PROYECTO DE CARBONO FORESTAL VICHADA ALIANZA FIDUCIARIA S.A.

Document prepared by:

bd Forestales Consultoría

Alianza Fiduciaria S.A.

Project Description Document	
Name of the project	Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A.
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Project Description Document	
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Project Description Document	
Project participants	Alianza Fiduciaria S.A.-Fideicomiso
Version	2.2
Date	18/04/2024
Project type	Scope 14 - Afforestation, Forestation and Other Land Use (AFOLU) Afforestation, Reforestation and Revegetation (ARR)
Grouped project	It is not a grouped project
Applied Methodology	METHODOLOGICAL DOCUMENT. AFOLU SECTOR. BCR0001 Quantification of GHG Emission Reductions. GHG REMOVAL ACTIVITIES. Version 3.0
Project location (City, Region, Country)	La Primavera, Vichada, Colombia
Starting date	01/01/2018
Quantification period of GHG emissions reduction	01/01/2018 - 31/12/2047 (30 years) First monitoring period: 01/01/2018 – 31/12/2019

Project Description Document	
Estimated total and average annual GHG emission reduction amount	During the project life it is expected to be generated a total GHG reductions of 1,001,597 tCO_2 eq. With an average of 33,387 tCO_2 eq./year.
Sustainable Development Goals	SDGs 8, 12, 13 and 15 
Special category, related to co-benefits	N/A

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1 Project type and eligibility

1.1 Scope in the BCR Standard

The scope of the BCR Standard is limited to:	
The following greenhouse gases, included in the Kyoto Protocol: Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O).	
GHG projects using a methodology developed or approved by BioCarbon Standard, applicable to GHG removal activities and REDD+ activities (AFOLU Sector).	
Quantifiable GHG emission reductions and/or removals generated by the implementation of GHG removal activities and/or REDD+ activities (AFOLU Sector).	X
GHG projects using a methodology developed or approved by BioCarbon Standard, applicable to activities in the energy, transportation and waste sectors.	
Quantifiable GHG emission reductions generated by the implementation of activities in the energy, transportation and waste sectors.	

1.1.1 Eligibility

- Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A. is an AFOLU project, that falls into the category of GHG Removal project as the project area is located in an area where the land cover has not been forested for more than 5 years prior to the project start date,
- The project is not located in wetlands areas or on organic soils (see section 3.7.1) and carbon stocks in the baseline scenario are likely decrease or remain stable in the absence of the project (see section 3.3),
- The impact of dewatering is negligible, so greenhouse gas emissions other than CO_2 are omitted (see section 3.2.2) and
- The project does not implement flood irrigation activities or any activity that generates alterations to the soil (see section 2.3).

1.2 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	

1.3 Project scale

N/A

2 General description of the project

The Forest Carbon proposal, represented by Alianza Fiduciaria S.A. as spokesperson for the autonomous Patrimonies trust Galicia y Andalucía, aims to establish a reforestation project with commercial forest species in the municipality of La Primavera (department of Vichada, in the eastern plains of Colombia), which aims, among other objectives, at fixing atmospheric carbon through the growth and development of plantations.

This environmental service contributes to the goals of reducing greenhouse gas emissions at a global level and adds dynamism to the international carbon market and the local market driven by policies for the consumption and combustion of fossil fuels.

The project aims to develop measures to protect the ecosystem and areas of special ecological interest, which for years have been dedicated to extensive grazing, constant mowing and burning of grasslands and savannah areas, which has led to soil degradation in the region. With the purchase of the properties and its legal ownership, extensive cattle grazing on the land was removed and the complete cessation of grassland burning was initiated. Although the region has great agroecological potential, measures need to be developed to improve soil use and farming conditions.

The formulation and implementation of the project proposal faces major challenges, such as the establishment of forestry production systems when environmental supply, road infrastructure, labor and other factors classify the area as having low or no forestry

potential. Therefore, land-use change processes ranging from extensive livestock farming on degraded soils to the establishment of new forests for commercial or natural use require species with special adaptation conditions and with known and experienced technology packages.

The commercial forest specie considered for the development of reforestation actions is *Pinus caribaea*, with an intervention area of 1,641.70 hectares, of the 1,645.85 eligible hectares of properties on which the project is developed. In this area, in accordance with the company's environmental regulations, withdrawals to water sources have been left, allowing the existing gallery forest could be protected, its area increased and coupled with the commercial forest units that form connecting corridors, especially for fauna.

In this way, it is expected that the forest will resemble the native forests of the region in structure and species composition, promoting the movement of fauna between ecosystems and ensuring the protection of environmental services important to the region, such as water, and together with the commercial areas, contributing to improving the chemical and physical conditions of the soil to activate a sustainable agroecology and contribute to the mitigation of global climate change.

Regarding the timeline, the start date of the project initiative is January 01, 2018 (Annex: Section 3 - Quantification of GHG emissions reduction/Start date). It is estimated that the potential of the forestry project for net removals of anthropogenic emissions in the first 30 years of accreditation is in the order of 1,001,597 CO2eq (Annex: Section 3 - Quantification of GHG emissions reduction/ Quantifications).

Within the plantations the production of native shrubs is predominant within the plantations, as they are left there for several years before thinning interventions or final harvests are carried out, making them one of the sinks of biomass area in the stands.

On the other hand, the project contributes to SDGs 8, 12, 13 and 15 through the development of its activities. This takes into account not only benefits to the community of the area and the biodiversity of the area, but also generates GHG removals.

In this way, the generation of income from the environmental service associated with the removal of atmospheric CO_2 as a result of the creation of new forests, contributes to national goals of mitigation of global climate change in the agricultural sector, improves regional environmental conditions, recovers and improves soil conditions to be more productive areas in the future and allows project proponents to assume economic risks by improving cash flows from the sale of the carbon environmental service.

2.1 GHG project name

Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A.

2.2 Objectives

General Objective:

The purpose of this carbon project named Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A. is contribute to the mitigation of climate change through the implementation of activities, contributing to the economic, productive, social and environmental development of the region, providing all documentation and supports attributable to the development and implementation of the project, in compliance with the Biocarbon Standard in accordance with all rules and requirements applied for this type of project (AFOLU).

Specific objectives:

- Establishment of *P. caribaea* as a commercial forest as a climate activity in the region with the planting of 1,641.70 hectares of forests.
- Contribute to the climate change mitigation goals at the sectoral level, adopted by the national government at the meetings of the Parties to the Executive Board on Climate Change.
- Develop measures aimed at removing greenhouse gasses (GHG), expressed in tCO2eq, through the creation of new forests on degraded soils.
- Certify the atmospheric carbon removal actions (tCO2eq.) of plantations and new forests, under internationally recognized certification standard Biocarbon.
- Creation of direct and indirect jobs, mechanization of the workforce in the region, development of a productive and social infrastructure that can serve as a framework for other projects.

2.3 Project activities

2.3.1 Proposed stand models for the project

The following is a description of each stand model and some specific activities.

2.3.1.1 Commercial stand model

The commercial model will be established in areas that are currently in abandoned pastures and managed pastures where extensive cattle ranching activities were carried out. Due to these conditions and the need to generate a transition area between pasture

and forest areas, it is proposed to carry out monospecific commercial plantations with the species: *Pinus caribaea*, in the current project proposal.

One of the objectives of the commercial model is to promote the ecological restoration of the surrounding areas by generating connectivity between native forest fragments, being a safe transit area for seed dispersers such as birds, rodents and mammals, and contributing to the protection of the fauna biodiversity.

2.3.2 Species

The selection of species for the establishment of forest plantations in the project proposal was based on the evaluation of the biophysical properties of the region and knowledge of its technological packages (Trujillo E. , 2011). It should also be noted that they have traditionally been used for reforestation in Colombia, specifically in the Colombian Orinoco region (CONIF, 1998, page. 48). The commercial model will use *P. caribaea*, of which 1,641.70 hectares will be established.

- ***Pinus caribaea Morelet***: the species is very well adapted to natural regeneration management and is the only tropical pine that grows naturally at low elevations. Also, because of its ability to grow in virtually any type of soil, it is one of the most widely planted pine species worldwide. It is used in pure plantations, along boundaries, windbreaks, for erosion control, and reclamation of watersheds and degraded sites. This pine is widely grown in plantations throughout the humid tropics (CATIE, Rojas Rodríguez, & Ortiz Malavasi, 1991; USDA, 2014). This pine is used for the production of resins and sawtimber. There is an estimated need for a total annual volume of 220,000 m3 transformed for the production of tongue-and-groove boards, planks, furniture and carpentry to cover the demand in the departments of Casanare, Meta, Santander and the city of Bogota. In the Orinoquia, Caribbean pine grows in soils that are not very fertile, with good drainage in piedmont areas; it generally does not grow on soils with poor drainage or with a hard, impermeable layer; it grows in sandy soils with good drainage, acid pH that varies from 4.3 to 6.5; it resists saline, clayey and heavy soils (Figure 1).

Figure 1 - Pinus caribaea Morelet

The ecological characteristics of each species (e.g., environmental, and edaphic requirements) necessary for them to establish favorably particular location are described in Table 1. These conditions of ecological and environmental supply are specific to the Colombian Orinoquia.

Table 1 - General description of the main commercial forestry species selected in the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A.

SCIENTIFIC NAME	CLIMATIC CONDITIONS						
	Common Name	Altitude Masl	Temp °C	Precipitation Mm (Annual)	Relative Humidity	Life Zone	Humidity Province
Pinus Caribaea	Pino Caribe	0 - 1500	22 - 26	600 - 3500	High	bs-PM, bmh-PM, bh-PM	dry, humid, very humid
	PHYSIOGRAPHIC CONDITIONS						
	Slope %			Topography			
	10 - 25			Undulated			
	SOIL CONDITIONS						
	Drainage	Texture	Ph	Fertility		Depth Soils	
	Good	A-Ar	Nearly neutral	Low fertile			

2.3.3 *Technologies applied for the Establishment of Forest Stands*

It should be noted that the establishment and forest management activities of commercial stands, as well as the areas of natural regeneration, are in accordance with the regulations of the regional environmental authority CORPORINOQUIA. The areas with the implementation of natural regeneration models will be exclusively for conservation and natural recovery in transition areas of gallery forests and plantations, which has been essential to structure more comprehensive proposals related to water resource conservation, recovery of degraded areas and promotion of biological corridors in the territory.

Now, within the procedures for the implementation of the commercial model, the following requirements have been established: soil preparation, nursery production, plantation establishment, weed control, fertilization and pruning regimes, thinning and harvesting. These will be applied in a similar manner in the planting of the two commercial species. However, the specific procedures for each of the species involved are detailed in the annex: Section 2 - General description of the project/Project activities/ Forest Establishment and Management Plans. The following is a brief description of the activities proposed for the implementation of the project.

2.3.3.1 *Nursery*

The plant material for planting will be produced in a temporary nursery that will be installed for this purpose on each farm that makes up the project (Figure 2). The best quality seed will be used, and the seedlings will be produced in tubular bags (without bottom) 40 mm in diameter and 12 centimeters high, with good resistance and root formation. Seeds for commercial species will come from certified suppliers such as El Semillero S.A.S. and Refocosta[1], the main suppliers of certified seed in the country.

[1] https://www.refocosta.com/

Figure 2 - Forest nursery of Pinus caribaea species.

2.3.3.2 *Plantation establishment*

Planting will be carried out during the months of April, May, June, July, August, and September, which coincide with the months with the highest rainfall in the region. The technical specifications include the following:

- Planting density: the planting density will be 1,040 trees per ha. Spaced at 3.1 x 3.1 m in a square.
- Design of the plantation: it will be of stands according to the pastures in the highlands, without including lowlands[2].

[2] Lowlands: areas with periodic flooding that limits root development of the proposed commercial species.

- Land preparation: Initially, weeds will be cleared, and tall grasses will be cut with cutting discs supported by tractors. Then it will be done with machinery, with a tractor passing through with a chisel (5-8 cm wide) for subsoiling (Figure 3). This chiseling practice prevents soil disturbance, compared to traditional plowing, which completely overturns the soil. It has been demonstrated that this practice promotes soil and water conservation, improving their physical properties without affecting their chemical conditions[3] (Amézquita, Rao, Rivera, Corrales , & Bernal , 2013). This process justifies the non-generation of emissions or significant alteration to the soil carbon pool.

Chiseling of soils in the Orinoquia.

The solution found to manage these soils, in order to make them productive and sustainable, was to develop an arable layer in them by vertical tillage (with chisels) to correct certain physical conditions, add lime and fertilizers to amend their chemical conditions and plant in them, as pasture components, forage species and improved cultivated species that are adapted to these soil conditions. In this way, the added fertilizer and amendments promote vigorous growth of grass roots in the pasture, which increase the fixation of atmospheric carbon (by 'sequestration') in the deep soil layers, as well as reduce nitrification and the emission of nitrous oxides from the soil, boost soil biological activity and stabilize the soil's physical structure. If farmers develop the idea of establishing an arable layer and combine this soil management technology, either with cultivars of forage species and crops adapted to acid soils in agropastoral systems or with tree components in silvopastoral systems, they (farmers) will have the tools and technology to transform the Colombian savannas, thus increasing agricultural productivity and mitigating climate change.

