stratification is key when performing reduced emissions assessments. It is recommended to develop stratifications based on aspects such as species, sowing date, and silvicultural management, among others, since it is presumed that these aspects will

allow unifying lots that present similar removal conditions and carbon content. However, it is highlighted that stratification seeks to unify areas with similar carbon content, regardless of management or species, since these can have effects such as pests, fires, and site qualities, among others that make stratification reformulate.

The stratification procedure is developed through the analysis of satellite images.

This is the first step in which we begin to obtain information from the image; it consists of assigning each pixel in the areas of interest a certain class in the established legend. In this study, a legend was defined based on the strata of development of the vegetation present in the plantations of each property. 4 classes were defined: High Strata, Middle Strata, Steady Strata, and Low Strata; These strata were defined taking into account the state of development of the vegetation, to homogenize the separation criterion between the strata and guarantee consistency in the information.

Once the resulting legend has been defined, the classification is prepared. In this case, the supervised classification technique was used through seeding, and the maximum likelihood algorithm with null class was used as the association algorithm, since due to the conditions in that the information is presented (crops), have a defined spatial association and are differentiated mainly by their spectral response.

The seeding process consists of taking representative samples of each of the classes that make up the legend. These samples must be sections of pure coverage, without mixtures, without the presence of clouds, shadows, or any other factor that modifies the spectral response captured by the sensor present in the satellite camera. Samples must be taken randomly over the entire image, where between each sample the standard deviation does not increase to more than 8 points.

To support the classification, it was decided to create a vegetation index (**¡Error! No se encuentra el origen de la referencia.**), the NDVI (Normalized Difference Vegetation Index), this index highlights the information of the near-infrared band (at this wavelength, the vegetation presents levels of reflection that help with the analysis of the state of the plants).

Once all the inputs are ready and the seeding has been carried out, the algorithm is run, managing to assign each pixel of the area of interest a respective qualitative value according to the legend prepared.

As in all semi-automated processes, supervised classification may present errors when assigning pixels to each of the classes. This is corrected through the process that consists of a visual review of the entire study area and changing the class of each of the pixels that, at the discretion of the interpreter, must be reclassified.

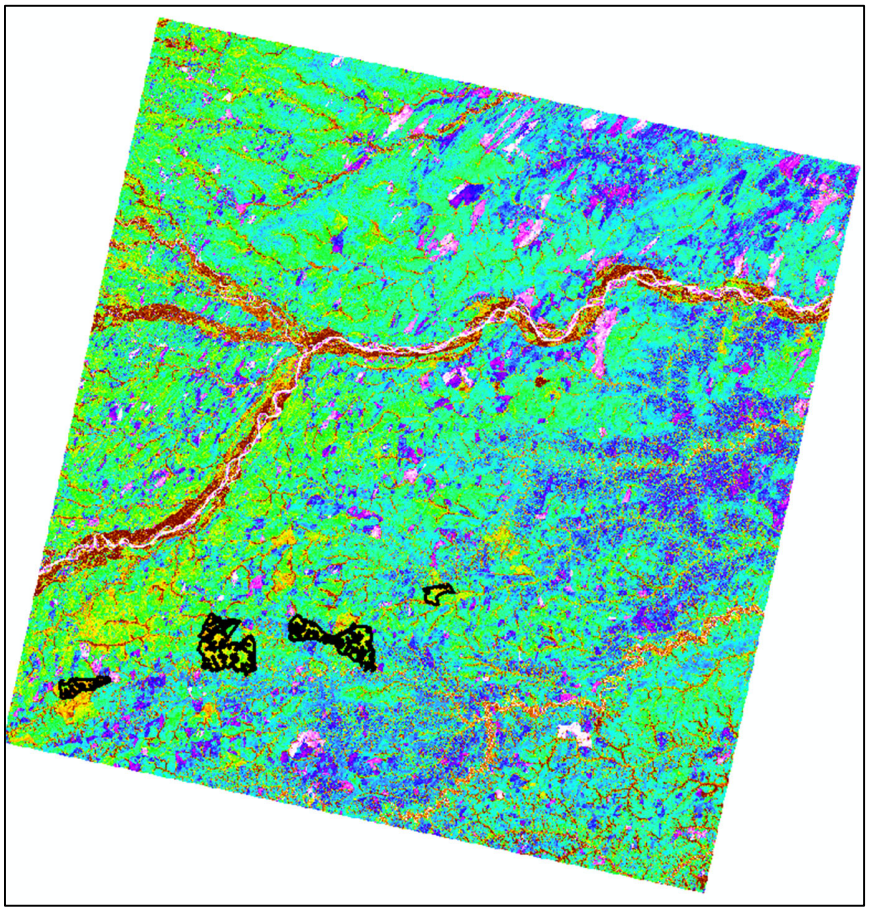
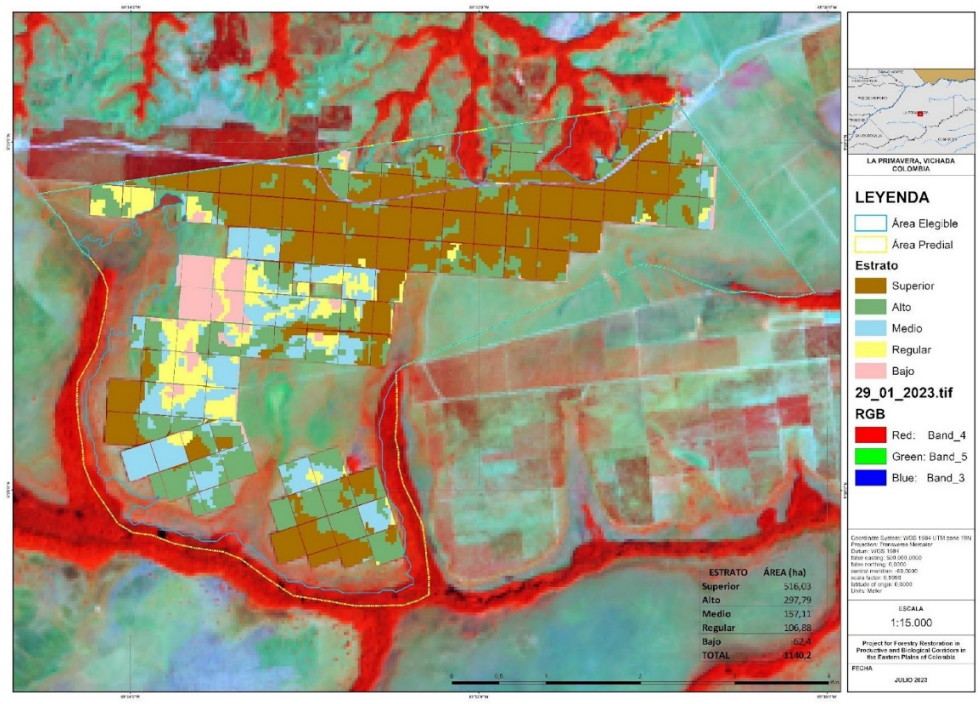


Image 15. NDVI results

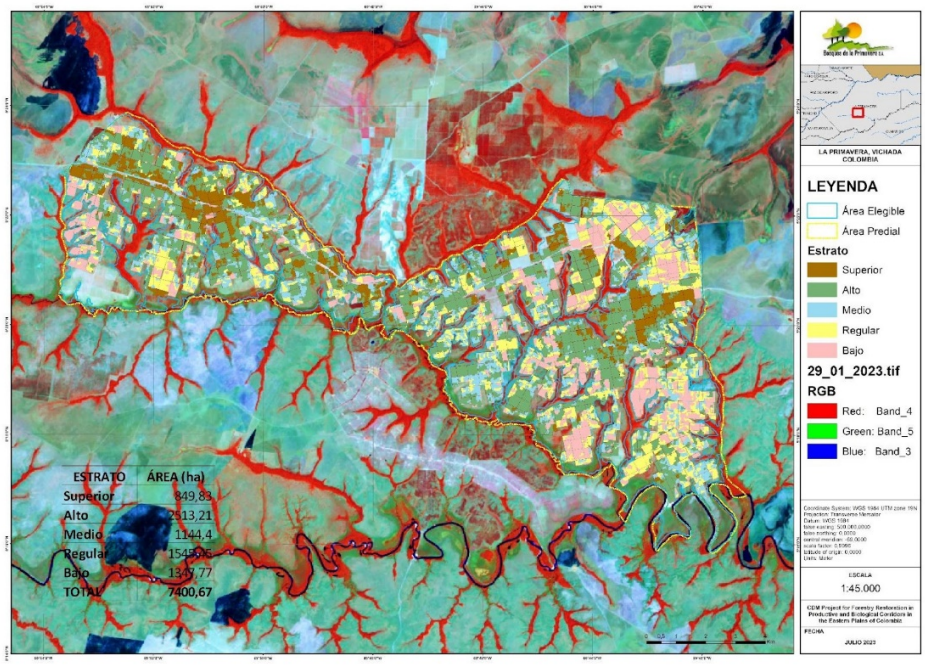
The results of the stratification were the following:

- Low
- Steady
- Middle
- High
- Upper

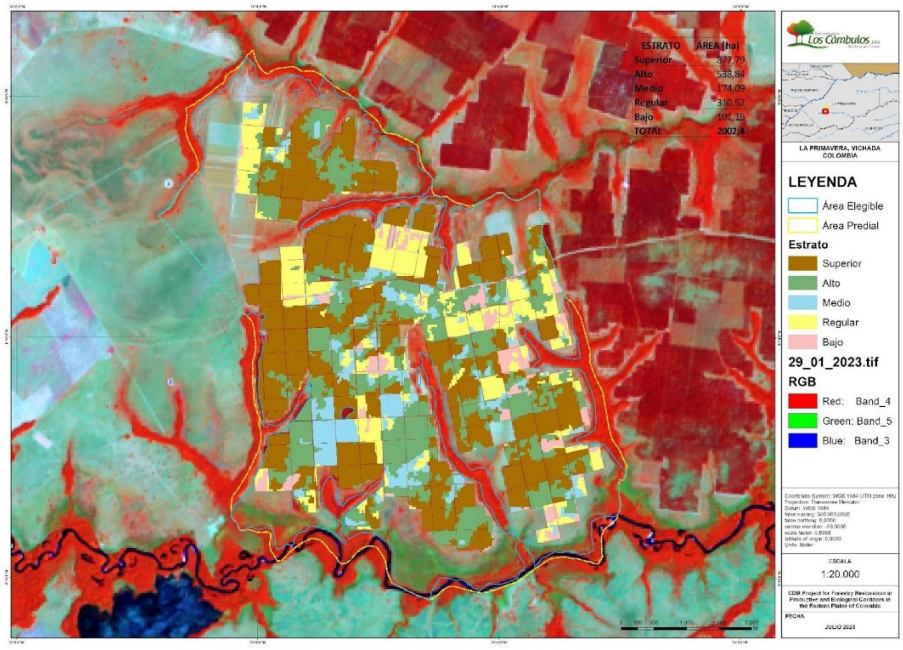
These strata can be identified in the following thematic maps for the three nuclei in which the distribution of the sample and the field inventory work were developed in the same way.