Source: *Agropastoral systems: An integrated approach for the sustainable management of Oxisols of the Eastern Plains of Colombia Amezquita et al (2013).*

[3] http://www.fao.org/3/ar804s/ar804s.pdf

Figure 3 - General presentation of chisel plowing in the preparation of soils prior to sowing.

- Simultaneously with this operation, soil acidity correctives will be applied with Dolomitic Lime and calphus amendments.
- Tracing: The planting will be carried out with polypropylene ropes in a west-east direction, maintaining 3.1 m wide alleys and distances between rows of 3.1 m (Figure 4), for a total of 1,040 trees per hectare.

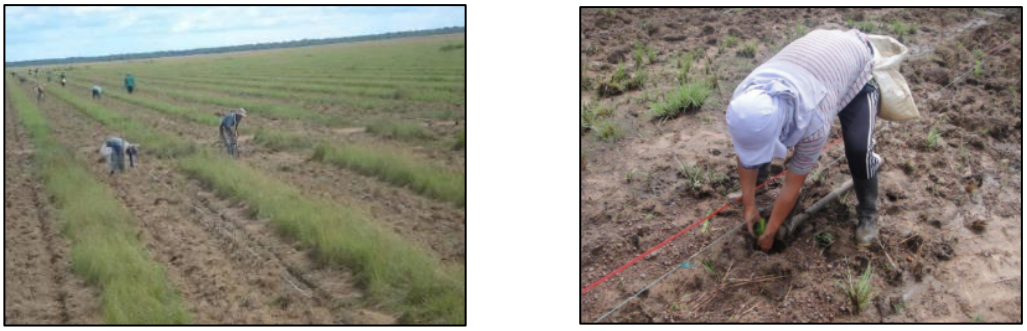


Figure 4 - Tracing and manual planting of seedlings.

- Planting: it will be done by removing the bag without crumbling the soil loaf and performing a slight root pruning. The feet should be pressed around the tree to avoid air pockets in the hole.
- Fertilization: Fertilization should be carried out immediately after planting by applying 100 g per tree of a mixture prepared with N, P, K, S and B (10-17-20/5-6-0.2), 40 g of Dap, 40 g of Sulfomag and 10 g of 48% Borax per tree, that is, 41.6 kg per hectare of each of the first two products and 1.04 kg per hectare of Borax. The application of other elements may be considered if necessary, and according to nutritional monitoring (visual observations and analysis of foliar plant tissue) of the plantation, the required nutrients will be supplied.
- Phytosanitary control: Intensive sanitary control (manual, chemical and cultural) will be carried out for the army ant. Generally, insecticides are applied with a

thermal fogger according to the product's instructions, at the mouths and streets of the ant nests (Figure 5) or by means of baits (oats + orange juice, etc.) impregnated with insecticide. These actions will be complemented with the necessary controls within an integrated pest and disease management (IPM) program that includes monitoring and timely reporting. An internal training plan for technicians and operators, led by the project's technical director, is included.

Figure 5 - Phytosanitary control

- Fire control: the commercial lots, which generally have an area of 11 hectares, will be surrounded by firebreak lines composed of roads and pipes. This type of corridors will not only be implemented in the areas of the commercial stands, but also in the areas adjacent to natural forests, water source protection zones, as well as passive natural regeneration zones (Figure 6).

Figure 6 - Barriers or firebreak lines within commercial stands and in areas adjacent to passive natural regeneration.

Although firebreaks are cleaned during the dry season, personnel must be trained to monitor and control firebreaks during high-risk periods with the appropriate equipment and tools for these tasks, such as back pumps, fire beaters, shovels, machinery, and other

alternatives. For this purpose, a control pump was purchased for the project. In addition, emphasis is placed on the implementation of a program of prevention and control of forest fires, which includes training for members of the forestry brigade and preventive forestry techniques that will be integrated in all nearby production centers and in coordination with local institutions (fire department, environmental society, mayor's office).

2.3.4 Planting plan

For the commercial stand model, the areas were established according to the following planting plan.

Table 2 - Planting plan by species and stand model.

Year	Area (ha) by stand model and species	
	Pinus caribaea	%
2015	1,053.20	64.2%
2016	440.50	26.8%
2017	148.00	9.0%
2018	0.00	0.0%
2019	0.00	0.0%
2020	0.00	0.0%
2021	0.00	0.0%
2022	0.00	0.0%
2023	0.00	0.0%
2024	0.00	0.0%
2025	0.00	0.0%
2026	**1,641.70**	**100%**

2.3.5 Forestry management plan (planting system, fertilizer use, forestry shifts, among others).

The management plans were submitted to qualify for the CIF in 2014, with implementation in 2015 as stated in the CIF 120 contract of 2015. (Section 2 - General description of the project/Project activities/Forest Records). On the other hand, activities related to pruning will only be carried out on species that do not have natural pruning.

As for thinning, this is related to the gradual reduction of the density of trees per hectare, which aims to have trees with larger diameters and greater commercial value at the end of the shift. Gradual reductions are planned, thinning 25% of the remaining trees. A total final density of 439 trees per hectare is expected (Table 3), depending on soil quality and stand development.

Table 3 - Thinning projection for the commercial stand model.

-	Remaining (trees/ha.)	Interstage (trees/ha.)	% of interstage and final harvest
Initial density	1040	-	-
Interstage 1	780	260	25%
Interstage 2	585	195	25%
Interstage 3	439	146	25%
Final turn	-	**439**	**100%**

However, these thinning will depend on the development and survival in the stands, which will be redefined according to the results of the technical evaluations (Table 4).

Weed and shrub control within the stands is developed in the first years of management to reduce competition for nutrients, water, and light from the trees with these shrubs. It is expected that in year five no clearing of the stands will be required until thinning or final harvesting activities.

Table 4 - Silvicultural activities plan for commercial stands for an 18-year management shift (based on a first stand with planting in 2015).

GROWTH CYCLE CHRONOGRAM (18 YEARS) *Pinus caribaea* year 2015																		
	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
LABOR / YEAR	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Adequacy and planting																		
Fertilization																		
Weed control																		
Sanitary control																		
Reseeding																		
Pruning																		
Interstage*																		
Fire Control																		
Administration and surveillance																		
Technical assistance																		
Harvests																		

**Interstage will be subject to the development of the stands, and the degree of mortality that the stands may present. If a stand, due to mortality causes, reaches its self-regulation in density, the activities may be redefined, up to two thinning and varying its % of intervention.*

2.4 Project location

The project is located in the municipality of La Primavera (5°29'26 "N - 70°24'33 "W), in the department of Vichada in eastern Colombia (Figure 7), bordering Venezuela. Its distance from the country's capital, Bogotá, is close to 556 km.

The locations for the lots that are part of the project proposal are shown in Table 5 (see KML files in the annex: Section 2 - General description of the project\Location).

Table 5 – Coordinates of the properties where the project is located

Name	Point Center		Eligible Area (ha)[4]
	Latitude	Longitude	
Andalucía	5° 22' 44,966" N	69° 46' 32,373" W	818.91
Galicia	5° 23' 28,807" N	69° 45' 23,290" W	826.94
Total			*1,645.85*

[4] See annex: Section 1 - Project type and elegibility/Elegibility/Análisis de elegibilidad Alianza.docx

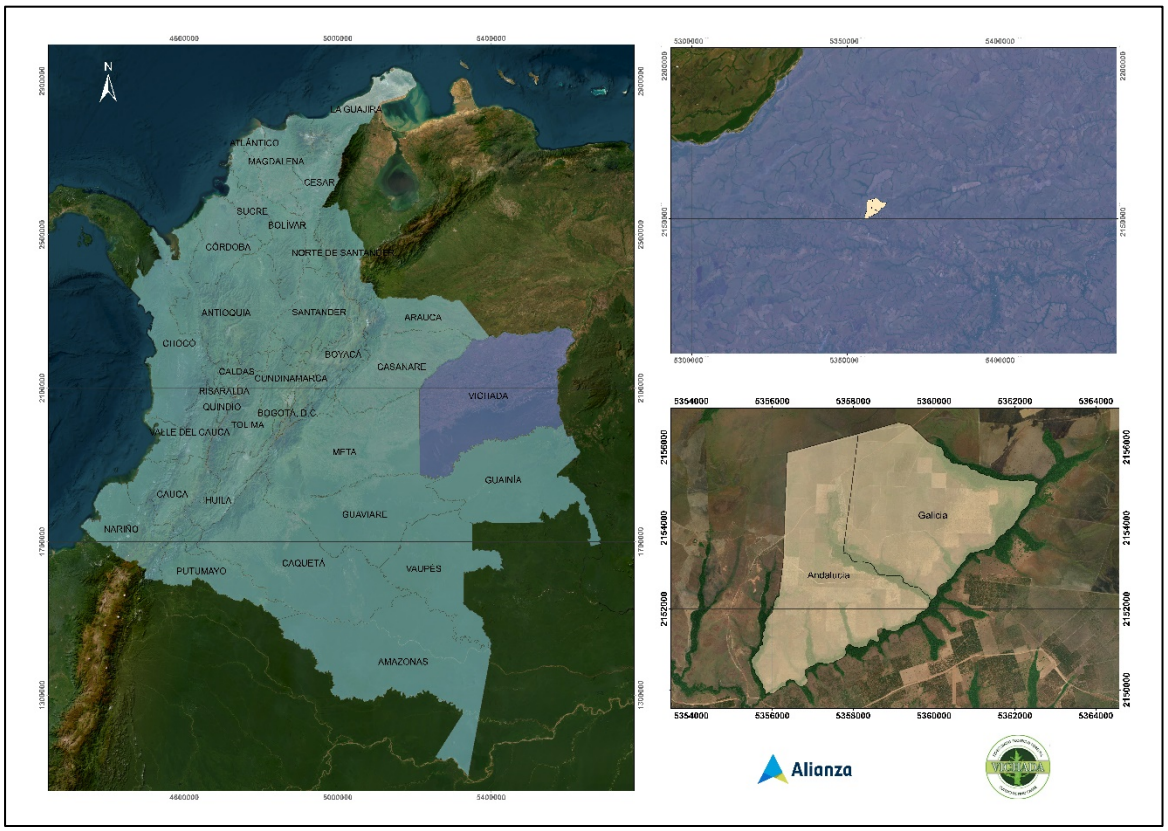


Figure 7 General location of the project Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A.

2.5 Additional information about the GHG Project

There is not relevant any additional information.

3 Quantification of GHG emissions reduction

3.1 Quantification methodology

Following the instructions of the BCR Program, the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A. applies methodological document "*BCR0001 quantification of GHG Emission Reductions GHG Removal Activities*" v3.0.

3.1.1 Applicability conditions of the methodology

Table 6 – Compliance of the project with applicability conditions of the BCR001

Condition	Applicability
a) The areas within the project boundary must not correspond to the category of forest (according to the definition adopted by the country in which the project activity is proposed), nor to natural vegetation other than forest, neither at the beginning of the project activities nor five years before the project start date.	The areas to be reforested do not meet the forest condition established by the national government (see section 3.7.1).
b) The areas within the project boundary must not be under wetland category.	This condition is applicable, since the areas to be reforested do not link wetlands, flooded lands or lands susceptible to flooding (see section 3.7.1).
c) The areas at the project boundary must not contain organic soils.	The soils in which the project activities will be implemented do not consider organic soils. The project area is dominated by *Typic haplustox isohyperthermic, kaolinitic soils*, with a high presence of iron oxides, giving the special characteristics of Oxisols. These soils are poor in organic matter, and because of the inadequate use of the soils under baseline conditions (extensive cattle ranching without pasture management or improvement), the soils in the project area have serious restrictions for agricultural use, due to their high susceptibility to degradation (Amezquita, 1999). Degradation is understood as the loss of some physical, chemical and biological qualities of the soil due to poor human intervention, which become negative production factors and, in the future, will affect agricultural sustainability. Finally, these pastures did not present management or external nutritional inputs; on the contrary, they were subjected to periodic burning processes for years, so that the grass shoots would grow and be more edible or digestible for livestock. Based on the above, the applicability condition is met.
d) Carbon stocks in soil organic matter, litter and dead wood decrease or remain stable, in	The baseline as described are areas dedicated to the production of unmanaged pastures,

Condition	Applicability
the absence of project activities, i.e., relative to the baseline scenario.	which are periodically subjected to burning. According to the (Intergovernmental Panel on Climate Change (IPCC), 2003) guidelines, an area that is subject to periodic slash and burns is considered to have a baseline of zero (0), so that soil, litter and dead wood stocks remain stable at zero (0).
e) Flood irrigation is not used.	The project does not implement flood irrigation; the proposed species do not support this type of conditions.
f) The effects of drainage are negligible, so that GHG emissions, other than CO_2, can be omitted.	In the project area effects of drainage are negligible, so that GHG emissions, other than CO_2, can be omitted, as shows the carbon pools and sources included (section 3.2.2).
g) Soil disturbance due to project activities, if any, is carried out following appropriate soil conservation practices and has not been repeated in less than 20 years.	Soil alterations are minimal, as explained in item c, and these are aimed at soil creation and conservation. The established areas stand out for being degraded soils due to the historical burns to which they have been subjected for the annual renewal of pastures, depleting the organic layer.

3.1.2 Methodology deviations

Not applicable since there is not methodology deviations.

3.2 Project boundaries, sources and GHGs

3.2.1 Spatial limits of the project

The areas where the project is being developed correspond to two properties, Andalucia and Galicia, located in the municipality of La Primavera in the department of Vichada, with an area of 1,300.99 ha and 1,223.66 ha respectively (total 2,524.65 ha).

Within the properties, a multitemporal analysis was used to determine the areas that meet the requirements of the standard and are therefore eligible. This area corresponds to 826.94 ha in Galicia and 818.91 ha, for a total of 1,645.85 eligible hectares. Of this eligible area, a total of 1,641.70 hectares was planted, which corresponds to the value of the project area.

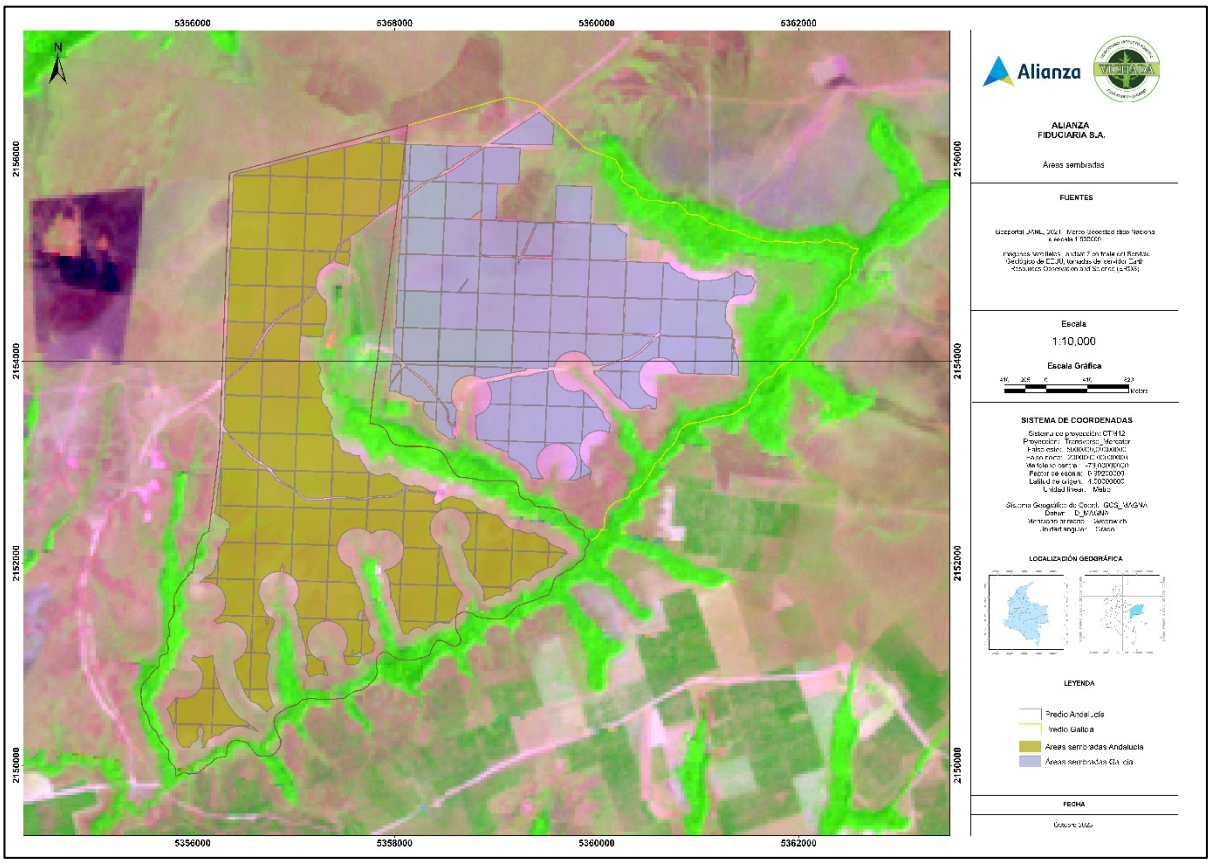


Figure 8 - Location of the properties of the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A., Andalucía and Galicia properties.

3.2.2 *Carbon reservoirs and GHG sources*

Table 7 - Sources of GHG emissions from project implementation

Source or reservoir	GHG	Included (Yes/No/Optional)	Justification
Burning woody biomass	CO_2	No	Emissions from biomass burning are accounted for 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 burning of woody biomass as part of forest management, the project complies with national regulations that restrict the use of controlled burns as part of agricultural soil management (DECREE NUMBER 4296 OF 2004). According to this decree, this activity is sanctioned by the regional autonomous corporations. Therefore, the burns and their potential emissions are **not** considered in the project activity.

On the other hand, for the accounting of reduced emissions balances, the methodology considers the following carbon reservoirs or sinks.

Table 8 – GHG reservoirs from project implementation

GHG reservoirs	Selection by methodology	Justification	Consideration for project
Aboveground biomass	Yes	It is the largest carbon pool in the project proposal.	YES, because it is the main carbon reservoir in soil change activities in the transformation from pasture to forest.
Belowground biomass	Yes	Carbon contents are expected to increase with the implementation of the project.	YES, it is accepted because with the project proposal the carbon content will be higher than those defined in the baseline.
Biomass in dead wood, litter and soil organic carbon.	Optional	Carbon contents may increase with project activity.	YES, the areas to be intervened (unmanaged pastures) do not have significant leaf litter or dead wood on the soil surface due to the periodic burning actions, eliminating the possibility of organic matter accumulation (Figure 9). Likewise, soil organic matter is extremely low or non-existent in some areas, which is why the project proposal will increase this reservoir (Figure 10).

Figure 9 - Comparison in the presence of litter on the soil between the baseline activity (left) pastures with periodic burning and the project activity (right) presence of needle and debris cover on the soil in plots of Caribbean pine.

Figure 10 - Comparison between the organic matter content in the baseline soil (unmanaged pastures, on Oxisols) A and B, versus the higher organic matter content in the first soil horizons of the plantations (evidence of soil in pine areas).

3.2.3 Time limits and analysis periods

3.2.3.1 Project start date.

The Project start date is January 01, 2018, in which the contract was signed for technical assistance in the maintenance work of the project (Annex: Section 3 - Quantification of GHG emissions reduction/Start date/ CONTRATO ASISTENCIA TECNICA AM.pdf).

The date of the contract with the AENOR auditing body supports compliance with section 10.4 of the standard, in the requirement related to the period of maximum 5 years that must exist between the start date of the project and the beginning of validation. The contract supports the commercial agreement signed with the OEC, which begins the validation process. Therefore, the start date of the project in 2018 is defined within the 5 years prior to the start of validation. (Annex: Section 3 - Quantification of GHG emissions reduction/Start date/AENOR).

It is important to clarify that sowing began in 2015, so these data are considered when making the calculations, however, the removals associated with the project, both ex ante and ex post, are taken into account starting in 2018.

3.2.3.2 Quantification period of GHG emission reductions

The time period for quantification of GHG emission removals is: January 01, 2018 - December 31, 2045 (30 years).

3.2.3.3 Monitoring periods

The first monitoring period is from January 01, 2018, to December 31, 2019.

3.3 Identification and description of the baseline or reference scenario

For the project area, and in principle for reforestation/afforestation activities, the Colombian Orinoquia does not have an official baseline, so it is necessary to reconstruct it.

With the application of the tool "*Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities*", this baseline will be defined for the project area.

3.3.1 Step 0 – Project start date.

The Project start date is January 01, 2018 (see section 3.2.3.1).

3.3.2 Step 1 - Identification of alternative land-use scenarios

The baseline approach was developed under the BCR0001 methodology (which is adapted from CDM Modalities and Procedures); it states that the actual variations with carbon pools within the project are the same as would have occurred due to historical land use. The baseline represents the continuation of economic activities that have occurred historically, exist today, and are unlikely to change in the absence of the project activity.

3.3.2.1 Sub-step 1a. Identification of probable land use alternatives in the project areas

Characterization and general information on possible land uses.

Conditions in the base scenario areas are homogeneous. At the beginning of the project activity, the vegetation cover is grasslands and eroded soils, where extensive cattle grazing has been the common land use historically in the project area (Municipal Mayor's Office of La Primavera, 2000). No other activities other than those already

mentioned have been identified. Therefore, there is only one stratum in the baseline scenario: pasture.

Extensive cattle ranching based on regular anthropogenic burning of pastures has been the dominant land use model for more than a century, where the culture and tradition of periodic burning to renew pastures is carried out in the summer without due control and regardless of the fact that it is prohibited (Municipal Mayor's Office of La Primavera, 2000, pág. 73). As a result of the remoteness, lack of infrastructure and high transportation costs for other agricultural products, this productive system has dominated land use in more than 90% of the productive land in the municipality of La Primavera (Municipal Mayor's Office of La Primavera, 2000, pág. 137). This extensive practice results in an average of 10 hectares per large livestock unit.

As defined by (Trillos Gualteros, 2010), cattle ranching is the basis of the economy of the department of Vichada and especially of the municipality of La Primavera. One explanation for this condition is the traditional way in which it is developed, extensively in herds - estates, with low production costs. The technologies used for livestock raising are old in most cases and in a high percentage of the land in the plains. It is estimated that 90% of the land in La Primavera is dedicated to extensive, non-technified cattle ranching. The same author highlights how only 2% of the municipality's soils are being exploited for agricultural activities, many of which are located in the valleys of the Meta River, which is more than 60 km from the project area.

As indicated in the previous sections, in the project activity area, land has historically been dedicated to extensive cattle ranching based on regular burning of pastures. This trend has been expanding between 2001 and 2008, the Colombian Orinoquia increased by more than 1.5 million hectares of pastureland for extensive cattle ranching (Viloria, 2009, pág. 54). In addition to this, soil quality limitations and the lack of adequate land access roads have limited the development of other agricultural activities in the territory, making extensive cattle ranching, managed in an artisanal manner on degraded soils (see section 8.1.1.6), the most likely land use activity.

This activity generally lacks adequate technological packages, which generates high pressure on pastures, the only sources of food and energy available for livestock. It leads to soil erosion and compaction, and the introduction of non-native grasses for cattle grazing leads to loss of biodiversity and land degradation. As a result, it is reported that in some areas there is a loss of natural regeneration capacity of the region's native flora.

Regarding the characterization of this baseline scenario, which corresponds to pastures degraded by extensive cattle grazing and regular anthropogenic burning of pasture, the dominant plant species are recognized as herbaceous, grasses, sedges and *xyrydaceous*,

among which are: *Aristida sp*. *Axonopus purpusii, Axonopus fissifolius, Digitaria decumbens, Eragrostis maypurensis, Panicum sp., Paspalum sp. Trachypogon plumosus*, among others.

In general, government policies and incentives for reforestation have been very limited. Agriculture, cultivation, and cattle ranching have been promoted by policies and programs (AGROCARDENAS, 2005, pág. 17), but not commercial forestry. Restoration of natural forests has been promoted by policies, but not economically or financially supported or structured.

Forestal plantation:

At the national level, prior to the project start date, there have been many laws and regulations related to the forestry sector, mostly conservation oriented, but not enough to encourage large-scale commercial forestry. A national forestry policy was adopted by the national planning document (Minambiente-DNP, 1996) to be developed within the framework of the Environmental Policy. Given that the policy at that time was strictly conservationist, the forest industry has expressed the need to update it and give more attention and guidelines to commercial forestry as a means for sustainable rural development and to combat poverty, especially in these isolated regions of the Orinoquia. In addition, (Acosta Contreras, 2004) argues that in the early 2000s the state lacked a policy to clearly govern commercial forestry activities, especially the rules governing private investors. In 2000, a more productive approach was adopted under the National Forestry Development Plan. To implement this plan, some limited resources were available to improve the competitiveness of the productive forest through research and development, but no funds were allocated for reforestation activities.

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

Commercial reforestation activity is incipient and marginal in the department of Vichada, where only 0.1% of the land is dedicated to this activity and it is concentrated in the municipalities that are closest to the interior of the country, i.e. Santa Rosalía and the western part of Cumaribo.

In view of the above, and due to the long rotation periods of forest plantations (more than 15 years), investments in the forestry sector can be put on hold while infrastructure conditions improve and can be supported temporarily by the relief that the CIF gives to forestry project developers, a situation that would not support agricultural crops with short production cycles and which are generally perishable.

Regarding alternative productive activities in the project region, section 3.4 develops an analysis of aspects related to land suitability, investment and cultural barriers that justify the maintenance of pastures as the predominant cover.