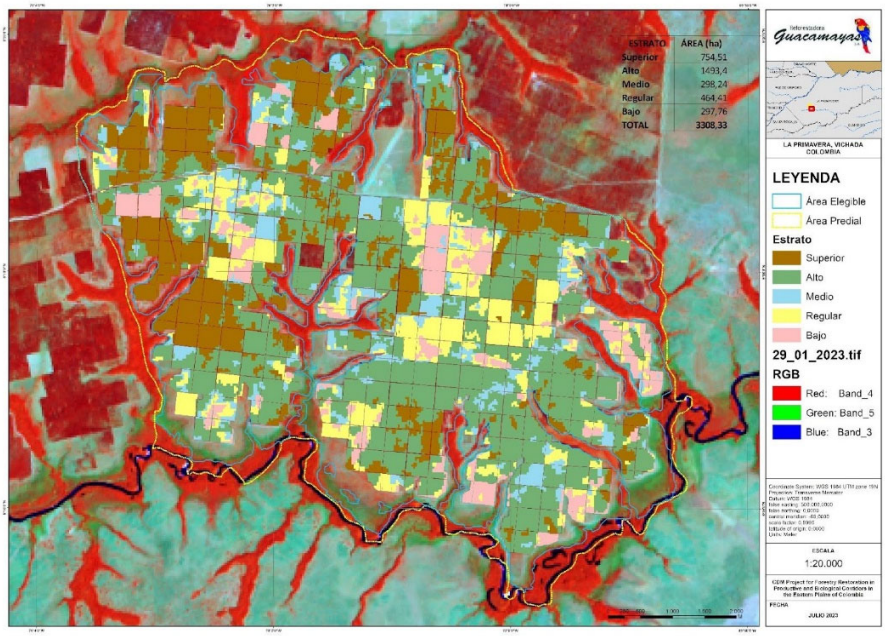
Map 1. Stratification Bosques de la Orinoquía S.A.



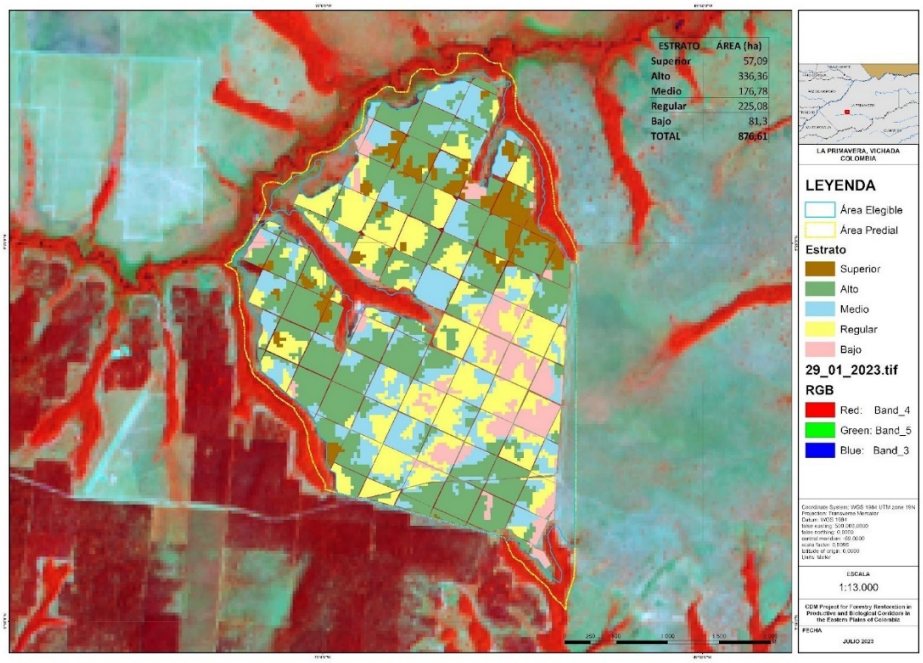
Map 2. Stratification Bosques de la Primavera S.A.



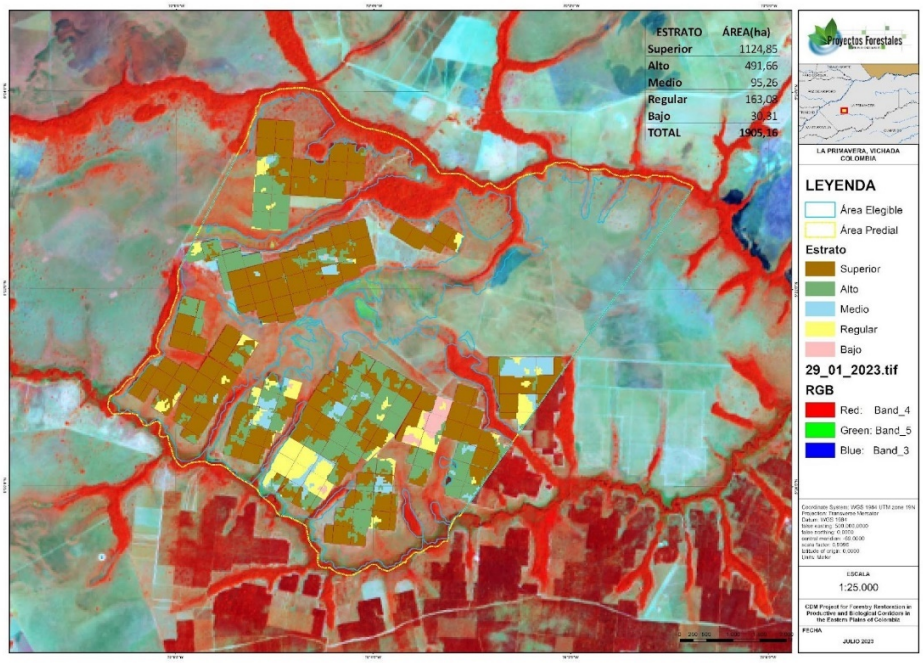
Map 3. Stratification Reforestadora Los Cámbulos S.A.S.



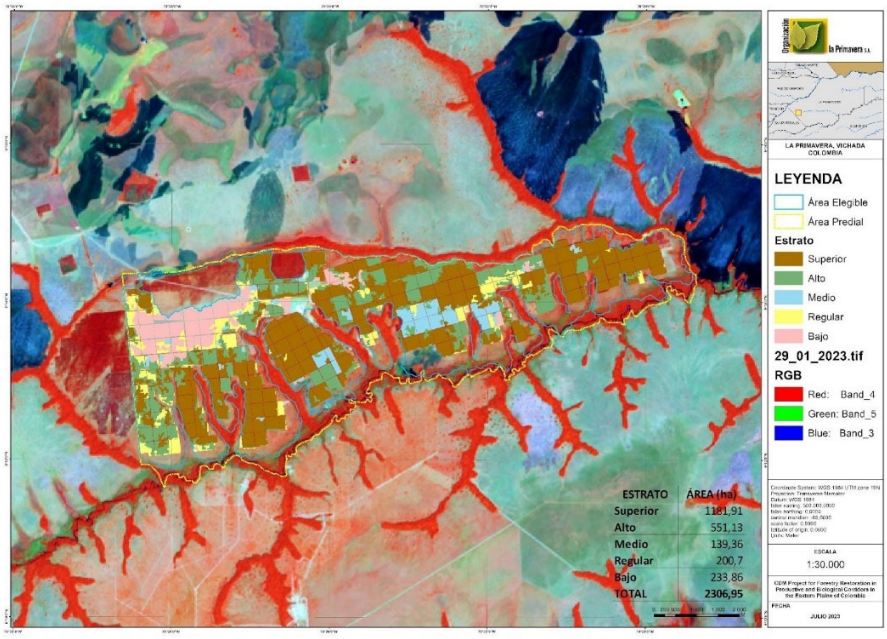
Map 4. Stratification Reforestadora Guacamayas S.A.



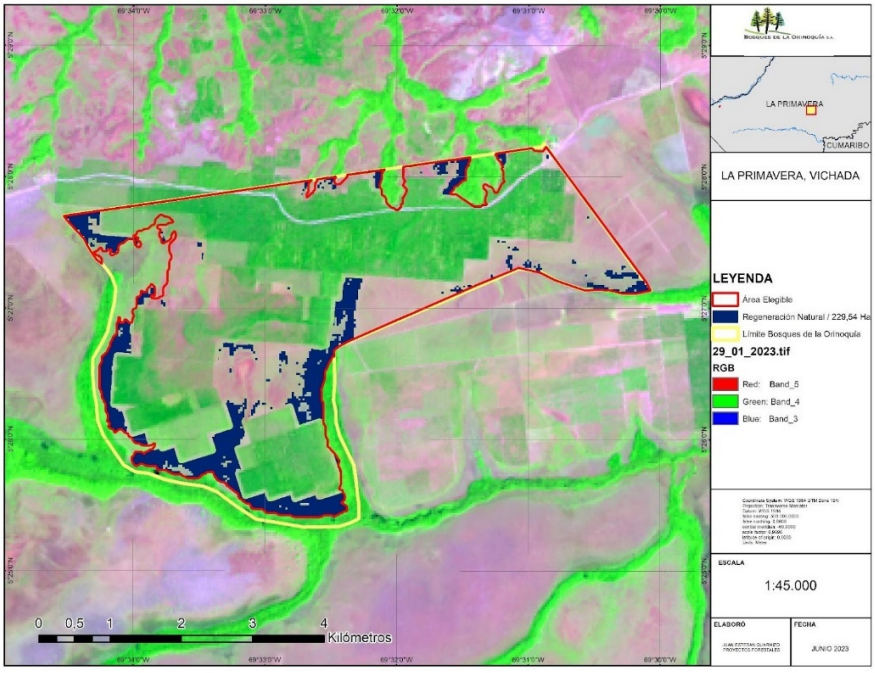
Map 5. Stratification INCOMSER LTDA



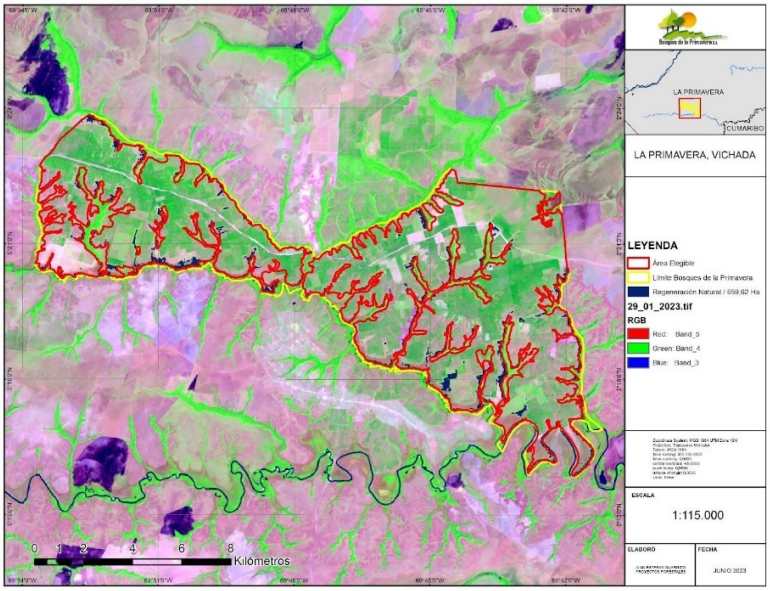
Map 6. Stratification Compañía de María Padres Montfortianos