Agriculture

In the case of agricultural crops, although the soils have fertility limitations, low organic matter content, low availability of nutrients and low capacity to retain them, and associated with poor physical conditions, this makes agricultural production costs high. and unprofitable, (MinCiencia, Findeter, FND, 2019) mentions the main sector of Vichada's economic activity, according to its participation in the departmental GDP, are public administration and defense activities with 35.0%, followed by agriculture, livestock, hunting and forestry with 32.69% and commerce with 10.2%. On the other hand, small plots (*conucos*) for subsistence agriculture and other traditional crops such as cocoa and sugar cane have traditionally been exploited by farmers and indigenous groups. These often deforest gallery forests with inadequate land management practices (CORPOGUAVIO, 2016). Alluvial soils near larger rivers, although regularly flooded, are used selectively for crops such as corn, bananas, cocoa, sugar cane, rubber, pineapple, fruits, and oil palm.

Likewise, (Rodríguez Rodríguez, 2022) mentions that agriculture in the department of Vichada focuses on the harvest of: cereals such as yellow corn (with a planted area in 2014 of 18,897 hectares), rice, soybeans, etc., sugar cane (planted area: 93 hectares with a percentage share in national production of 0.03%), banana, cassava, cashew (which is very important in relation to all the products that can be obtained from it), cocoa beans, cotton and timber trees. Regarding this production and more specifically, in relation to rice production, it should be noted that the massive adoption program of AMTEC technology led by the National Rice Fund (FEDEARROZ) has been working with the department for several years.

Analysis of land use alternatives from the point of view of financial investment.

In the municipalities of Vichada, and particularly in La Primavera, extensive cattle ranching predominates in natural savannas (herds or ranches, or cattle ranching). This type of cattle ranching has historically adapted to the conditions of the regional

ecosystems. Due to its rusticity and poor management in improved pastures, its productivity is low, and due to the lack of road infrastructure, transportation costs to trade centers are high, making its profitability low (Bernal Adan, 2010). Among the possible agricultural products that could be established in the area are rice, corn and soybeans, as traditional activities (Corporación Latinoamericana Misión Rural, 2012). A comparison of profitability for the possible land uses, related to the historical use of extensive cattle ranching, in addition to dry rice, corn and soybeans, shows that the NPV of the project proposal is 50% higher than these productive alternatives, with improvement of the activities. Although these reference values are from 2005, for the start date of the project (INCODER, 2012), the value would still be similar, given that the conditions of road, service and industrial infrastructure in the region have not changed.

Table 9 - Income scenarios for alternative activities in productive land use. Scenario for productive activities in a first production cycle.

Productive activity	VPN/(ha)	Source
Corn current technology	-$ 155,592.8	(CORPOICA, 2005)
Corn with improved seed	$ 232,844.5	
Dryland rice Current technology	$ 449,549	
Dryland rice direct seeding	$ 1,704,398	
Improved seed dry rice	$ 641,006	
Soybean Current technology	$ 972.032	
Improved soybeans	$ 1,426,494	
Cattle breeding Current technology	$ 482.083	
Cattle breeding use of forage alternatives for pasture grazing and range nutrition	$ 1,358,857	
Forestry project proposal including carbon certificates	$3,359,169	Present proposal (see financial flow [5]).

Another study developed in 2005 by the Colombian Agricultural Research Corporation (Quijano Rodríguez & Álvarez de León, 2007) developed a new cash flow analysis under combined scenarios of potential products for the Upper Orinoquía region. The most viable products considered in this study were corn, soybeans, rice, pineapple, cashew, timber products such as eucalyptus, rubber, and cattle.

[5] Annex: Section 3 - Quantification of GHG emissions reduction/Additionality/Financial Data

Table 10 – VPN of the activities of the identified scenarios

Product	VPN ($ COL)	Internal rate of return	Revenue generator
Corn	$ 8,237,490.3	7.1 %	Possible
Soybean	$ 2,711433.0	6.2 %	Non-generator
Rice	$ 6,485,636.9	6.8 %	Non-generator
Eucalyptus	$ 4,909,302.3	6.8 %	Possible
Rubber	$ 4,909,302.3	3.2 %	Non-generator, possible losses
Marañon	$ 1,026430.4	8.5 %	Possible
Pineapple	$ 88,493,667.1	6.2 %	Possible
Cattle	$ 117,769,223.0	6.3 %	Potential generator

The combination between the NPV and the internal rate of return shows the viability of profitability for investment in the agricultural sector of potential products for the highland region. In this context, although some of the products can eventually generate income, they continue to have limitations regarding the road infrastructure conditions for their positioning in markets beyond the high plains, making them not attractive for investment. For their part, timber, with the exception of rubber, is considered a long-term income generator and an important source of employment (it is estimated that 11 hectares can provide 1 direct job and a few indirect jobs). The process of estimating the potential financial viability, when estimating each of the crop alternatives, it is observed that there is a better development of the variables immersed in the process of estimating the potential financial viability of cashew-pineapple crops. (mixed), corn-rice (mixed) and cattle, notwithstanding pineapple and cashew, continue to present restrictions as an agricultural activity since the limitations of mobility and preservation (perishable products) mean that the risk of product loss is high.

Without a doubt, the activity that continues to generate the best profitability performance is the bovine chain, that is, the continuation of the savannah areas dedicated to grazing.

Outcome of Sub-step 1a

Based on the above supports, the most possible land use in the proposed project areas would remain grasslands on soils degraded to support **extensive livestock** systems. Likewise, as demonstrated by the department's GDP and the information presented above, **agricultural activity** turns out to be another plausible scenario. Finally, the other viable alternative activity, thanks to the financial support of the government, the

incipient developments for the first decade of the 2000s and the long production cycles, **forestry activity** would be a second alternative land use.

3.3.2.2 Sub-step 1b. Consistency of land use alternatives with applicable laws and regulations

In the alternatives identified in step 1a, the only conditions that would limit the development of the identified activities would be regarding territorial planning and land use.

According to the studies developed by INCODER, regarding the economic, environmental and land tenure characterization, Figure 11 shows how agricultural activities are consistent with the vocation of the land in the project area and the projections of the Colombian agricultural frontier.

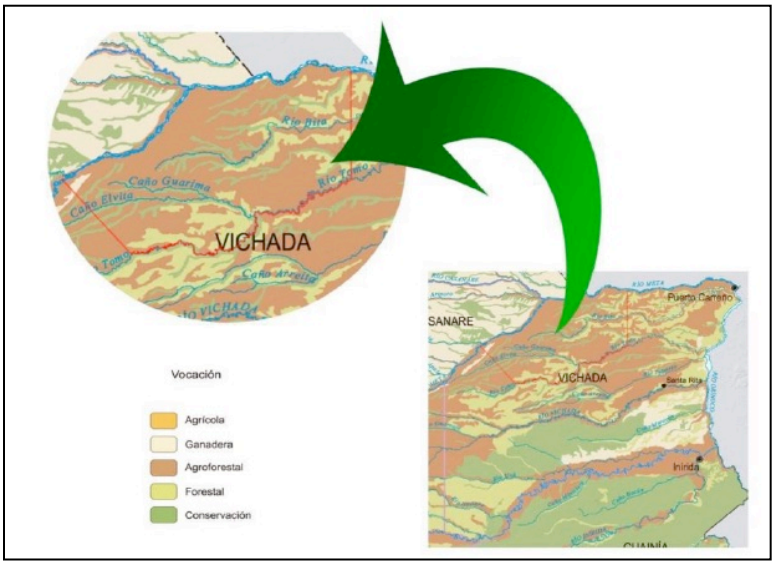


Figure 11 - Vocation of the land in the municipality of La Primavera, Vichada (INCODER, 2012)

Likewise, the legal regulations, especially the activity of livestock farming due to its historical and cultural activity, and the suitability of the soil (Figure 13), do not show legal restrictions or regulations for its development.

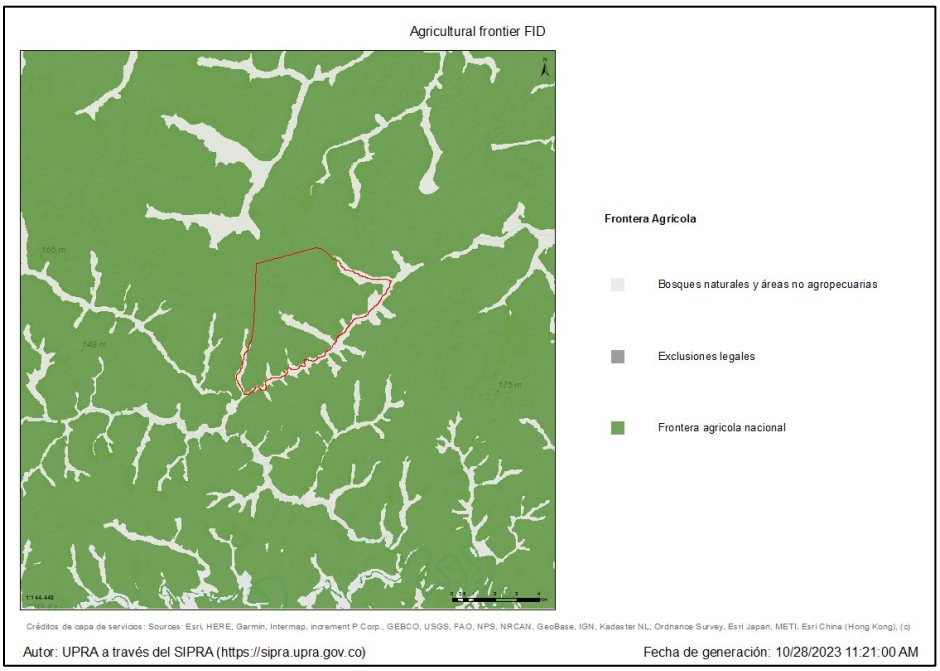


Figure 12 - National soil planning, determination of the agricultural frontier and legal exclusion zones (SIPRA, 2023)

For forestry activity, the territorial planning scheme of the municipality of La Primavera identifies Urban zones as those that delimit the urban perimeter zone associated with the provision of public services. Likewise, the projected urban expansion zone is framed within this area, which is defined by three subzones, determined by distances between 350 meters to 1000 linear meters from the urban perimeters identified in the year 2000. The project areas, at being more than 80 kilometers away from these areas of urban expansion, they comply with the delimitation for agricultural activities in rural areas (Art. 53, territorial planning scheme, 2000). However, the same scheme determines certain restrictions on use associated with risk zoning and natural threats, for which any rural productive project must request certification for use before the respective municipal and environmental entities Art. 52 (UMATA, Secretary of Agriculture, CORPORINIQUIA).

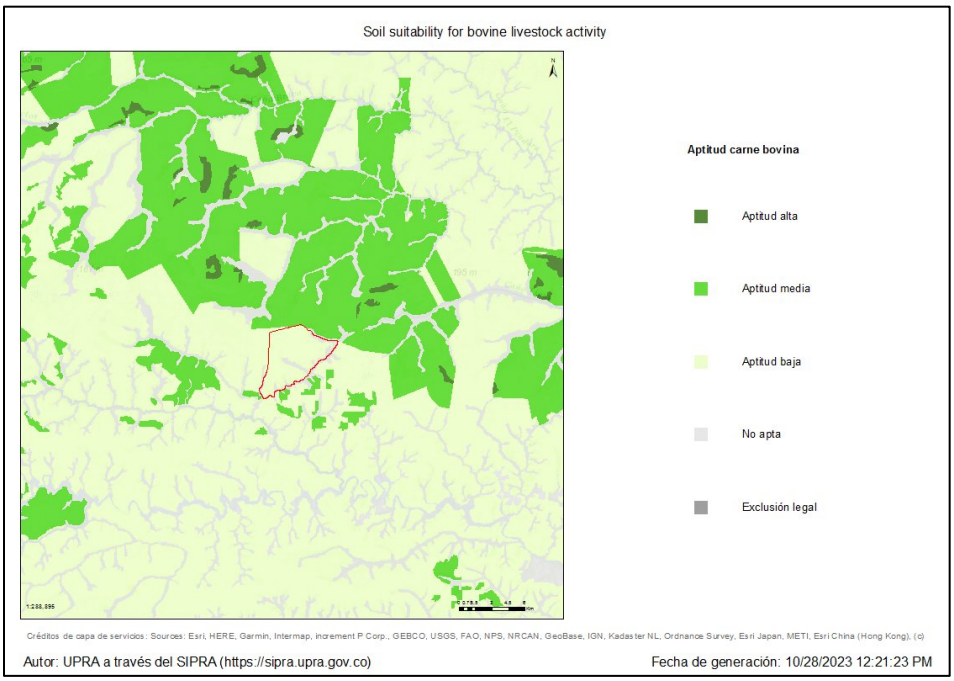


Figure 13 - Soil suitability for bovine livestock activity (SIPRA, 2023)

Article 52 of the La Primavera territorial planning scheme (2000) also refers that the land will be used and occupied according to its original, agrological and potential vocation. For forestry activity, UPRA has identified forestry vocation in the Vichada region as suitable, but with limitations regarding environmental and soil supply. But it does not present restrictions on legal conditions. Like agricultural and livestock activities, forestry activity must obtain the appropriate permits for its development in accordance with art 52, but it has no legal limitations for its establishment. As evidence of compliance with the law for forestry activity, the certification of land use for the forestry project is supported (13082018-CTD0267, Secretary of Planning, Annex Section 3 - Quantification of GHG emissions reduction/Additionality/Vocation and land use), and is in accordance with the suitability of the ground (Figure 14).