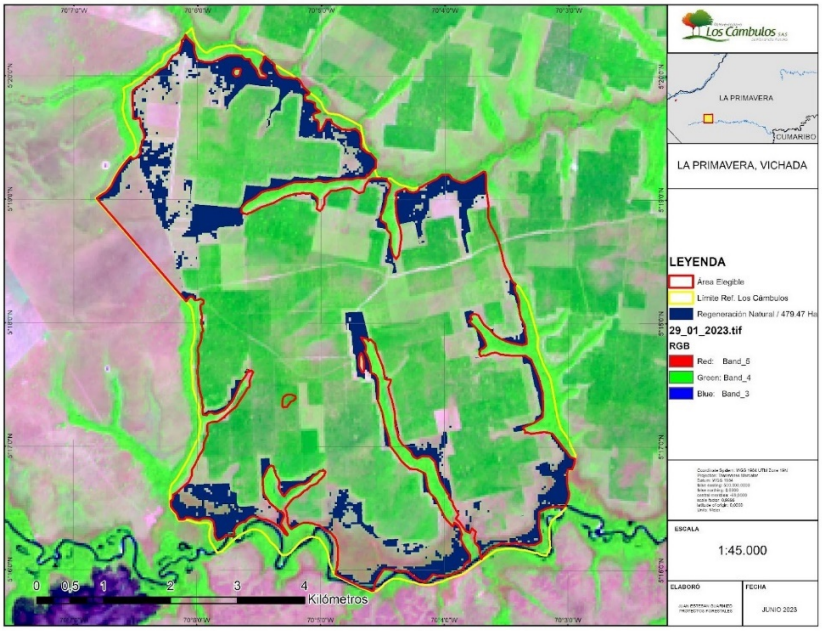
Map 7. Stratification Organización La Primavera S.A.



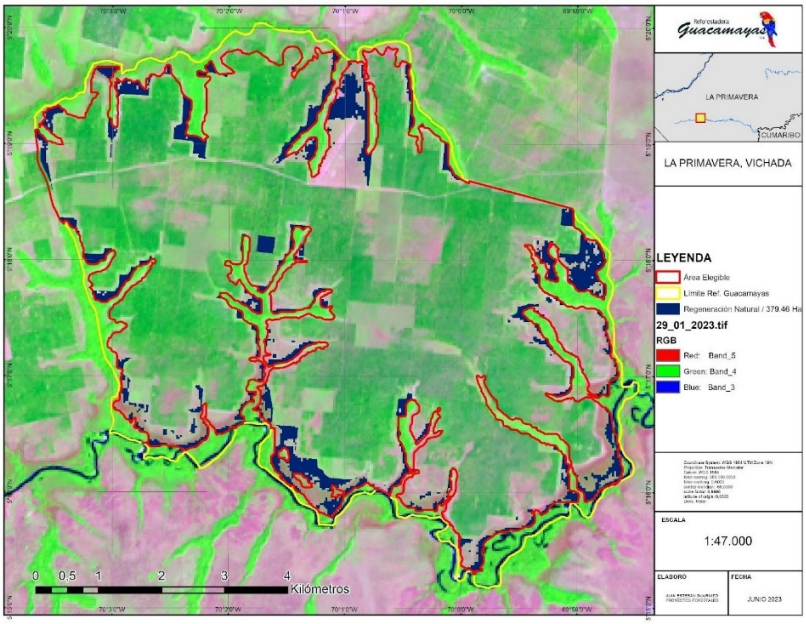
Map 8. Natural regeneration Bosques de la Orinoquía S.A.



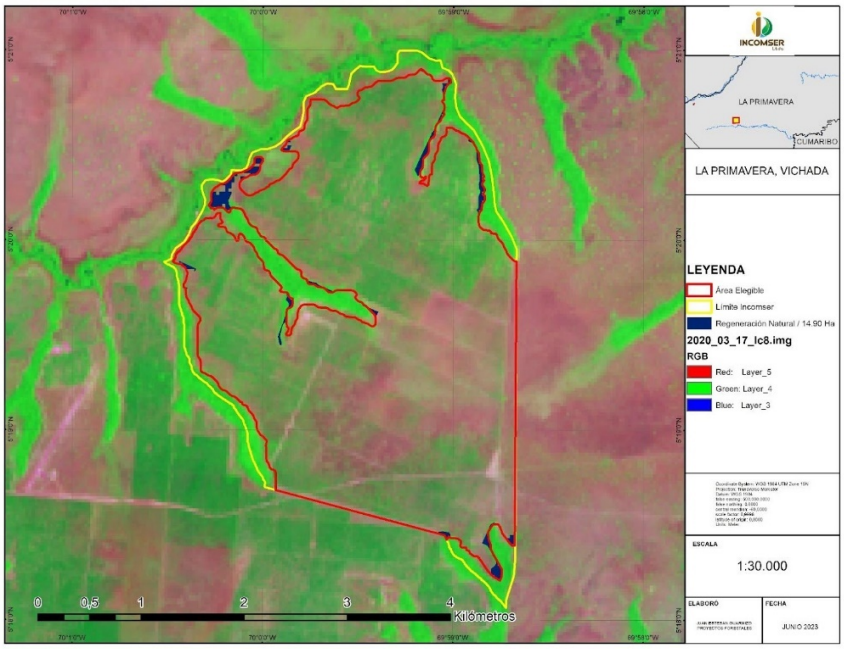
Map 9. Natural regeneration Bosques de la Primavera S.A.



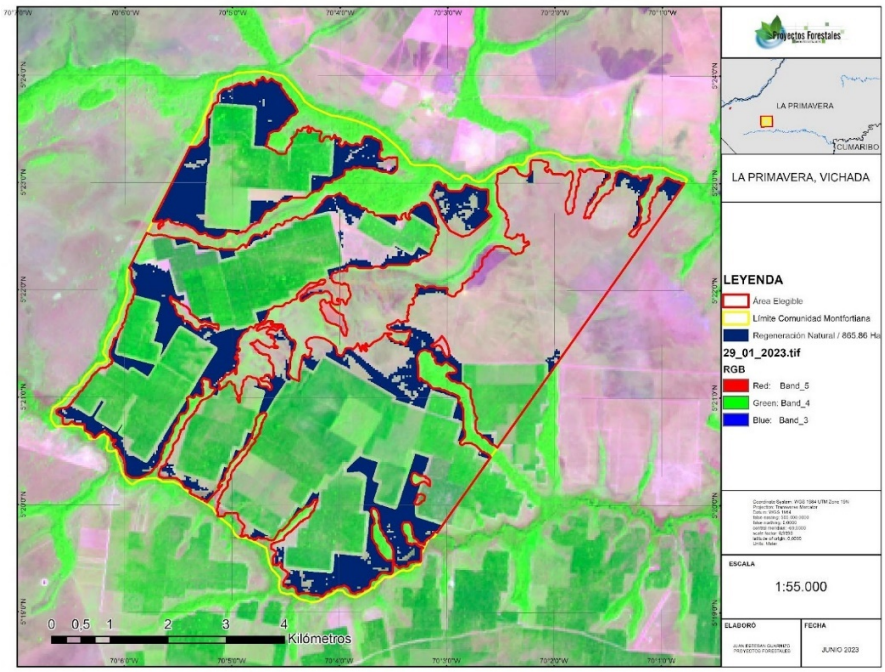
Map 10. Natural regeneration Reforestadora Los Cámbulos S.A.S.



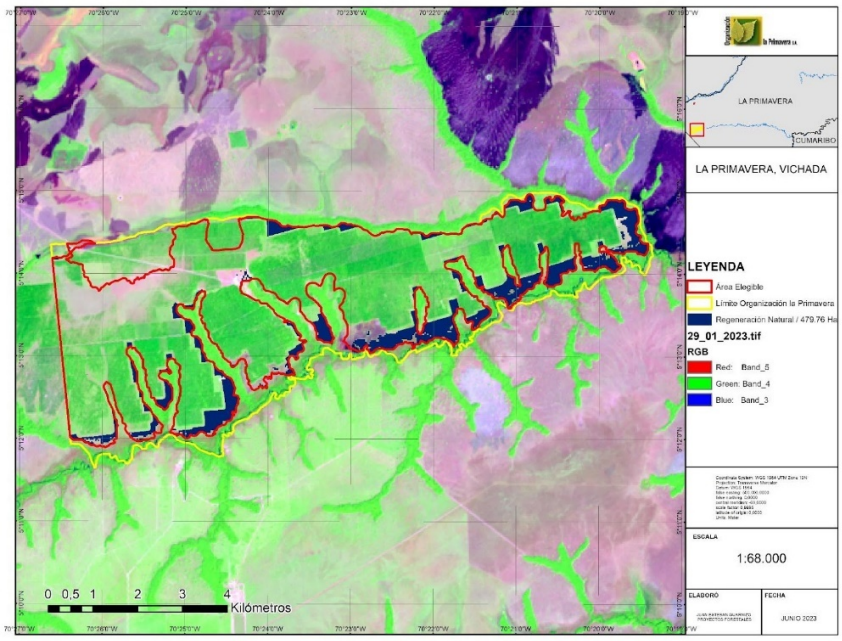
Map 11. Natural regeneration Reforestadora Guacamayas S.A.



Map 12. Natural regeneration INCOMSER LTDA.



Map 13. Natural regeneration Compañía de María Padres Montfortianos



Map 14. Natural regeneration Organización La Primavera S.A.

Comparison with Primary Information

To increase the quality criteria of the process and further adjust the information to the reality found in the field, the data obtained in the plot surveys were added as samples to the seeding process and were considered in the manual editing phase. Thus, the statistical sample is increased without systematic errors, reducing the variances between the classes to be classified, which should be clarified, as they all respond to plantation coverage, they may present similarities in their spectral responses, and thus achieve low correlations between the training areas and the resulting classes.

The field plots were classified considering the amount of carbon retained, calculated based on the amount of biomass found

Table 17. Table of results by Strata

Forest Project	
ESTRATA	**AREA (ha)**
Low	***1.398,7***
Steady	***2.691,5***
Middle	***1.632,8***
Higth	***5.952,7***
Upper	***7.264,7***
RNA	***3.509,8***
Total	***22.450,15***

16.2.2 Field inventory results

Based on the stratification and the areas of each stratum, a sample size distribution was developed following the UNFCCC methodological recommendations for a CDM reforestation project.

In total, 217 plots were established in nucleus, distributed in the five strata as follows

Table 18. Sample number inventoried in the sampling of the strata

Strata	Established plots
Low	34
Steady	60
Middle	48
High	52

Upper	23
RNA	N.A
Total	217

The plots with geographical coordinates are shown in **¡Error! No se encuentra el origen de la referencia.**.

Table 19. Plots in the project.

NUM_PARC	Nucleus	Strata	N	W
boo_2_2	BOSQUE_DE_ORINOQUIA	Middle	5° 25' 52,300" N	69° 32' 37,500" W
boo_2_4	BOSQUE_DE_ORINOQUIA	Steady	5° 27' 20,900" N	69° 32' 8,200" W
boo_2_3	BOSQUE_DE_ORINOQUIA	Middle	5° 26' 11,500" N	69° 33' 54,100" W
boo_2_5	BOSQUE_DE_ORINOQUIA	Upper	5° 27' 10,300" N	69° 32' 30,000" W
boo_2_6	BOSQUE_DE_ORINOQUIA	High	5° 27' 45,800" N	69° 33' 12,200" W
boo_2_7	BOSQUE_DE_ORINOQUIA	Upper	5° 27' 36,800" N	69° 33' 24,900" W
boo_2_8	BOSQUE_DE_ORINOQUIA	Low	5° 26' 51,800" N	69° 33' 27,900" W
boo_2_9	BOSQUE_DE_ORINOQUIA	Middle	5° 26' 31,300" N	69° 33' 51,400" W
bop_1_5	BOSQUES DE LA PRIMAVERA	Low	5° 21' 52,200" N	69° 52' 40,400" W
bop_1_14	BOSQUES DE LA PRIMAVERA	Steady	5° 22' 54,100" N	69° 51' 41,800" W
bop_1_15	BOSQUES DE LA PRIMAVERA	Low	5° 18' 53,300" N	69° 43' 54,400" W
bop_1_16	BOSQUES DE LA PRIMAVERA	Upper	5° 21' 14,900" N	69° 43' 20,100" W
bop_1_17	BOSQUES DE LA PRIMAVERA	Middle	5° 20' 46,400" N	69° 45' 45,200" W
bop_1_18	BOSQUES DE LA PRIMAVERA	Steady	5° 21' 25,600" N	69° 50' 24,900" W
bop_1_19	BOSQUES DE LA PRIMAVERA	Low	5° 21' 41,600" N	69° 53' 10,600" W
bop_1_20	BOSQUES DE LA PRIMAVERA	Low	5° 21' 32,000" N	69° 42' 56,300" W
bop_1_21	BOSQUES DE LA PRIMAVERA	Upper	5° 20' 23,100" N	69° 43' 12,200" W
bop_1_22	BOSQUES DE LA PRIMAVERA	Low	5° 20' 16,300" N	69° 47' 34,000" W
bop_1_23	BOSQUES DE LA PRIMAVERA	Low	5° 21' 43,000" N	69° 50' 21,900" W
bop_1_6	BOSQUES DE LA PRIMAVERA	Steady	5° 23' 6,600" N	69° 52' 57,900" W
bop_1_24	BOSQUES DE LA PRIMAVERA	Steady	5° 21' 9,700" N	69° 42' 57,900" W
bop_1_25	BOSQUES DE LA PRIMAVERA	Low	5° 21' 47,200" N	69° 43' 26,900" W
bop_1_26	BOSQUES DE LA PRIMAVERA	High	5° 21' 20,500" N	69° 44' 42,400" W
bop_1_27	BOSQUES DE LA PRIMAVERA	Low	5° 21' 25,000" N	69° 51' 20,200" W
bop_1_28	BOSQUES DE LA PRIMAVERA	Low	5° 21' 9,700" N	69° 42' 46,000" W
bop_1_29	BOSQUES DE LA PRIMAVERA	Steady	5° 17' 13,700" N	69° 42' 46,200" W
bop_1_30	BOSQUES DE LA PRIMAVERA	Steady	5° 23' 14,900" N	69° 52' 42,700" W
bop_1_31	BOSQUES DE LA PRIMAVERA	Low	5° 17' 58,800" N	69° 43' 43,800" W
bop_1_32	BOSQUES DE LA PRIMAVERA	Low	5° 19' 19,800" N	69° 45' 1,000" W
bop_1_33	BOSQUES DE LA PRIMAVERA	Low	5° 20' 29,000" N	69° 44' 22,000" W
bop_1_7	BOSQUES DE LA PRIMAVERA	High	5° 21' 44,500" N	69° 50' 43,600" W
bop_1_34	BOSQUES DE LA PRIMAVERA	Low	5° 18' 56,600" N	69° 42' 47,400" W
bop_1_36	BOSQUES DE LA PRIMAVERA	Low	5° 19' 28,100" N	69° 45' 50,300" W

NUM_PARC	Nucleus	Strata	N	W
bop_1_37	BOSQUES DE LA PRIMAVERA	Low	5° 21' 3,800" N	69° 42' 29,900" W
bop_1_38	BOSQUES DE LA PRIMAVERA	Upper	5° 20' 38,600" N	69° 43' 1,700" W
bop_1_39	BOSQUES DE LA PRIMAVERA	High	5° 20' 9,800" N	69° 43' 6,600" W
bop_1_40	BOSQUES DE LA PRIMAVERA	Low	5° 19' 11,300" N	69° 44' 15,500" W
bop_1_41	BOSQUES DE LA PRIMAVERA	Middle	5° 20' 31,200" N	69° 48' 15,700" W
bop_1_42	BOSQUES DE LA PRIMAVERA	Steady	5° 18' 42,100" N	69° 43' 40,000" W
bop_1_43	BOSQUES DE LA PRIMAVERA	Low	5° 21' 43,400" N	69° 44' 2,000" W
bop_1_8	BOSQUES DE LA PRIMAVERA	Low	5° 22' 6,000" N	69° 53' 3,200" W
bop_1_44	BOSQUES DE LA PRIMAVERA	Steady	5° 21' 56,700" N	69° 51' 17,400" W
bop_1_45	BOSQUES DE LA PRIMAVERA	Steady	5° 22' 15,500" N	69° 50' 27,800" W
bop_1_46	BOSQUES DE LA PRIMAVERA	Low	5° 22' 31,800" N	69° 50' 48,900" W
bop_1_47	BOSQUES DE LA PRIMAVERA	Steady	5° 19' 17,200" N	69° 42' 21,300" W
bop_1_48	BOSQUES DE LA PRIMAVERA	Middle	5° 20' 52,700" N	69° 44' 57,400" W
bop_1_49	BOSQUES DE LA PRIMAVERA	High	5° 20' 59,100" N	69° 45' 8,900" W
bop_1_52	BOSQUES DE LA PRIMAVERA	Steady	5° 20' 31,000" N	69° 48' 2,500" W
bop_1_53	BOSQUES DE LA PRIMAVERA	High	5° 20' 8,800" N	69° 43' 35,400" W
bop_1_54	BOSQUES DE LA PRIMAVERA	Middle	5° 18' 10,600" N	69° 43' 34,200" W
bop_1_55	BOSQUES DE LA PRIMAVERA	Steady	5° 18' 42,500" N	69° 43' 49,700" W
bop_1_9	BOSQUES DE LA PRIMAVERA	Steady	5° 21' 42,500" N	69° 50' 7,100" W
bop_1_56	BOSQUES DE LA PRIMAVERA	Low	5° 18' 4,300" N	69° 44' 6,400" W
bop_1_57	BOSQUES DE LA PRIMAVERA	High	5° 18' 21,900" N	69° 44' 35,400" W
bop_1_59	BOSQUES DE LA PRIMAVERA	Low	5° 22' 0,500" N	69° 43' 35,800" W
bop_2_1	BOSQUES DE LA PRIMAVERA	Steady	5° 20' 11,200" N	69° 42' 30,400" W
bop_2_2	BOSQUES DE LA PRIMAVERA	Steady	5° 20' 39,000" N	69° 46' 52,800" W
bop_2_3	BOSQUES DE LA PRIMAVERA	Upper	5° 20' 28,900" N	69° 48' 0,300" W
bop_2_4	BOSQUES DE LA PRIMAVERA	High	5° 20' 20,300" N	69° 48' 0,600" W
bop_1_10	BOSQUES DE LA PRIMAVERA	Low	5° 20' 1,300" N	69° 43' 22,200" W
bop_1_11	BOSQUES DE LA PRIMAVERA	Steady	5° 21' 3,400" N	69° 43' 28,200" W
bop_1_12	BOSQUES DE LA PRIMAVERA	Steady	5° 18' 50,200" N	69° 45' 54,100" W
bop_1_13	BOSQUES DE LA PRIMAVERA	Low	5° 21' 34,200" N	69° 43' 14,300" W
bop_2_5	BOSQUES DE LA PRIMAVERA	Steady	5° 22' 22,400" N	69° 53' 13,600" W
bop_2_6	BOSQUES DE LA PRIMAVERA	High	5° 20' 25,200" N	69° 46' 23,700" W
bop_2_7	BOSQUES DE LA PRIMAVERA	Middle	5° 20' 1,700" N	69° 46' 55,100" W
boo_1_1	BOSQUE_DE_ORINOQUIA	Steady	5° 27' 19,200" N	69° 32' 40,700" W
boo_1_2	BOSQUE_DE_ORINOQUIA	Low	5° 27' 35,100" N	69° 33' 34,800" W
boo_1_10	BOSQUE_DE_ORINOQUIA	Steady	5° 27' 39,600" N	69° 33' 58,600" W
boo_2_1	BOSQUE_DE_ORINOQUIA	High	5° 25' 46,300" N	69° 32' 45,900" W
cam_1_4	REFO LOS CAMBULOS	Steady	5° 18' 26,200" N	70° 5' 4,500" W
cam_1_13	REFO LOS CAMBULOS	Low	5° 18' 50,300" N	70° 4' 54,000" W
cam_1_14	REFO LOS CAMBULOS	Upper	5° 17' 26,500" N	70° 5' 20,800" W
cam_1_15	REFO LOS CAMBULOS	Low	5° 18' 18,700" N	70° 4' 13,200" W
cam_1_16	REFO LOS CAMBULOS	Steady	5° 18' 12,100" N	70° 5' 28,400" W
cam_1_17	REFO LOS CAMBULOS	Middle	5° 18' 23,000" N	70° 4' 57,900" W
cam_2_1	REFO LOS CAMBULOS	Low	5° 16' 42,200" N	70° 4' 54,000" W