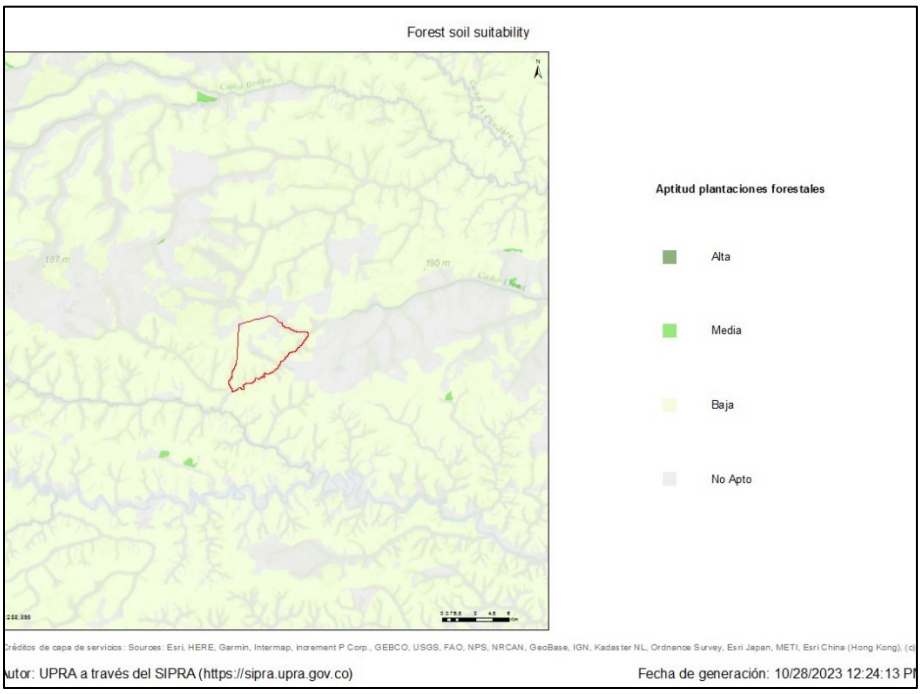


Figure 14 - Aptitude and vocation of the soil for forestry activity in Vichada (SIPRA, 2023)

A final legal requirement or restriction is associated with the possibility of formalizing the land to private parties for the development of agricultural activities. These areas specifically exclude areas of national parks, national forest reserves, state bleats, among other forms of ownership of the territory that corresponds to the administration of the local or national government. In the department, 94.4% of the freedom to formalize private property is identified, including the project area. As a result of this, in Figure 15, no legal restrictions are identified for the formalization of private land for agricultural use. The closest thing identified is associated with the Tuparro National Park (eastern side of the image), very distant from the project area.

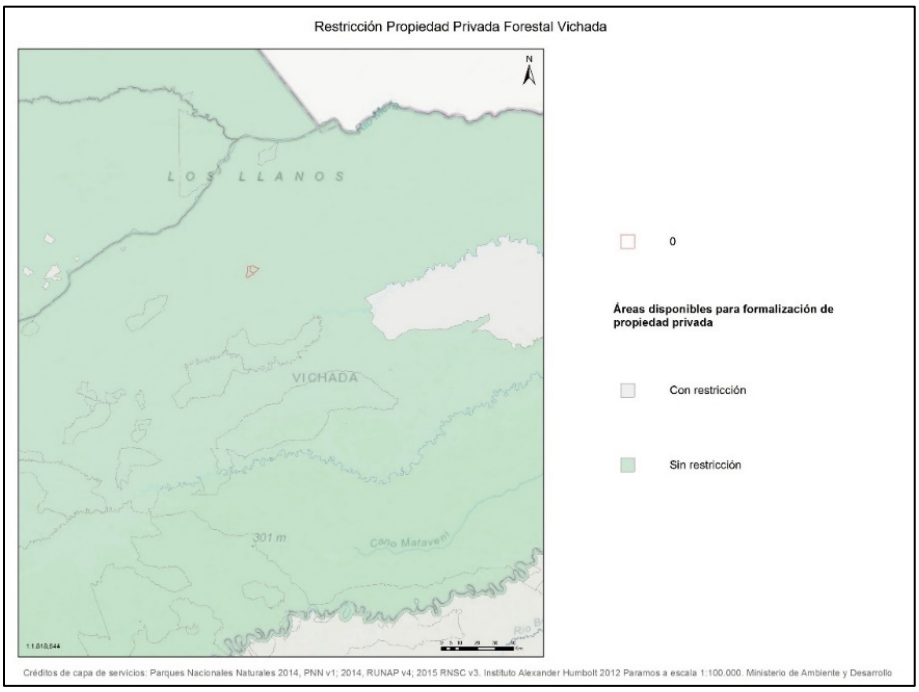


Figure 15 - Availability for the formalization of private property in the project area

Outcome of sub-step 1b. The extensive livestock activities, agriculture activities and forestry activities identified in sub-step 1a comply with the conditions of law and regulations applicable for their development in the project area.

According to BCR Additionality Guidelines v1.2, once you have obtained a list of likely land-use alternatives, go to Step 2 (Investment Analysis) or Step 3 (Barrier Analysis), as at least one of these two steps needs to be done to demonstrate the additionality of the Project. In this case, it was decided to perform step 3, barrier analysis, which can be found in the following section.

3.4 Additionality

In line with the requirements of BCR's "Baseline and Additionality Guidance", some elements are highlighted as to why the net anthropogenic removals could not have been achieved by the project proposal. These relate to political conditions, investment and cultural barriers. Finally, the demonstration of additionality is based on the potential land uses in the territories, but first some regional limitations are outlined that allow identifying that the GHG removals associated with the forestry project would not have occurred under baseline conditions because the social, economic, infrastructure and other elements suggest the continuity of extensive cattle ranching in the territory.

3.4.1 Step 3 – Barriers analysis

3.4.1.1 Sub-step 3a. Identify the barriers that would prevent the project implementation

3.4.1.1.1 Barries of Political nature

The National Government, through the Colombian Agricultural Research Corporation CORPOICA, has been conducting research to rescue the forestry potential of the Colombian Eastern Plains and more specifically the Upper Orinoquia, assuming that this is a profitable and environmentally friendly alternative. In 2005, an agreement was signed for the Formulation and Integral Evaluation of Agroforestry Production Projects to Promote the Sustainable Development of the Colombian High Orinoquia for the Benefit of the World (Contract No. 004/2005 of Agreement 008/2005, CORPOICA), which sought to obtain a greater benefit from the land in conjunction with the ecosystem potential of the Region, the modes of production and the local and national needs.

This study included vast areas of the Orinoquia, such as the productive nucleus of La Primavera in Vichada. Among the preliminary results obtained, forest species were identified as sustainable productive alternatives for the Meta and Orinoco River axis, based on forest and silvopastoral production systems in accordance with the environmental and cultural reality of the human groups that inhabit this area of influence.

However, this study was not the first to be developed with the purpose of identifying agroforestry potentialities. In 1999, a study called "*Environmental Zoning as a Strategy for the Planning of Agroforestry Systems and the Recovery and Conservation of Natural Resources*" was developed in areas of the Eastern Plains and also developed by CORPOICA (Bustamante 1999). This study also included the municipality of La Primavera and concluded in the existence of a wide range of possibilities for agroforestry land use that, with an adequate interpretation of the technologies that direct sustainable development and a socio-cultural and economic accompaniment and characterization, can promote the conservation of strategic areas, the transformation of the biophysical base according to its potential and at the same time, intervene in the reduction of the existing degradative processes. Subsequently, in July 2004, an initiative of the then President of the Republic was born, the generation of an economic development pole in the region, through a mega-project of agro-environmental reconversion that leads to the

reforestation of the Eastern Plains, more precisely the lands of the right bank of the Meta River, from Puerto Lopez (Meta) to Puerto Carreño (Vichada)[6].

For the above efforts that sought to convert the Colombian Orinoco into a national attraction (Agrosavia, 2007), from the productive, commercial and social point of view, and from the international perspective, in a focus of oxygen generation and a carbon capture center to participate in the improvement of the environment and global welfare.

The Agrosavia study (2007), details how historically the major productive activity of the municipality of La Primavera is livestock followed by commerce. Activities related to agricultural production are in specific corridors such as La Primavera - San Jorge, on the meadows and islands of the Meta River. These activities face difficulties due to the lack of technical assistance, lack of credit for agricultural development and the high production costs related to the lack of road infrastructure, which is still evident (Table 11), making transportation costs high. This will be reflected later in the investment and social barriers.

Table 11 - Road conditions in the department of Vichada.

Track hierarchy	Paved	Affirmed	Onshore	Total
Primary	37	59	66.9	**162.9**
Secondary	1.14	678.5	1,056.55	**1,736.19**
Departmental tertiary	0	0	0	**0**
Municipal Tertiary	0	93.23	510.21	**603.44**
Total	**38.14**	**830.73**	**1,633.66**	**2,502.53**

Source: (Departmental Government of Vichada, 2021)

Despite national and regional policies that present a development vision for Vichada, road infrastructure limitations continue to be the greatest challenge for investment. Thus, extensive cattle ranching continues to be the major source of income for the department and the municipality of La Primavera.

3.4.1.1.2 Investment barriers

Referring to the regional history on the development of forestry activities, it is important to point out that at the beginning of the 2000–2010-decade, reforestation is a marginal

[6] "*El Espectador*" newspaper, edition 2005-06-12.

activity in the country. This is reflected in the participation of the forestry sector in the National economy, which has normally represented between 0.4 and 0.5% of the Gross Domestic Product (GDP) in the decade of 2000-2010, falling to figures of 0.20% in 2014 (MinAgricultura, 2015) and that by 2017 it contributes only 0.79% (DNP_ONFA, 2018). As can be seen, the figures show high volatility, but reflect the low certainty of the economic benefits that the sector brings to the decision, making process of investors and especially the country's isolated territories such as Vichada.

As is well known, commercial reforestation involves the cultivation of late-yielding species and, therefore, the return on investment is obtained after long periods and with high associated risks (fire, pests, high mortality, among others). In addition, as this activity is not sufficiently consolidated, the market is incipient and therefore there is high uncertainty about the profits that could be generated. An example of uncertainty in the dynamics of timber trade income is especially true for Vichada. As can be seen in Table 12, in less than six months, reforested areas increased +3,500 hectares, and a total of 95,940 hectares were planted in the department. However, the amount of timber mobilized per year (2018 and 2019) is tiny compared to the number of hectares planted, and their ages. This is associated, to a certain extent, with transportation costs.

Table 12 - Relationship between areas planted with forest crops and the mobilization of timber to markets (years 2018-2019). ***Source****: (MinAgricultura, 2019)*

Department	Area planted (ha)		Timber mobilized (m^3)	
	2018	2019	2018	2019
Antioquia	135,927	139,327	1,152,783	416,580
Arauca	445	445	24	105
Atlántico	2,154	2,154	2,845	1,706
Bolivar	16,083	17,280	8,292	7,154
Boyacá	7,464	11,005	127,585	80,452
Caldas	22,536	23,308	207,780	107,469
Caquetá	658	648	46	0
Casanare	6,967	10,521	43,456	21,697
Cauca	27,622	32,157	607,945	355,089
Cesar	12,947	17,185	33,430	19,042
Choco	1,205	1,109	4,261	299
Cordoba	44,369	44,021	65,947	30,513
Cundinamarca	7,920	13,230	74,017	40,142
Guaviare	427	375	142	109
Huila	2,734	5,580	7,818	3,158
La Guajira	714	710	153	169

Department	Area planted (ha)		Timber mobilized (m^3)	
	2018	2019	2018	2019
Magdalena	23,313	30,646	20,959	16,269
Meta	43,407	44,846	12,089	15,806
Nariño	1,984	1,962	13,390	4,665
Norte de Santander	2,515	2,497	1,161	338
Putumayo	209	183	185	0
Quindío	6,675	8,867	56,886	28,363
Risaralda	7,467	10,407	125,694	64,839
Santander	6,577	7,557	14,168	9,496
Sucre	5,580	7,505	9,440	18,662
Tolima	5,068	6,674	11,932	5,219
Valle del Cauca	31,196	32,631	431,033	244,201
Vichada	92,272	95,940	5,036	2,205
Total	**516,461**	**568,769**	**3,038,496**	**1,493,746**

Finally, the UPRA identifies and highlights the country's low investment in research activities, specifically in the National Forestry Program for Scientific and Technological Production, Innovation, Knowledge Management and Technical Assistance (CTI & GCAT), in the agricultural sector, which directly affects the allocation of resources for forestry issues compared to other subsectors that have a more relevant participation in national production (during the period 2000-2013, the average investment in science and technology activities in the country was only 0.05% of national GDP, with an average annual growth rate of 0.13%. 05% of national GDP, with an average annual growth rate of 0.13%, Colombia invests on average less than 0.5% of GDP when the recommended level for developing countries is 1% of national GDP (UPRA, 2016).

3.4.1.1.3 Barriers due to social and infrastructural conditions

The main social barrier has to do with the scarcity of labor in the area to carry out forestry activities. The population density in the department of Vichada is too low (0.73 inhabitants/km^2) and therefore there is not enough manpower to carry out forestry activities (Government of Vichada, 2017). Traditional cattle ranching activities require only one person (one direct job) to manage up to 100 ha, while forestry activities require one person to manage 10 ha (Personal communication La Primavera Organization 2006), when focused on timber extraction activities or many more when resin harvesting activities are incorporated. On the other hand, extensive cattle management does not require skilled labor; on the contrary, traditional management is continued, contrary to

what is required for forestry activities, especially in territories full of adversities for productive forestry development.

Infrastructure limitations undoubtedly have an impact on social conditions. It is to be expected that a territory with good road conditions will bring better living conditions to the population. The department of Vichada has no presence in the national road network and the financial capacity of the department is not a guarantee to solve mobility and transportation within the departmental territory and articulate it with the national environment. The situation is replicated within the municipalities; the size of the department limits the municipalities in the attention required for tertiary roads, which are fundamental for the integration of the municipality internally and with the region. The absence of programmed investments contemplating winter and its implications in the execution of works has been a constant excuse for the completion and good execution of works; mobility between summer and winter is inversely proportional to the need for road supply and demand (Vichada Departmental Government, 2008) (Table 13). During the rainy season, traffic on the roads becomes almost impossible for private and public transportation, and null for cargo transportation (Figure 16). This has a direct impact on the region's competitiveness, limits access to better livelihoods and is a limiting variable for timber harvesting, increasing the cost of extracting the product (due to a lack of labor and adequate roads for the transit of inputs, materials and harvested timber throughout the year).

Table 13 - Number of roads in the department of Vichada and their traffic by time of year

Pathways	Km	Transit (%)	
		Summer	Winter
Secondary	1,670	95	25
Tertiary	835	85	15

Figure 16 - Condition of roads during the rainy season in Vichada.

3.4.1.2 *Sub-step 3b. Demonstrate that the identified barriers would not prevent the implementation of at least one of the identified land use alternatives (except the project activity)*

As evidenced in the previous analysis, **extensive livestock farming continues to be the most feasible scenario**, both from the point of view of public policies, due to the great agricultural vocation of the country, and of the department; Likewise, being one of the most predominant activities in the rural area of the country, this scenario is not affected by investment and cultural barriers.

3.4.2 *STEP 4. Impact of Project registration*

Alternative activities to the forestry proposal in accordance with regional and national policies

In accordance with the characteristics of the region, described above, the soils in the area are characterized by their degraded state as a result of extensive cattle ranching and the fire cycle, a condition that has been progressively accentuated and amplified over the years. The predominant species in the area stand out for their tolerance to natural fires, adaptation to conditions of intense drought and flooding, strong winds, as well as the generalized low fertility of the soils. The suitability of soils in the region is determined mainly by the quality and classes of soils, the climate present in its geography (see paragraphs above) and aspects related to natural vegetation.

For the study area, landscapes with only moderate suitability for crops present limitations related to low fertility, low nutrient availability and low nutrient retention capacity. The few crops that are present are generally located in small plots called '*conucos*' on the banks of the streams and small extensions of forest are cut down for these crops. In general terms, the land is used for forestry.

In 1998, (CONIF, 1998), based on the forestry possibilities of the Colombian eastern plains, developed the work entitled "Guide for Commercial Forest Plantations in the Orinoquia" in which, among other aspects, the potential areas for commercial reforestation in the Colombian Orinoquia were defined. This work was developed by consulting existing information on soil studies, climatology and land use information in the area under Corporinoquia's jurisdiction. A total of 5,954,962 hectares suitable for reforestation were identified in the departments of Casanare, Meta and Vichada. However, as will be shown below, the Rural Land Planning Unit (UPRA), relating environmental, economic and road infrastructure supply conditions, redefined the forest zoning showing that the department has a little more than three million hectares suitable for forestry activities, but of these more than 90% are of low suitability, and no hectares of high suitability (Figure 17).

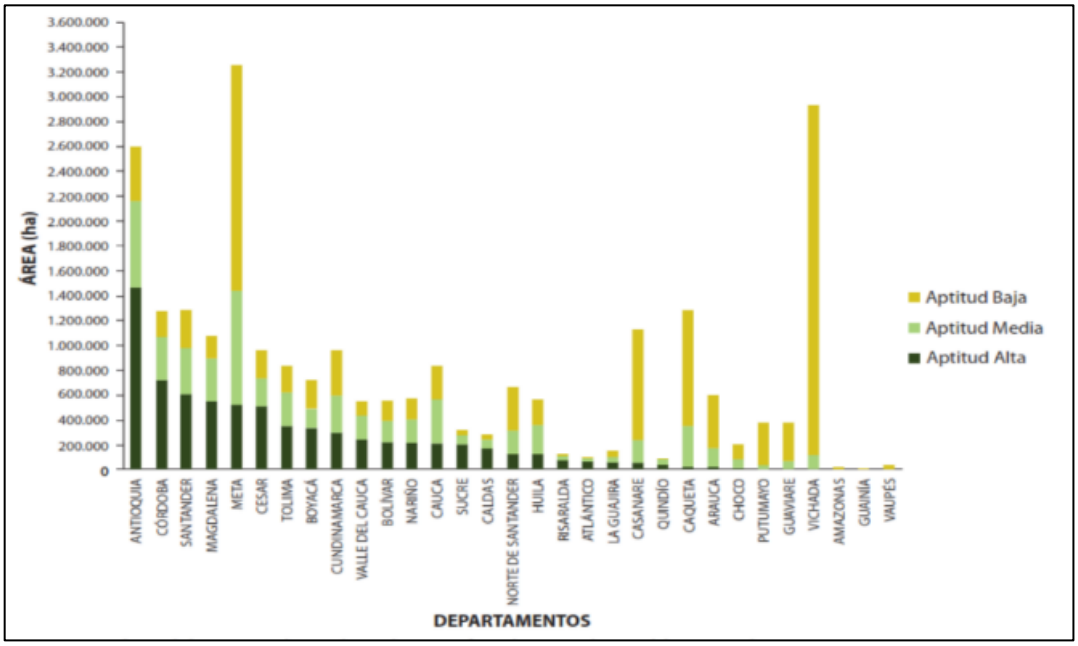


Figure 17 - Forest suitability for the Colombian territory. Source: (UPRA, 2015)

Adequacy of Agricultural Land and Uses

The productive alternatives in the area are determined by the characteristics of the soils that affect their capacity for use, as noted. In the municipality of La Primavera, the areas destined for commercial reforestation (excluding the areas destined for natural regeneration) are suitable for the development of forest plantations. In addition, the proposed species are well adapted to the low natural fertility of the soils, and particularly *Pinus caribaea* and *Eucalyptus pellita* generate a gradual recovery of the physical and chemical characteristics of the soils in the medium and long term (Figure 18), as has been reported in some studies (Fernández Méndez, Camargo Martínez, & Sarmiento, 2012; Cortés Pérez, Dueñas Gómez, & Cardozo, 2005).

As detailed above, extensive **cattle ranching is a widespread activity in the region and corresponds to the baseline activity in the project**, and in the case of identifying productive alternatives associated with regional development policies, prior to the start of the project activity are the cattle ranching activity (baseline activity) and the forestry activity (without the carbon component). Both activities were promoted in the region's Development Plan in a regulated manner (prior to the start of the project). In the first instance, the plan seeks to provide technical and economic support tools to develop the livestock sector, observing the region's potential and in accordance with the support policies provided by the Ministry of Agriculture, to increase the number of livestock,

initiate the region's export potential and implement milk reconversion plans in the department (Vichada Departmental Government, 2008).

Figure 18 - Soil conditions in the baseline degraded soils with livestock activities (left) and with the implementation of the project (right).

However, the guidelines to continue producing with low environmental impact are not widely applied, and due to the low nutritional capacity of the pastures, burning continues to be used to take advantage of grass regrowth, with the implications this has on the soil, especially on the carbon reservoir, as pointed out by Hernandez (2018) on the research carried out in this regard in the Colombian Orinoquia.

In the case of forestry activity, this is promoted with emphasis on plantations of native species that strengthen the potential that the region has as a scenario for the rational use and conservation of biodiversity (Vichada Departmental Government, 2008), but does not prioritize commercial reforestation as an alternative for soil recovery and protection, mechanisms to reduce pressure on ecosystems, improve livelihoods and employment alternatives for the region. Thus, demonstrating that the policies are inconsistent with the potential of the region and the prioritizations in the development plans.

3.5 Uncertainty management

To manage uncertainty in the quantification of baseline and mitigation results, Table 3 "*Discounts for quality and applicability of GHG estimation models*" of the BCR0001 methodological tool was taken into account in the project calculations, where it is indicated the quality discount factors associated with GHG removal data, applying a discount value of 20%, for national aboveground biomass data and (R:S) factor for belowground biomass.

3.6 Leakage and non-permanence

These are related to the displacement of activities that are carried out within the scope of the project to areas outside it. The project, as conceived, does not foresee the production of leaks due to displacement of activities, since it focuses on a model of land use change in areas dedicated to extensive livestock farming, with very low units of livestock per hectare. The project region is characterized by large areas of plains of native and introduced grasses that are continually burned in order to be renewed, depleting their fertility and promoting soil degradation. It is estimated that the activity does not lead to the generation of escapes, since the region is capable of supporting the possible displaced heads of livestock, if this were the case. Likewise, the project owners are not intervening in all areas of the properties, 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.

A demonstration of the carrying capacity is demonstrated in the leakage analysis developed for the CDM Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia (ID:9199), from which the current project proposal was derived.

Now, this analysis complies with literal a) of section 15.3 BCR0001, therefore the leaks are considered **zero**.

3.7 Mitigation results

3.7.1 Eligible areas within GHG project boundaries (AFOLU sector projects)

For the analysis of coverage within the project limits, the definition of natural forest was taken into account in structural aspects according to the reference level presented by Colombia to the UNFCCC (IDEAM, 2019),which defines forest as:

> *"Land occupied mainly by trees that may contain shrubs, palms, guaduas, herbs and lianas, in which tree cover predominates with a minimum canopy density of 30%, a minimum canopy height (in situ) of 5 m at the moment of its identification, and a minimum area of 1.0 ha."*

With this definition, and in accordance with BCR, which determines that areas devoid of forest cover at least five (5) years before the start of project activities are considered eligible areas for the carbon project. This is how it was determined that those areas that had Gallery, Water and Cloud Forest coverage, in each of the evaluated nuclei, would not be considered as potentially eligible areas. For their part, areas with pastures and barren lands will potentially be eligible.

The eligibility analysis must be carried out through a multi-temporal analysis of satellite images, through which changes in land use coverage are determined (based on the Corine Land Cover categories adapted for Colombia).

The land cover and use maps were produced from the interpretation of satellite images. To this end, the following steps were followed:

1. **Downloading satellite images:** The satellite images used in this case were those from the LANDSAT 7 satellite (path 05 and row 56), which were selected and downloaded from the server of the Earth Resources Observation and Science Center - EROS of the United States Geological Survey - USGS through of the Glovis viewer for the years 2013, 2018 and 2019. It is important to highlight that the bands used in the analysis carried out have a spatial resolution of 30 meters, complying with the scale and resolution requirements indicated for multi-temporal analysis by the standard BCR.

2. **Input preprocessing:** Within this stage, all the error management was carried out (specifically the scan line errors that the images of this satellite usually present), the composition of bands, the geometric correction to manage the appropriate coordinate system and the application of the normalized vegetation index to identify vegetation cover more easily.

3. **Identification of coverage (processing):** During this step, the supervised classification of the coverage present in the area was carried out, in addition to the driving matrices to determine the precision with which the process was carried out and the validation with the categories established by the official methodology of the country, Corine Land Cover.

For more information about each of the steps in the analysis carried out, please consult the annex: Section 1 - Project type and elegibility/Elegibility).

3.7.1.1.1 Eligibility Results

According to the analysis carried out, the project area has areas that do not meet the eligibility conditions established by the standard, presented below:

Table 14 - Areas that do not meet the eligibility conditions of the BCR.