NUM_PARC	Nucleus	Strata	N	W
cam_2_3	REFO LOS CAMBULOS	Steady	5° 16' 36,900" N	70° 5' 35,200" W
bop_1_1	BOSQUES DE LA PRIMAVERA	Upper	5° 20' 33,100" N	69° 42' 38,100" W
cam_1_5	REFO LOS CAMBULOS	Low	5° 17' 35,900" N	70° 3' 52,000" W
cam_1_6	REFO LOS CAMBULOS	Middle	5° 17' 12,700" N	70° 5' 25,100" W
cam_1_7	REFO LOS CAMBULOS	Steady	5° 18' 38,600" N	70° 3' 42,300" W
cam_1_8	REFO LOS CAMBULOS	Middle	5° 17' 45,700" N	70° 4' 4,900" W
cam_1_9	REFO LOS CAMBULOS	Low	5° 18' 19,100" N	70° 5' 29,200" W
cam_1_10	REFO LOS CAMBULOS	Middle	5° 17' 7,800" N	70° 5' 38,400" W
cam_1_11	REFO LOS CAMBULOS	Middle	5° 17' 54,800" N	70° 4' 16,600" W
cam_1_12	REFO LOS CAMBULOS	High	5° 16' 40,300" N	70° 3' 40,500" W
bop_1_2	BOSQUES DE LA PRIMAVERA	Low	5° 20' 44,700" N	69° 44' 42,100" W
bop_1_3	BOSQUES DE LA PRIMAVERA	Low	5° 21' 46,139" N	69° 53' 21,580" W
bop_1_4	BOSQUES DE LA PRIMAVERA	Middle	5° 18' 41,100" N	69° 42' 32,300" W
gua_1_5	REFORESTADORA_GUACAMAYAS	Steady	5° 17' 38,150" N	69° 59' 54,400" W
gua_1_13	REFORESTADORA_GUACAMAYAS	Steady	5° 17' 31,590" N	69° 59' 56,940" W
gua_1_14	REFORESTADORA_GUACAMAYAS	Low	5° 17' 54,990" N	70° 0' 37,140" W
gua_1_15	REFORESTADORA_GUACAMAYAS	Steady	5° 17' 50,590" N	69° 59' 43,850" W
gua_1_16	REFORESTADORA_GUACAMAYAS	High	5° 17' 24,930" N	70° 2' 11,200" W
gua_1_17	REFORESTADORA_GUACAMAYAS	High	5° 17' 8,790" N	70° 0' 43,940" W
gua_1_18	REFORESTADORA_GUACAMAYAS	Middle	5° 19' 5,530" N	70° 1' 47,190" W
gua_1_19	REFORESTADORA_GUACAMAYAS	Middle	5° 18' 31,690" N	70° 1' 10,950" W
gua_1_20	REFORESTADORA_GUACAMAYAS	Steady	5° 17' 28,460" N	70° 0' 19,910" W
gua_1_21	REFORESTADORA_GUACAMAYAS	Steady	5° 16' 53,840" N	69° 59' 57,360" W
gua_1_23	REFORESTADORA_GUACAMAYAS	Steady	5° 18' 44,280" N	70° 1' 58,230" W
gua_1_6	REFORESTADORA_GUACAMAYAS	High	5° 17' 19,490" N	70° 0' 5,230" W
gua_1_24	REFORESTADORA_GUACAMAYAS	Low	5° 18' 12,800" N	70° 2' 15,900" W
gua_1_25	REFORESTADORA_GUACAMAYAS	Low	5° 18' 32,690" N	70° 3' 2,400" W
gua_1_26	REFORESTADORA_GUACAMAYAS	Upper	5° 19' 7,400" N	70° 2' 48,810" W
gua_1_27	REFORESTADORA_GUACAMAYAS	Low	5° 19' 30,250" N	70° 1' 54,650" W
gua_1_28	REFORESTADORA_GUACAMAYAS	Upper	5° 17' 38,620" N	70° 2' 32,160" W
gua_1_29	REFORESTADORA_GUACAMAYAS	High	5° 18' 52,270" N	70° 0' 23,870" W
gua_1_30	REFORESTADORA_GUACAMAYAS	High	5° 16' 57,260" N	70° 0' 55,740" W
gua_2_1	REFORESTADORA_GUACAMAYAS	High	5° 16' 15,610" N	69° 59' 14,850" W
gua_2_4	REFORESTADORA_GUACAMAYAS	High	5° 16' 26,350" N	69° 59' 0,800" W
cam_1_1	REFO LOS CAMBULOS	Low	5° 18' 19,800" N	70° 5' 44,000" W
gua_1_8	REFORESTADORA_GUACAMAYAS	Steady	5° 16' 28,960" N	69° 59' 37,050" W
gua_1_9	REFORESTADORA_GUACAMAYAS	Steady	5° 17' 4,110" N	70° 2' 25,080" W
gua_1_10	REFORESTADORA_GUACAMAYAS	Middle	5° 17' 43,130" N	70° 0' 40,200" W
gua_1_11	REFORESTADORA_GUACAMAYAS	Low	5° 19' 19,720" N	70° 1' 31,790" W
gua_1_12	REFORESTADORA_GUACAMAYAS	Steady	5° 18' 27,470" N	70° 0' 24,870" W
cam_1_2	REFO LOS CAMBULOS	High	5° 18' 0,800" N	70° 5' 28,000" W
cam_1_3	REFO LOS CAMBULOS	Steady	5° 17' 32,900" N	70° 4' 4,500" W
inc_1_1	INCOMSER	Low	5° 19' 39,362" N	69° 59' 2,494" W
inc_1_10	INCOMSER	Steady	5° 19' 28,412" N	70° 0' 12,187" W

NUM_PARC	Nucleus	Strata	N	W
inc_1_11	INCOMSER	Middle	5° 19' 45,639" N	70° 0' 14,192" W
inc_1_12	INCOMSER	Steady	5° 20' 11,937" N	70° 0' 1,427" W
inc_1_13	INCOMSER	Middle	5° 20' 12,579" N	69° 59' 37,618" W
inc_1_14	INCOMSER	Middle	5° 20' 32,223" N	69° 59' 37,564" W
inc_1_15	INCOMSER	Middle	5° 20' 46,205" N	69° 59' 21,856" W
inc_1_16	INCOMSER	Middle	5° 20' 43,637" N	69° 59' 11,967" W
inc_1_17	INCOMSER	Middle	5° 20' 22,948" N	69° 59' 19,068" W
inc_1_18	INCOMSER	Middle	5° 19' 44,423" N	69° 59' 27,344" W
inc_1_19	INCOMSER	High	5° 19' 53,953" N	69° 58' 54,094" W
inc_1_2	INCOMSER	Low	5° 19' 23,666" N	69° 58' 58,623" W
inc_1_20	INCOMSER	Steady	5° 19' 45,767" N	69° 58' 55,113" W
inc_1_21	INCOMSER	Middle	5° 20' 3,393" N	69° 59' 17,318" W
inc_1_22	INCOMSER	Steady	5° 18' 50,972" N	69° 58' 54,768" W
inc_1_23	INCOMSER	Steady	5° 18' 44,676" N	69° 59' 53,120" W
inc_1_24	INCOMSER	Steady	5° 20' 6,611" N	69° 59' 52,135" W
inc_1_25	INCOMSER	Steady	5° 20' 30,620" N	69° 59' 16,416" W
inc_1_26	INCOMSER	Steady	5° 20' 6,054" N	69° 59' 23,854" W
inc_1_27	INCOMSER	Steady	5° 19' 53,591" N	69° 59' 5,010" W
inc_1_28	INCOMSER	Steady	5° 19' 45,647" N	69° 59' 16,172" W
inc_1_29	INCOMSER	Middle	5° 20' 26,161" N	69° 59' 3,085" W
inc_1_30	INCOMSER	Steady	5° 20' 20,656" N	69° 58' 57,575" W
inc_1_4	INCOMSER	Low	5° 19' 1,598" N	69° 59' 7,999" W
inc_1_5	INCOMSER	Low	5° 19' 18,643" N	69° 58' 49,117" W
inc_1_6	INCOMSER	Low	5° 20' 0,097" N	70° 0' 18,942" W
inc_1_7	INCOMSER	Low	5° 18' 38,416" N	69° 59' 7,692" W
inc_1_8	INCOMSER	Low	5° 19' 50,922" N	69° 58' 48,003" W
inc_1_9	INCOMSER	Low	5° 19' 11,829" N	70° 0' 8,471" W
mon_1_1	MONTFORTIANOS	Low	5° 22' 18,800" N	70° 4' 29,400" W
mon_1_10	MONTFORTIANOS	Steady	5° 21' 27,700" N	70° 5' 19,800" W
mon_1_11	MONTFORTIANOS	Steady	5° 21' 2,900" N	70° 5' 0,200" W
mon_1_12	MONTFORTIANOS	Upper	5° 20' 6,500" N	70° 3' 0,400" W
mon_1_14	MONTFORTIANOS	Steady	5° 20' 54,200" N	70° 5' 10,100" W
mon_1_15	MONTFORTIANOS	Steady	5° 20' 42,600" N	70° 5' 8,000" W
mon_1_17	MONTFORTIANOS	Low	5° 20' 38,700" N	70° 3' 25,600" W
mon_1_18	MONTFORTIANOS	Upper	5° 20' 55,500" N	70° 4' 17,200" W
mon_1_19	MONTFORTIANOS	Steady	5° 21' 5,200" N	70° 5' 29,700" W
mon_1_20	MONTFORTIANOS	Steady	5° 21' 2,600" N	70° 2' 26,000" W
mon_1_21	MONTFORTIANOS	Steady	5° 20' 50,000" N	70° 6' 7,100" W
mon_1_2	MONTFORTIANOS	Middle	5° 20' 47,400" N	70° 4' 22,000" W
mon_1_22	MONTFORTIANOS	High	5° 21' 50,500" N	70° 5' 51,100" W
mon_1_23	MONTFORTIANOS	High	5° 20' 22,300" N	70° 4' 24,200" W
mon_1_24	MONTFORTIANOS	Middle	5° 22' 8,700" N	70° 5' 10,900" W
mon_2_1	MONTFORTIANOS	Middle	5° 20' 0,600" N	70° 3' 54,500" W
mon_2_2	MONTFORTIANOS	Steady	5° 19' 39,700" N	70° 3' 55,600" W

NUM_PARC	Nucleus	Strata	N	W
mon_2_3	MONTFORTIANOS	Steady	5° 20' 52,700" N	70° 2' 29,200" W
mon_1_3	MONTFORTIANOS	Middle	5° 22' 10,300" N	70° 4' 23,100" W
mon_1_4	MONTFORTIANOS	Steady	5° 20' 49,800" N	70° 2' 27,500" W
mon_1_5	MONTFORTIANOS	Middle	5° 20' 54,700" N	70° 5' 35,700" W
mon_1_8	MONTFORTIANOS	Upper	5° 21' 25,500" N	70° 5' 46,700" W
mon_1_9	MONTFORTIANOS	Upper	5° 23' 9,400" N	70° 4' 22,100" W
mon_2_4	MONTFORTIANOS	Upper	5° 21' 54,100" N	70° 5' 19,000" W
mon_2_5	MONTFORTIANOS	Steady	5° 22' 28,900" N	70° 3' 10,200" W
mon_2_6	MONTFORTIANOS	Upper	5° 20' 31,400" N	70° 4' 3,800" W
gua_1_1	REFORESTADORA_GUACAMAYAS	Middle	5° 16' 13,820" N	69° 59' 46,570" W
gua_1_2	REFORESTADORA_GUACAMAYAS	Steady	5° 18' 54,970" N	70° 1' 58,190" W
gua_1_4	REFORESTADORA_GUACAMAYAS	Middle	5° 17' 18,130" N	70° 2' 46,400" W
olp_1_1	ORGANIZACION LA PRIMAVERA	High	5° 12' 22,546" N	70° 24' 42,401" W
olp_1_10	ORGANIZACION LA PRIMAVERA	Steady	5° 13' 21,000" N	70° 24' 45,000" W
olp_1_11	ORGANIZACION LA PRIMAVERA	Upper	5° 14' 23,300" N	70° 20' 48,600" W
olp_1_12	ORGANIZACION LA PRIMAVERA	Middle	5° 13' 11,400" N	70° 25' 22,500" W
olp_1_13	ORGANIZACION LA PRIMAVERA	Steady	5° 14' 12,400" N	70° 21' 29,200" W
olp_1_14	ORGANIZACION LA PRIMAVERA	Low	5° 14' 30,200" N	70° 21' 19,500" W
olp_1_15	ORGANIZACION LA PRIMAVERA	Steady	5° 13' 15,800" N	70° 24' 34,100" W
olp_1_16	ORGANIZACION LA PRIMAVERA	Middle	5° 12' 58,000" N	70° 25' 3,300" W
olp_1_18	ORGANIZACION LA PRIMAVERA	High	5° 14' 0,400" N	70° 23' 39,800" W
olp_1_19	ORGANIZACION LA PRIMAVERA	Low	5° 13' 54,600" N	70° 22' 15,200" W
olp_1_20	ORGANIZACION LA PRIMAVERA	Middle	5° 13' 56,900" N	70° 22' 51,900" W
olp_1_3	ORGANIZACION LA PRIMAVERA	Upper	5° 14' 16,300" N	70° 23' 13,400" W
olp_1_4	ORGANIZACION LA PRIMAVERA	Middle	5° 13' 50,000" N	70° 23' 47,400" W
olp_1_5	ORGANIZACION LA PRIMAVERA	High	5° 14' 3,000" N	70° 22' 58,600" W
olp_1_6	ORGANIZACION LA PRIMAVERA	Middle	5° 13' 39,000" N	70° 23' 4,500" W
olp_1_7	ORGANIZACION LA PRIMAVERA	Low	5° 14' 16,600" N	70° 23' 42,500" W
olp_1_8	ORGANIZACION LA PRIMAVERA	Steady	5° 14' 39,300" N	70° 20' 28,100" W
olp_1_9	ORGANIZACION LA PRIMAVERA	Middle	5° 13' 39,775" N	70° 22' 40,631" W
olp_2_1	ORGANIZACION LA PRIMAVERA	Steady	5° 14' 0,991" N	70° 22' 11,683" W
olp_2_10	ORGANIZACION LA PRIMAVERA	Upper	5° 14' 39,909" N	70° 21' 14,051" W
olp_2_11	ORGANIZACION LA PRIMAVERA	Upper	5° 14' 8,684" N	70° 23' 5,614" W
olp_2_12	ORGANIZACION LA PRIMAVERA	Middle	5° 14' 39,311" N	70° 20' 51,183" W
olp_2_13	ORGANIZACION LA PRIMAVERA	Upper	5° 14' 30,604" N	70° 20' 4,139" W
olp_2_14	ORGANIZACION LA PRIMAVERA	High	5° 14' 32,059" N	70° 20' 37,724" W
olp_2_15	ORGANIZACION LA PRIMAVERA	High	5° 14' 17,976" N	70° 20' 9,760" W
olp_2_16	ORGANIZACION LA PRIMAVERA	Upper	5° 14' 24,956" N	70° 21' 9,445" W
olp_2_17	ORGANIZACION LA PRIMAVERA	Low	5° 13' 46,604" N	70° 21' 53,893" W
olp_2_18	ORGANIZACION LA PRIMAVERA	Upper	5° 14' 33,455" N	70° 19' 52,505" W
olp_2_19	ORGANIZACION LA PRIMAVERA	Middle	5° 12' 29,415" N	70° 24' 51,620" W
olp_2_2	ORGANIZACION LA PRIMAVERA	Middle	5° 13' 47,812" N	70° 22' 25,998" W
olp_2_20	ORGANIZACION LA PRIMAVERA	High	5° 13' 59,517" N	70° 23' 50,972" W
olp_2_22	ORGANIZACION LA PRIMAVERA	High	5° 12' 57,818" N	70° 25' 18,303" W

NUM_PARC	Nucleus	Strata	N	W
olp_2_23	ORGANIZACION LA PRIMAVERA	High	5° 13' 45,868" N	70° 23' 45,529" W
olp_2_24	ORGANIZACION LA PRIMAVERA	Steady	5° 12' 50,640" N	70° 26' 18,788" W
olp_2_26	ORGANIZACION LA PRIMAVERA	Middle	5° 13' 19,495" N	70° 23' 59,512" W
olp_2_27	ORGANIZACION LA PRIMAVERA	High	5° 13' 6,045" N	70° 24' 1,247" W
olp_2_28	ORGANIZACION LA PRIMAVERA	Middle	5° 12' 59,811" N	70° 24' 23,498" W
olp_2_3	ORGANIZACION LA PRIMAVERA	Steady	5° 13' 50,634" N	70° 22' 19,466" W
olp_2_30	ORGANIZACION LA PRIMAVERA	Low	5° 13' 14,305" N	70° 26' 14,404" W
olp_2_31	ORGANIZACION LA PRIMAVERA	Low	5° 13' 15,471" N	70° 25' 52,256" W
olp_2_4	ORGANIZACION LA PRIMAVERA	High	5° 14' 18,614" N	70° 23' 22,825" W
olp_2_5	ORGANIZACION LA PRIMAVERA	Upper	5° 13' 32,762" N	70° 22' 0,000" W
olp_2_6	ORGANIZACION LA PRIMAVERA	High	5° 14' 27,420" N	70° 20' 48,918" W
olp_2_8	ORGANIZACION LA PRIMAVERA	Upper	5° 14' 24,328" N	70° 23' 2,265" W
olp_2_9	ORGANIZACION LA PRIMAVERA	Upper	5° 13' 51,252" N	70° 23' 35,909" W

16.2.3 Carbon Account

Aboveground and Belowground Biomass

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

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

To select the equations, we followed the recommendations of the tools *"Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A / R CDM project activities*" and "*Demonstrating appropriateness of allometric equations for estimation of aboveground biomass in A / R CDM project Activities*". It should be noted that for the region there are no equations for the project species, but there are equations from official national sources. For pine species, equations developed in regions with similar conditions and management were sought as the tools requested. The sources of information for the equations used are provided to the auditor in annex[42].

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

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

Table 20. **Equations of volume and above biomass applied for included species in work-field survey.**

Specie	Equations	*Observation /applied*	Source
P. caribaea	$Ln(Vol) = -9.66 + 1.834 * ln(DAP) + 1.007Ln(h_t)$	**Edafo climatic conditions:** Temperature: 21.7 °C Soils: Ultisols, red clay soils and acidic. Very humid, tropical premotane forest **Statistics:** ✔ R^2= 0.97 ✔ N=45 **Application range:** DAP≥ 10-28 cm	Salazar, 1985[43].
	$BA = 0.887 + \left(\frac{10486 * DAP^{2.84}}{(DAP^{2.84}) + 376907}\right)$	**Edafo climatic conditions:** Pines of temperate and tropical zones **Statistics:** R^2= 0,98 N= 137 **Application range:** DAP 0,6 - 56 cm.	IPCC 2003[44].
A. mangium	$BA = 0.204 * DAP^{2.2801}$	**Edafo climatic conditions:** Humid tropical forest Temperature: 26 °C – 28 °C Alluvial plane. Acid soils, low fertility Slope 0-3% **Statistics:** N=52 R^2= 0.94 **Application range:** *DAP> 5cm*	Recommended in the national carbon protocol of Colombia, Yepes et al, IDEAM, 2011[45].

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

[44] 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.

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

E. pellita	$BA = 1.22 * DAP^2 * h_t * 0.01$	**Edafo climatic conditions:** *Subtropical zone*. Temperature: 17.3 °C. **Statistics:** R^2= 0.97. N= 130. **Application range:** *DBH:1-31 cm*	*Recommended in the national carbon protocol of Colombia, Yepes et al, IDEAM, 2011, Surce IPCC 2003.*

DBH: Diameter at chest height (1.3 m) above the ground. BA: Biomass (kg), ht: total height of the tree.

The carbon content in the belowground biomass component was estimated following the methodological recommendations of the IPCC 2003, which determines different factors to be applied according to the biomass contents per hectare and for each species. It is important to clarify that only in the 2003 IPCC Good Practice Guides does it make specific reference to what factors to use for root biomass in coniferous plantations and plantations of eucalyptus and other broadleaf species. (**¡Error! No se encuentra el origen de la referencia.**).

Table 21. R values for the species of P. caribaea, A. mangium, and E. pellita according to IPCC 2003. Obtained from IPCC 2003, table 3A.1.8.

Coverage	Reference aerial biomass (tha-1)	R factor. (Root-shoot relationship)
Coniferous Plantations	<50	***0.46***
	50-150	***0.32***
	>150	***0.23***
Eucalyptus and *A. mangium* plantation.	<50	***0.45***
	50-150	***0.35***
	>150	***0.2***

Estimation of sample quantity.

For its estimation, Winrock's CDM A/R Sample Plot Calculator Spreadsheet Tool was used, which applies the equations and statistics to estimate sample size. The tool uses a maximum error level of 10% and a minimum confidence level of 90%.

The following table shows the results of minimum plots for the project and for each stratum and the number of actual plots established for the project.

Table 22. List of sampling units (plots) established in the forest carbon project initiative Organización La Primavera in La Primavera, Vichada.