Coverage	Source	Area per year (ha)			% of project area
		2013	2018	2019	
Very dense vegetation (class *3.1.4. Gallery and riparian forest*)	Coverage analysis	204.10	273.83	278.27	9,98[7]
Wetland Zone	Analysis of special management zones	41,33			1,64
Areas RES1130/2011		835,17			33,08

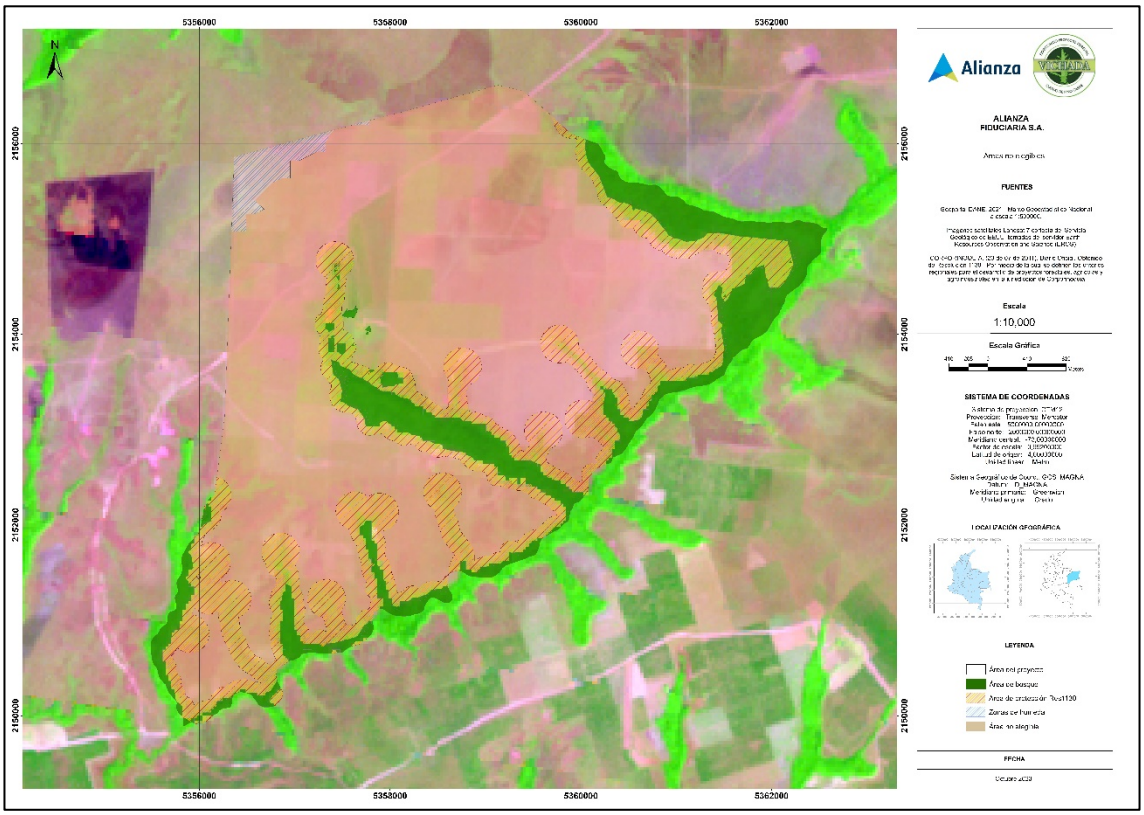


Figure 19 - Areas within the project area and its compliance with BCR requirements

Given this information, the area not eligible for the development of the project corresponds to the union of the forest areas identified through the analysis of satellite

[7] Average over the three years analyzed

images (taking into account those identified for the years 2013 and 2018), the protection areas according to resolution 1130 and the area of the Bita River Basin Wetland Complex, so the area where the project activities can be developed according to the standard BCR criteria corresponds to 1,645.85 eligible hectares.

3.7.2 Stratification

Generally, stratification leads to separation in terms of the capacity for biomass or carbon accumulation by each type of land use. This separation will also be determined by the types of plant species that make up the same use. However, it is important to consider stratifications based on their capacity to reduce net emissions. Faced with these considerations, the BCR0001 methodology defines the following (section 13 of the methodology):

> a) For baseline net GHG removals by sinks, it is usually sufficient to stratify the project area according to land use categories.
>
> For the project proposal, the baseline is considered only one and is defined by pastures in use for extensive livestock farming.
>
> b) For the project scenario, stratification can be based on establishment plans (species/planting year).

3.7.3 GHG emissions reduction/removal in the baseline scenario (unmanaged pastures)

The removal balances for the baseline are defined by:

$$\Delta C_{BSL,t} = \Delta C_{TREE_{BSL},t} + \Delta C_{SHRUB_{BSL},t} + \Delta C_{DW_{BSL},t} + \Delta C_{LI_{BSL},t}$$

Where:

$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks in year *t*; t CO_2-e
$\Delta C_{TREE\_BSL,t}$	=	Change in carbon stock in baseline tree biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{SHRUB\_BSL,t}$	=	Change in carbon stock in baseline shrub biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" t CO_2-e
$\Delta C_{DW\_BSL,t}$	=	Change in carbon stock in baseline dead wood biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in deadwood and litter in A/R CDM project activities"; t CO_2-e

$\Delta C_{LI\_BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in deadwood and litter in A/R CDM project activities; t CO2-e

The carbon stocks in the Baseline scenario correspond to those stored in the biomass of the plant species present in the areas identified as eligible. As established in the previous chapters, the eligible areas corresponded to those areas covered by unmanaged grasses or savannahs that have historically been subjected to continuous burning; the presence of trees or shrubs is not evident since the burning restricts their permanent presence.

In this way, according to Rao et al (2001) the productivity ranges of the native savannah grasses of the Orinoquía range on average between **3.60** and **5.22** tons of dry matter per hectare (t MSha-1), considering the biomass above the ground and under it. Assuming that 50% of the weight of this biomass is carbon (Intergovernmental Panel on Climate Change (IPCC), 2003), it is defined that these covers present 1.80 and 2.61 tons of carbon per hectare (t C ha-1), respectively.

It is noteworthy that authors such as Rippstein et al (2001) have identified that the pasture and savannah covers of the Colombian highlands are very old, which allows us to assert that it is likely that the biomass of the native vegetation that has been subjected to historical slashing and burning processes remain at stable average values, generating a certain dynamic balance. This suggests that even after intervention processes, the biomass of the existing vegetation recovers quickly to maintain said balance, but not beyond the supply of environmental resources provided to the ecosystem (limits due to soil fertility, degree of degradation and alteration of soil horizons and also the levels of chemical and physical indicators of the soil, among others). With this hypothesis and wanting to model the behavior of recovery and accumulation of the carbon produced (t C ha-1) in the biomass of the pastures, the biomass information (aerial and root) collected in the Carimagua region (Department of Meta) by Rao et al. (2001), for different alterations and variation in rest periods (weeks) after slash and burn. To determine its growth and biomass accumulation, the Bertalanffy growth model was used ($C = A[1–exp(-bt)]\ 1/(1-m)$, Equation 1., later) that describes the growth of the individual (living organism) depending on the life span. The cloud of carbon points and the model trend indicate that after felling, the carbon of the native vegetation stabilizes quickly around the fifth week, towards a constant value of 2.37 t C ha-1 (Figure 20). The results allow us to conclude that, indeed, after the intervention processes, the aerial biomass of the native vegetation recovers quickly and remains stable.

For its part, a study carried out in Carimagua region (Department of Meta) in introduced and poorly managed pastures concluded that this type of coverage produces 2.9 t C ha-

1year-1 after 17 years of establishment. Apparently, these pastures incorporate greater amounts of carbon compared to savanna vegetation (Fisher, 1994). However, various authors affirm that the net growth in introduced pastures is limited to the first years of their establishment. For example, in poorly managed pastures in "*Cerrado Biome*" (Brazil), initial net accumulation rates were high and were associated with considerable increases in carbon incorporation. However, the respiration rates of soil microorganisms compensated for these gains over time (Davidson E. A., 1995), but for the Orinoquia region of Colombia, the strong degradation and burning of soils reduces the macrobiotic activity of the soils, reducing the effectiveness of the compensation.

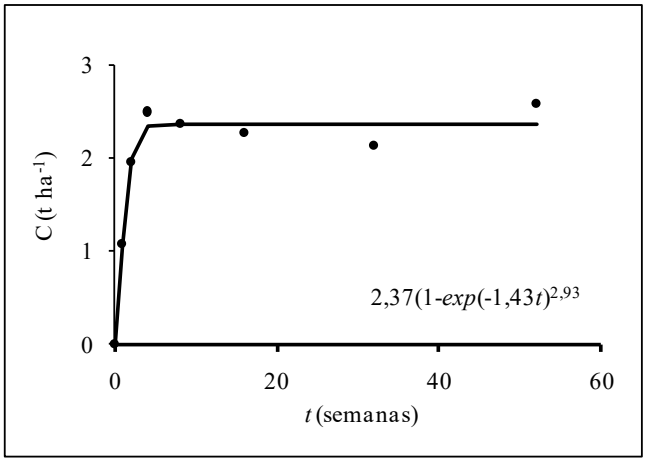


Figure 20 - Carbon production in native savannahs and unmanaged pastures in the Colombian eastern plains region, estimate developed for one year of analysis

Note: The beginning of the analysis corresponds to the rest period between two cutting and burning of the non-forest cover. The black dots are the carbon values corresponding to the biomass reported by Rao et al. (2001), after assuming 50% carbon in the biomass. The solid line corresponds to the estimates made using the von Bertalanffy model.

Regarding the average residence period of the carbon contained in the biomass in this type of savannas, it is 10 years when it is not altered, and authors such as (Trumbore, 1995) have estimated that the annual rates of carbon accumulation at 20 years decrease by about of 10% of the net accumulation observed during the first three years of growth. The aforementioned evidence then suggests that carbon incorporation in savannahs reaches constant, or even negative, values, both for savannahs and introduced pastures.

In this way, it is assumed that the carbon incorporated in the baseline for the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A. initiative is between the extreme content values mentioned, that is, 1.8 and 2.9 tCha-1, and is within the values of aboveground and belowground biomass incorporated in different pastures of the tropical region (1.8 and 5.0 t C ha-1) reported IPCC (2003).

Finally, accepting the recommendations of the AR-Tool14 tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities", in its literal 5, paragraph 12, consideration f, recommends assuming the removals of the baseline as zero when:

> e) Soils are subject to cyclical periods of slashing and burning, causing biomass contents to oscillate between a minimum and maximum baseline value.

As detailed, the burning activity in the grasslands of the Colombian plain is a cultural practice that has been developed for decades and includes the project areas. These burns have been documented and have been the center of discussion for their prohibition or management[8], and recommendations have been developed to prevent their presence and spread. **According to the above, changes in baseline removals are assumed to be zero.**

Despite the above, it is important to clarify that, as it was explained in section 3.5, to manage uncertainty Table 3 "Discounts for quality and applicability of GHG estimation models" of the BCR0001 methodological tool was taken into account in the project calculations.

3.7.4 GHG emissions reduction/removal in the project scenario

The balance of net removals is defined by the relationship between the changes in the net removals of the project activity and the emissions that are generated due to its implementation.

The BCR standard for terms of carbon balances for the establishment of forest systems assumes that the accounting will be supported by the individual contributions of the sinks of above and below ground biomass, leaf litter, dead wood, shrubs and soil organic carbon.

Likewise, the standard establishes that emissions derived from the removal of herbaceous vegetation, burning of fossil fuels, application of fertilizers among other

[8] http://www.humboldt.org.co/images/pdf/notibita/notibita-06-web.pdf

- https://elmorichal.com/tag/incendio-forestal-vichada/
- https://es.mongabay.com/2019/07/incendios-norte-amazonia-deforestacion-colombia/
- https://www.contextoganadero.com/regiones/quemas-reducen-el-carbono-organico-del-suelo-en-la-orinoquia

sources, not related to the elimination of tree or shrub components for soil preparation, can be considered NOT significant. and therefore, it is valued as ZERO. The BCR0001 methodology defines the methodological steps for the respective calculation, which are applied in the following reduction estimates GHG emissions of the proposed project.

Therefore, the calculation of net anthropogenic removals with the project proposal is defined by:

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

Where:

$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{P,t}$	=	Change in the carbon stocks in Project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$GHG_{E,t}$	=	Increase in non-CO2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t, as estimated in the tool "*Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity*"; t CO_2-e

Changes in carbon content are defined by:

$$\Delta C_{P,t} = \Delta C_{TREE_{PROJ},t} + \Delta C_{SHRUB_{PROJ},t} + \Delta C_{DW_{PROJ},t} + \Delta C_{LI_{PROJ},t} + \Delta SOC_{AL,t}$$

Where:

$\Delta C_{P,t}$	=	Change in the carbon stocks in Project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	=	Change in carbon stock in tree biomass in Project in year t, as estimated in the tool *"Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"*; t CO_2-e
$\Delta C_{SHRUB\_PROJ,t}$	=	Change in carbon stock in shrub biomass in Project in year t, as estimated in the tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*"; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	=	Change in carbon stock in deadwood in Project in year t, as estimated in the tool, *"Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities";* t CO_2-e

$\Delta C_{LI\_PROJ,t}$	=	Change in carbon stock in litter in Project in year t, as estimated in the tool, "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO_2-e
$\Delta SOC_{AL,t}$	=	Change in carbon stock in SOC in Project, in year t, in areas of land meeting the applicability conditions of the tool *"Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*"; t CO_2-e

3.7.5 Balance of the Net Anthropogenic Removals Derived from the Implementation of the Project

This balance is determined by:

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

Where:

$\Delta C_{PROJ,t}$	=	Net anthropogenic GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks, in year *t*; t CO_2-e
LK_t	=	GHG emissions due to leakage, in year *t*; t CO_2-e

3.7.5.1 Estimation of current net GHG removals

Application of methodological tools:

- AR-TOOL14 Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities.
- A/R Methodological tool, "*tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*"

In addition, it is important to clarify that, as it was explained in section 3.5, to manage uncertainty Table 3 "Discounts for quality and applicability of GHG estimation models" of the BCR0001 methodological tool was taken into account in the project calculations.