Strata	Established plots	Estimated Parcels
Low	34	3
Steady	60	5
Middle	48	3
High	52	10
Upp	23	16
Total	***217***	***15***

Uncertainty

For the estimation of uncertainty in the calculations, the procedure described in the methodological tool *AR-TOOL14 V04.2*, *Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, section 3: Definition and Notation, paragraph 6 Uncertainty:*

Uncertainty: *Uncertainty - is in the mean value of an estimated parameter equal to the estimated standard error of the mean expanded at 90 per cent confidence level divided by the mean value, expressed as percentage.*

The tool in appendix 2 establishes the values that must be discounted when the uncertainty in the data exceeds 10%. The result of applying the above procedures is presented in Table 23.

Table 23. Result of carbon estimates (tCO2ha-1) in aboveground and belowground reservoirs by plot and stratum.

LOW		Steady		Middle		HIGH		UPP	
Plot Cod	CO_2 ha^{-1}	Plot Cod	CO_2 ha^{-1}	Plot Cod.	CO_2 ha^{-1}	Plot Cod	CO_2 ha^{-1}	Plot Cod	CO_2 ha^{-1}
BOO_1-2	74,7	BOO_1-1	140,1	BOO_1-8	158,2	BOO_2-1	237,7	BOO_1-7	308,4
BOO_2-4	89,1	BOO_1-10	83,5	BOO_2-10	144,8	BOO_2-6	202,9	BOO_2-5	274,8
BOO_2-8	87,8	BOP_1-12	131,7	BOO_2-2	176,5	BOP_1-26	271,1	BOP_1-1	333,7
BOP_1-10	67,6	BOP_1-14	130,5	BOO_2-3	181,6	BOP_1-39	242,1	BOP_1-16	318,3
BOP_1-2	46,9	BOP_1-20	132,4	BOO_2-9	193,8	BOP_1-41	213,4	BOP_1-21	300,4
BOP_1-25	79,6	BOP_1-23	98,1	BOP_1-11	153,7	BOP_1-48	215,9	BOP_1-38	283,1
BOP_1-27	30,6	BOP_1-24	139,7	BOP_1-17	179,5	BOP_1-49	238,5	BOP_2-3	303,6
BOP_1-28	49,1	BOP_1-3	102,9	BOP_1-18	158,4	BOP_1-53	238,8	BOP_2-6	285,4
BOP_1-31	53,1	BOP_1-32	119,3	BOP_1-29	151,1	BOP_1-57	237,9	CAM_1-12	276,0
BOP_1-37	29,7	BOP_1-34	115,1	BOP_1-30	145,1	BOP_1-7	226,0	CAM_1-14	287,1
BOP_1-43	42,8	BOP_1-36	113,9	BOP_1-4	184,0	BOP_2-4	218,9	GUA_1-26	327,6
BOP_1-46	83,2	BOP_1-42	123,5	BOP_1-54	197,5	CAM_1-10	219,0	GUA_1-28	276,8
BOP_1-56	26,8	BOP_1-44	143,1	BOP_1-55	166,0	CAM_1-11	243,9	INC_1-19	282,9
CAM_1-1	20,0	BOP_1-45	128,6	BOP_2-2	184,1	CAM_1-17	217,9	MONF_1-18	328,1
CAM_1-8	69,6	BOP_1-47	120,6	BOP_2-5	175,2	CAM_1-2	255,6	MONF_1-8	293,7

LOW		Steady		Middle		HIGH		UPP	
CAM_1-9	50,2	BOP_1-5	106,3	BOP_2-7	185,0	CAM_1-6	223,8	MONF_1-9	291,9
GUA_1-10	29,5	BOP_1-52	119,5	CAM_1-3	152,3	GUA_1-16	239,3	MONF_2-4	328,8
GUA_1-11	88,3	BOP_1-59	99,5	CAM_1-4	167,5	GUA_1-17	221,3	MONF_2-6	325,2
GUA_1-14	65,0	BOP_1-6	123,8	CAM_2-3	175,5	GUA_1-18	217,1	OLP_1-11	297,3
GUA_1-24	67,4	BOP_1-9	122,1	GUA_1-1	179,3	GUA_1-19	202,3	OLP_2-10	335,7
INC_1-1	39,6	BOP_2-1	140,3	GUA_1-13	155,6	GUA_1-29	235,7	OLP_2-11	295,6
INC_1-4	85,2	CAM_1-15	101,9	GUA_1-15	150,0	GUA_1-30	223,3	OLP_2-13	337,9
INC_1-5	34,0	CAM_1-16	136,0	GUA_1-21	154,6	GUA_1-6	241,2	OLP_2-16	312,8
INC_1-7	79,7	CAM_1-5	105,0	GUA_1-25	185,2	GUA_2-4	253,4	BOO_1-7	308,4
INC_1-8	30,6	CAM_1-7	123,1	GUA_1-4	189,2	INC_1-11	236,8	BOO_2-5	274,8
MONF_1-1	79,3	CAM_2-1	101,0	GUA_2-2	147,7	INC_1-12	200,3	BOP_1-1	333,7
MONF_1-17	64,4	CAM_2-2	116,4	INC_1-10	189,0	INC_1-13	230,6	BOP_1-16	318,3
OLP_1-19	74,0	GUA_1-12	144,2	INC_1-18	195,4	INC_1-14	202,2	BOP_1-21	300,4
OLP_1-7	65,7	GUA_1-2	138,6	INC_1-22	179,9	INC_1-15	257,3	BOP_1-38	283,1
OLP_2-17	85,3	GUA_1-20	132,4	INC_1-24	188,2	INC_1-16	227,8	BOP_2-3	303,6
OLP_2-21	69,8	GUA_1-23	133,9	INC_1-25	195,4	INC_1-17	213,1	BOP_2-6	285,4
OLP_2-3	87,9	GUA_1-27	88,3	MONF_1-11	187,1	INC_1-29	231,7	CAM_1-12	276,0
OLP_2-30	43,4	GUA_1-5	141,8	MONF_1-16	182,8	MONF_1-12	253,4	CAM_1-14	287,1
OLP_2-31	79,3	GUA_1-8	140,8	MONF_1-19	153,9	MONF_1-22	234,0	GUA_1-26	327,6
		GUA_1-9	128,6	MONF_1-2	184,2	MONF_1-23	221,3	GUA_1-28	276,8
		GUA_2-1	111,4	MONF_1-20	167,9	OLP_1-1	259,7	INC_1-19	282,9
		INC_1-20	124,9	MONF_1-24	160,2	OLP_1-16	206,8	MONF_1-18	328,1
		INC_1-23	122,8	MONF_1-3	169,3	OLP_1-3	207,5	MONF_1-8	293,7
		INC_1-28	127,7	OLP_1-10	147,9	OLP_1-5	244,4	MONF_1-9	291,9
		INC_1-30	143,9	OLP_1-12	179,6	OLP_1-6	201,5	MONF_2-4	328,8
		INC_1-6	99,4	OLP_1-20	178,1	OLP_2-14	244,2	MONF_2-6	325,2
		INC_1-9	108,7	OLP_1-4	147,7	OLP_2-15	266,2	OLP_1-11	297,3
		MONF_1-10	124,0	OLP_1-8	147,7	OLP_2-18	239,7	OLP_2-10	335,7
		MONF_1-13	95,6	OLP_2-12	168,7	OLP_2-20	208,9	OLP_2-11	295,6
		MONF_1-14	118,9	OLP_2-19	185,4	OLP_2-22	233,0	OLP 2-13	337,9
		MONF_1-15	102,8	OLP_2-2	152,4	OLP_2-23	207,9	OLP_2-16	312,8
		MONF_1-21	108,4	OLP_2-26	175,0	OLP_2-27	249,2		
		MONF_1-25	92,0	OLP_2-28	170,9	OLP_2-4	204,3		
		MONF_1-4	116,0			OLP_2-5	246,7		
		MONF_1-5	130,6			OLP_2-6	227,0		
		MONF_1-6	138,0			OLP_2-8	261,7		
		MONF_2-1	142,7			OLP_2-9	203,8		
		MONF_2-2	133,7						
		MONF_2-3	90,0						
		MONF_2-5	118,3						
		OLP_1-15	109,7						
		OLP_1-18	142,6						
		OLP_1-9	141,7						
		OLP_2-1	121,5						
		OLP_2-24	114,1						

Statistics Low			Statistics Steady		Statistics Middle		Statistics High		Statistics upp	
	Mean	*60,863*		*120,767*		*170,795*		*212.307*		*229,968*
	Mean adjusted	*59,28*		*120,77*		*170,8*		*209.1*		*229,97*
	Stand Desv	*21,789*		*16,331*		*16,023*		*22.38*		*18,97*
	N	*34*		*60*		*48*		*10*		*52*

Soil Organic Carbon

For its estimation, the tool was used: "*Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*".

This tool, according to the conditions of the pre-existing soil material in the project area, its management and state of degradation, sets a value for each hectare that is part of the project, defined by the following equation:

$\Delta SOC = \frac{44}{12} \sum A_i * dSOC_{t,i} * 1year$ ***Equation 8 from methodological tool.***

ΔSOCAL,t: Change in soil organic carbon content t C ha^{-1} yr^{-1}.

dSOC: Annual rate of change of soil organic carbon content. t C ha^{-1} yr^{-1}.

A_i: Area of each stratum of the project ha.

I: Stratum *i*

For this estimate, the tool "ARWG30_SOC_Tool_Multizones.xls" was used, that applies the established procedures mentioned in the tool "*Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*".

Under the conditions of the project areas, the annual rate of change in organic soil carbon content is dSOC = 0.8, per hectare per year. This value, multiplied by 44/12, results in a change of 2.93333 tCO2 per year per hectare in the soil carbon sink. The results for the areas accumulated to 2019 are shown in Table 24.

Table 24. Estimation of soil organic carbon

t	*Year*	*Area (ha)*	*Accumulated area (ha)*	*CO_2 (t)*
0	2005	835,88	835,88	0,00
1	2006	489,92	1.325,80	2.451,93
2	2007	1.005,77	2.331,58	3.889,03
3	2008	2.582,01	4.913,58	6.839,29
4	2009	2.902,05	7.815,63	14.413,17
5	2010	3.595,05	11.410,68	22.925,85
6	2011	3.098,67	14.509,35	33.471,33
7	2012	2.609,97	17.119,32	42.560,76

8	2013	3.953,15	21.072,47	50.216,67
9	2014	1.377,63	22.450,10	61.812,59
10	2015	0,00	22.450,10	65.853,64
11	2016	0,00	22.450,10	65.853,64
12	2017	0,00	22.450,10	65.853,64
13	2018	0,00	22.450,10	65.853,64
14	2019	0,00	22.450,10	65.853,64
15	2020	0,00	22.450,10	65.853,64
16	2021	0,00	22.450,10	65.853,64
17	2022	0,00	22.450,10	65.853,64
18	2023	0,00	22.450,10	65.853,64
19	2024	0,00	22.450,10	65.853,64
20	2025	0,00	22.450,10	65.853,64
		22.450,10		***962.970,61***

Other sinks

Shrubs

This reservoir was estimated following the methodological recommendations and using the default factors determined by the methodological tools. This component assumes a relationship between the aboveground biomass content for the types of natural forests present in the project area and the content related to the areas established for each year of intervention. The balances for this component are shown in Table 25.

Table 25. Carbon content estimates for the project's shrub reservoir

ha	**Years 2020-2025**
	22.450.1
Default tool values for Shrubs (t.d.m ha^{-1})	
CF_S	0.47
R_S	0.4
BDR_{SF}	0.1
b_{FOREST}	231.7
$CC_{SHRUB.I}$	0.50
44/12	3.67
$b_{SHRUB,i}$	11.585

Table 26. Shrub sink removal tCO_2

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015-2025	Total
Area (ha)	350,89	489,92	793,70	1.363,14	2.510,39	3.093,57	2.894,00	2.405,30	3.937,95	1.101,45	0,00	
2005	**9.807,6**											**9.807,6**
2006	**9.807,6**	**13.693,6**										**23.501,3**
2007	**9.807,6**	**13.693,6**	**22.184,5**									**45.685,8**
2008	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**								**83.786,5**
2009	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**							**153.953,8**
2010	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**						**240.421,4**
2011	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**					**321.310,8**
2012	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**				**388.540,8**
2013	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**			**498.609,4**
2014	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**		**529.395,7**
2015	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2016	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2017	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2018	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2019	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2020	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2021	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2022	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2023	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2024	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**
2025	**9.807,6**	**13.693,6**	**22.184,5**	**38.100,8**	**70.167,3**	**86.467,6**	**80.889,5**	**67.229,9**	**110.068,6**	**30.786,3**	**0,0**	**529.395,7**

Litter

The litter was considered for this verification, but this component was not measured directly. The indirect processes considered by the methodological tool were used: *Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities V. 03.1* "*The estimates are assumed from the results of the carbon content of the trees present in each stratum* ($C_{tree,i,t}$), multiplying by a DF_{LI} *conversion factor, which expresses the carbon content present in the litter, as a percentage of the content identified in the biomass of the trees".*

Although the methodological tool recommends a general factor, it also suggests applying other values when these are based on specific analyses carried out for the project

species under similar conditions. For litter, the factor of 10% was assumed, which is the result of the average values identified in other studies for the *Pinus sp* species in the tropical region.

Table 27. Estimates of carbon removals (tCO2 ha^{-1}) from the leaf litter component for the monitoring period

DF_{LI}	*10%*	
Stratum	**Area (ha)**	**Litter $C_{LI,t}$ (tCO2)**
Low	1.398,7	4.975
Regular	2.691,5	19.502
Medium	1.632,8	16.732
High	5.952,7	82.136
Upper	7.264,7	132.758
Total		***256.103***

Dead wood

It is estimated from default values, recommended by the methodological tool. This tool suggests an expansion factor of 6%, which relates the dead wood on the ground with respect to the aboveground carbon in each stratum. This average value was multiplied by the areas of each stratum in the monitored project area.

The results of estimated dead wood carbon per hectare are shown in **¡Error! No se encuentra el origen de la referencia.**.

Table 28. Carbon estimates per hectare aboveground dead wood biomass component

DF_{DW}	**Area (ha)**	**6%**
Stratum		**CDW,i, t ha-1**
Low	1.398,7	13.266
Regular	2.691,5	52.007
Medium	1.632,8	44.620
High	5.952,7	219.028

Upper	7.264,7	354.022
Total		***682.943***

Total reductions in GHG emissions or net GHG removals by sinks achieved in this Monitoring period.

According to the applied and validated methodology, it is assumed that the carbon contents in the baseline are zero C_{bsl}= 0.

The total accumulated net removals for the 02/06/2025 cut is estimated at **6.793.704** $tCO_2eq.$ (t_2)

Table 29. Relationship between reduced emissions and by Strata for t2 (2005-2025)

Balance t2							
STRATA	**AREA (ha)**	***Sinks* (tCO2)**					
		tCO_2 Aboveground + belowground biomass (tCO2)	**Shrubs CSHRUBS(tCO_2)**	**Deadwood CDW (tCO_2)**	**Leaf litter CLI (tCO_2)**	**COS (tCO_2)**	**Total (tCO_2)**
Low	1.398,7	82.915	39.093	4.975	13.266	958.768	
Steady	2.691,5	325.042	75.229	19.502	52.007		
Middle	1.632,8	278.874	45.638	16.732	44.620		
High	5.952,7	1.368.926	166.382	82.136	219.028		
Upper	7.264,7	2.212.635	203.054	132.758	354.022		
RNA	3.509,8	98.102	0	0	0		
Total	22.450,15	4.366.494	529.396	256.103	682.943	958.768	6.793.704

The accumulated carbon for the 2023-2025 verification period is determined according to the following equation.

$$\Delta C_{ARB} = C_{ARB,t1} - C_{ARB,t2}$$

Table 30. List of removals in t1 (2020-2023).

Balance t1							
STRATA	**AREA (ha)**	***Sinks* (tCO2)**					
		tCO_2 Aboveground + belowground biomass (tCO2)	**Shrubs CSHRUBS(tCO_2)**	**Deadwood CDW (tCO_2)**	**Leaf litter CLI (tCO_2)**	**COS (tCO_2)**	**Total (tCO_2)**
Low	2,154.6	90,918	60,222	5,455	14,547	752.802	

Steady	3,016.1	342,385	84,302	20,543	54,782		
Middle	2,185.2	341,104	61,079	20,466	54,577		
High	6,222.4	1,262,938	173,920	75,776	202,070		
Upper	5,362.0	1,397,714	149,872	83,863	223,634		
RNA	3,100.45	86,660					
Total	22,040.77	3,521,719	529,396	206,104	549,609	752.802	5.559.630

In this way the removals for the current period are determined by:

$$\Delta C_{ARB} = \mathbf{6.793.704 - 5.559.630}$$

$$\Delta C_{ARB\ (2023-2025)} = \mathbf{1.234.074}\ tCO_2$$

16.3 Leakages

These are related to the displacement of activities carried out within the scope of the project to areas outside of it. The project, as conceived, does not foresee the generation of leakage due to the displacement of activities, as it focuses on a land-use change model in areas dedicated to extensive livestock farming, with very low livestock density per hectare. The project region is characterized by large expanses of plains with native and introduced grasses that are continuously burned for renewal, depleting their fertility and promoting soil degradation.

To prevent leakage, the project implements measures such as monitoring land-use changes through periodic satellite imagery analysis and field inspections, which have confirmed that the forested areas established for commercial purposes, as well as those dedicated to passive and active natural regeneration, have been maintained. Additionally, land-use agreements with landowners and the Ministry of Agriculture (through the CIF) ensure that areas converted to forestry are not reverted to livestock use. Since there are no available areas for pastures, it is not possible to replace livestock during this monitoring period or in the future.

It is estimated that the activity does not generate leakage, as the region has the capacity to support the potential displacement of livestock. Likewise, the project owners do not intervene in all areas of the property, allowing for livestock rotation areas as the remaining heads are sold. These livestock are not expected to be replaced in the future

in the project areas, as confirmed through ongoing monitoring and compliance verification with landowners.

16.4 Net GHG Emission Reductions / Removals

Quantify the net GHG emission reductions and removals, summarizing the key results using the table below.

Table 31. Net GHG emission reductions and removals

Year	*Baseline emissions / removals (tCO_2e)*	*Project emissions / removals (tCO_2e)*	*Leakage emissions (tCO_2e)*	*Net GHG emission reductions / removals (tCO_2e)*
2023 (31-01-2023- 31-12-2023)	***0***	544.684	***0***	544.684
2024 (01-01-2024- 31-12-2025)	***0***	591.835	***0***	591.835
2025 (01-01-2025 31-03-2023)	***0***	97.555	***0***	97.555
Total	***0***	**1.234.074**	***0***	**1.234.074**

16.5 Comparison of actual emission reductions with estimates in the project document

Amount achieved during this monitoring period. **(t CO_2e)** **2005-2025**	**The amount estimated ex-ante for this monitoring period in the PDD** **(t CO_2e)** **2005-2025**
6.368.010	**6.793.704**

16.6 Remarks on difference from estimated value in the registered project document

The highland region of the Colombian Orinoquia still has limited communication routes between the center of the country and the region. This situation has meant that thinning and harvesting activities in the forest stands do not comply with the initial management plans. In addition, the high costs of harvesting, transporting and marketing timber are not covered by selling it at current market prices. It can be estimated that only 2% of the areas prepared for harvest have been thinned.

This situation has contributed to the fact that the carbon balances are higher than those projected ex ante, since the harvests have not been carried out and the stands are still growing.

16.7 Permanence and risk management.

The project developed a risk analysis tool, based on the Continuity and Risk Management V1.1 tool, for the components identified in the tool. Values were assigned for the probability of the process occurring and the level of impact it could have on the reversion of the service.

The principal elements assessed according to the tool were:

- Environmental Risk
- Financial Risk
- Social Risk

Impact scores are distributed from 1 to 10 and probability of occurrence from 1 to 3. The combination of these scores for a carbon impact event ranges from 1 to 30 points.

Impacts are classified as low if they are between a value ≤ 5% affected, medium if between >5%-≤10% and high ≥10%.

The analysis carried out showed that the greatest risk is associated with possible fires in the region, due to anthropogenic and cultural processes related to the burning of pastures, which could at some point get out of control and affect the plantations. However, as a mitigation mechanism, the project has an action plan derived from early fire warnings based on IDEAM reports and in coordination with the environmental company. Fire control equipment and qualified personnel are also available.

No fires affecting forest stands were detected and reported during the monitoring period.

In general, the risk balance is classified as low with a value of 4.92%. (See calculation tool).

The project complies with the BCR recommendation to set aside 20% (see below), even though the risk is low.

16.8 Balance of credits for the market

Following the provisions of BCR V3.2, AFOLU projects must reserve 20% of the period reductions as a BUFFER. In this way, net accounting establishes that an availability of **987.259** Verified Carbon Certificates is generated for the period 2023-2025. The distribution of these is presented in the following table

Table 32. Distribution of removals for the years between 2015 and 2023. In 2023, only 4 months are taken, which corresponds to the cut-off of monitoring period 2.

VINTAGE	% year	Buffer (20%)	tCO2 Net (CCV)	Vintage
2023 (31 de January)	44,1%	108.937	435.747	544.684
2024	48,0%	118.367	473.468	591.835
2025 (31 de March)	7,9%	19.511	78.044	97.555
	100,0%	**246.815**	**987.259**	**1.234.074**