3.7.5.1.1 Aboveground biomass

Tree Estimate

To determine the carbon accumulation of a forest species, it is assumed as a good practice (Intergovernmental Panel on Climate Change (IPCC), 2003) to develop projections based on its average annual increase (MAI), or based on the growth curves per forest species and stand model in volume. ($m^3 ha^{-1} year^{-1}$), which is converted, through

expansion factors, to carbon. The adjustment of asymptotic growth models is generally obtained through information taken in permanent plots located in stands where the studied species grows, ensuring that they cover a wide range of ages and site qualities (Zeide, 1993). For the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A. estimates were developed with information sources for IMA ($m^3 ha^{-1} year^{-1}$) and wood density (Table 15) (Roncancio D, 1998)

Table 15 - Average annual increases (IMA) in volume (V) and in Carbon (C), reported and calculated for the proposed species and assisted natural regeneration using expansion factors. P: wood density.

Specie	*R*	HAS		Total Yield (Biomass)	Source
	Average (g/cm^3)	*In* (m^3 *ha-1* $^{year-1}$)	*C (total aerial + underground)* (*t C ha-1* $^{year-1}$)	*Biomass* (*t ha-1* $^{year-1}$)	
Pinus caribaea	585	13.0	14.1		(Trujillo E. , 2011; Trujillo, 2007; CONIF, 1998)

From the information, carbon accumulation curves were generated for each of them after assuming that 50% of the biomass is represented by said element (National Forest Inventory). Priority was given to information resulting from studies carried out in Colombia, specifically in the Eastern Plains region. In other cases, volume expansion factors, biomass or other dendrometric variables were used, which were obtained directly from the literature or calculated from the equations generated for the calculation of carbon in species or forest stand models taking growth as a starting point (Recommended indirect method).

Using the dendrometric information (e.g. diameter, height, wood density and volume) found for each species (Table 26), the carbon content stored by them at various ages was estimated. The *von Bertalanffy* model that is explicit the following Equation (bertalanffy, 1976; Zeide, 1993; Lei, 2004) was parameterized using the mathematical approximation method.

$$C = \frac{A[1 - \exp(-bt)]1}{1 - m}$$

Where:

C is carbon (t ha-1),
t is the time (years)
A, b and m are parameters of the equation.

The term exp denotes the exponential operator and A is the asymptote or maximum quantity that the organism can reach over time, which controls the maximum growth rate of the species.

This model states that the organism's anabolism rates are proportional to its mass raised to the 2/3 power, while catabolism is only proportional to mass. Therefore, the parameter m in the Bertalanffy model is 2/3 (Zeide, 1993). In the cases in which said model was used, this constant was tried to be assumed since it has been observed empirically that this value allows conservative asymptotic values to be estimated, in this way the iteration process of the other parameters is facilitated and makes the term 1/1-m, becomes a constant term c = 3.

The mathematical approach consists of using a system of equations based on asymptotic values and average annual increases in carbon, in order to obtain a von Bertalanffy type model (Equation above). For this case, the asymptotes corresponding to the maximum amount of carbon stored that was found in the literature for the species, the average annual increases (IMAs) in carbon and the initial carbon content calculated as 1/3 of the asymptote were available.

The fitted functions estimate the carbon accumulation trends in the potential scenarios and, consequently, the aforementioned models constitute the additionality functions of the project.

The results for the productive stand model based on *Pinus caribaea* is presented in the following table.

Table 16 - Regression parameters of the volume functions (m3ha-1) for commercial stand models with the species P. caribaea

Specie	Model			Source
	A	b	c	
Pinus caribaea	234.0	0.1256	3.00	Roncancio et al, 1998

Note: The letters A and b are the regression parameters, c = 1/1-m, where m = 2/ 3.

In Figure 21 and Figure 22 the volume accumulation curves ($m^3ha^{-1}year^{-1}$) over time are observed. These do not include changes due to thinning or mortality; this analysis is done in the final projection of the change in $tC\ year^{-1}$.

Based on the annual establishment plans by species and their respective area, the estimate of carbon accumulation for the aerial and underground component is developed as follows:

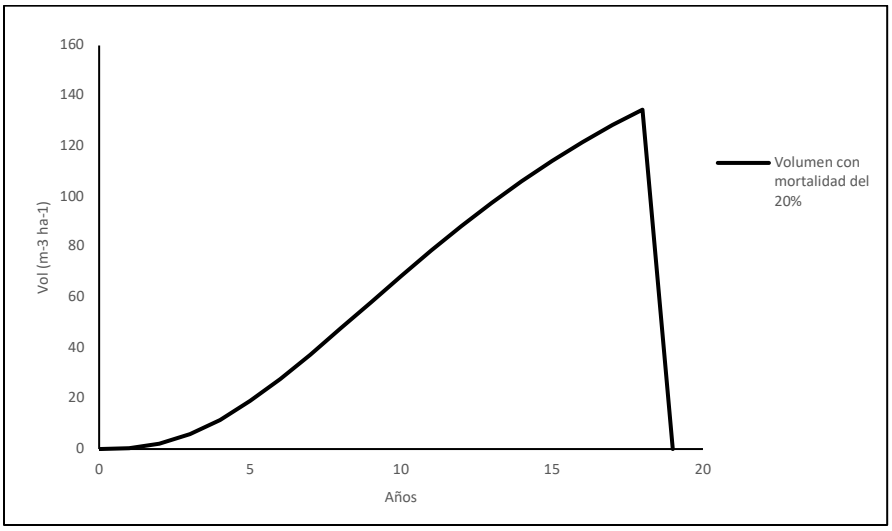


Figure 21 - Modeling the volume growth (m^3 ha^{-1} $year^{-1}$) of the species P. caribaea var. hondurensis, using the von Bertalanfy growth model

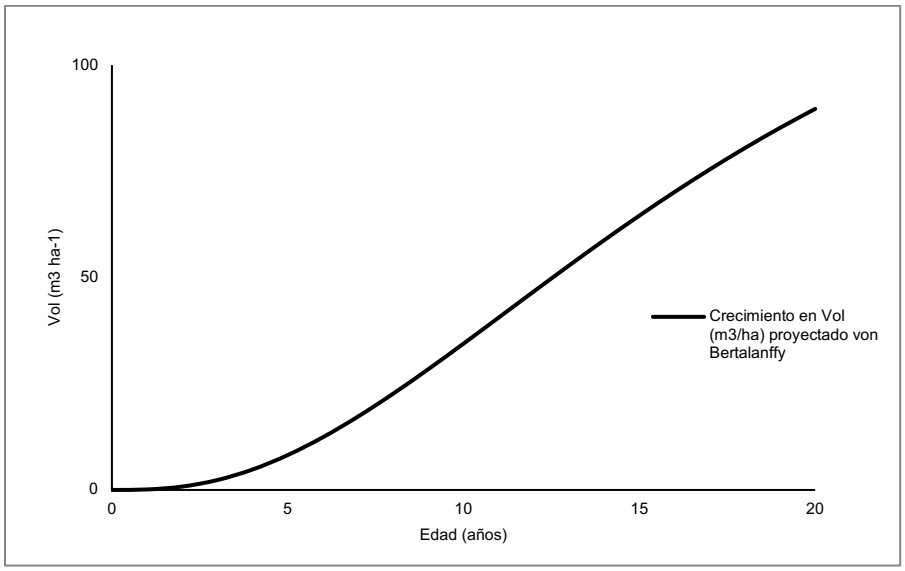


Figure 22 - Additionality functions (m^3 ha^{-1} $year^{-1}$) for the natural regeneration model considered in the project; The model was obtained after fitting von Bertalanffy equations.

Likewise, in order to develop modeling based on silvicultural interventions such as volume reduction and therefore carbon as a consequence of thinning, models were developed with 25% interventions (reduction in coverage of 25% of the total trees) in each commercial stand model in years 10 and 14 with a final harvest in year 18. This modeling assumes 20% mortality.

The natural regeneration model remains without interventions. The results of the behavior of the projections for the commercial stand model with *Pinus caribaea* dominant species of the system for a first rotation are seen in the following figure.

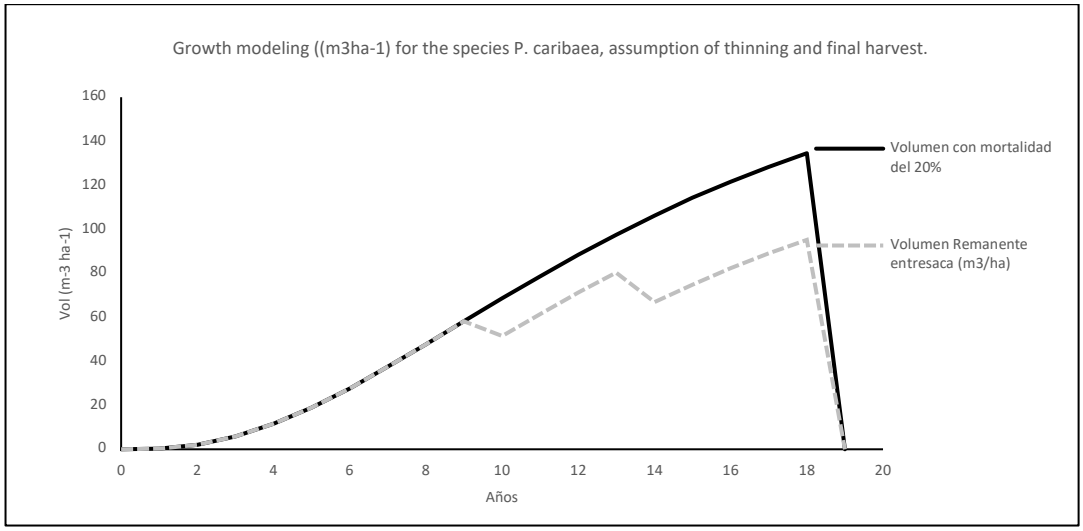


Figure 23 - Carbon accumulation behavior with thinning interventions in commercial forestry shoot models of P. caribaea. The solid line is the modeled projection, and the dotted line refers to the change with thinning and final harvest.

Shrubs

According to the tool AR_Tool14, Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, this sink is considered positive when the values of shrub biomass are above those identified in the baseline.

On the other hand, this component in AR activities, the forest considers bushes as an integral part of the definition for Colombia. Therefore, their changes, being significant compared to the baseline values, are counted in the anthropogenic net carbon balance.

As noted in previous paragraphs, due to periodic burning activities, the eligible areas only considered clean pastures without the presence of scattered trees or shrubs. These areas, being subject to periodic burning, restrict the presence of this component in the baseline conditions. Therefore, these are assumed to be zero.

Now the estimation of this component for the project conditions is carried out following the recommendations of literal 11, of the AR-TOOL 14 tool.

Its application is made in strata where the dominance in the coverage of the crowns of the bushes is above 5%.

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

$$b_{SHRUBS,i} = BDR_{SF} \times b_{FOREST} \times CC_{SHRUBS,I}$$

Where:

$C_{SHRUB,t}$	=	Carbon stock in shrubs within the project boundary at a given point of time in year. t CO_2-e
CF_s	=	Carbon fraction of shrub biomass (t.d.m.)$^{-1}$. Default value of 0.47.
R_s	=	Root-shoot ratio for shrubs a. Default value of 0.40.
$A_{SHRUB,t}$	=	Area of shrub biomass estimation stratum *i,* ha.
$b_{SHRUB,t}$	=	Shrub biomass per hectare in shrub biomass estimation stratum *i, td.m.ha*$^{-1}$
BDR_{SF}		Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 (i.e. 100 per cent) and the default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project activity is located A value of 0.10 may be used unless transparent and verifiable information is provided.
b_{FOREST}	=	Default above-ground biomass content in forest in the region/country where the A/R CDM project activity is located. *td.m.ha*$^{-1}$
$CC_{SHRUBS,i}$	=	Crown cover of shrubs in shrub biomass estimation stratum i at the time of estimation, expressed as a fraction (e.g. 10 per cent crown cover implies $CC_{SHRIBS,i}$= *0.10)*

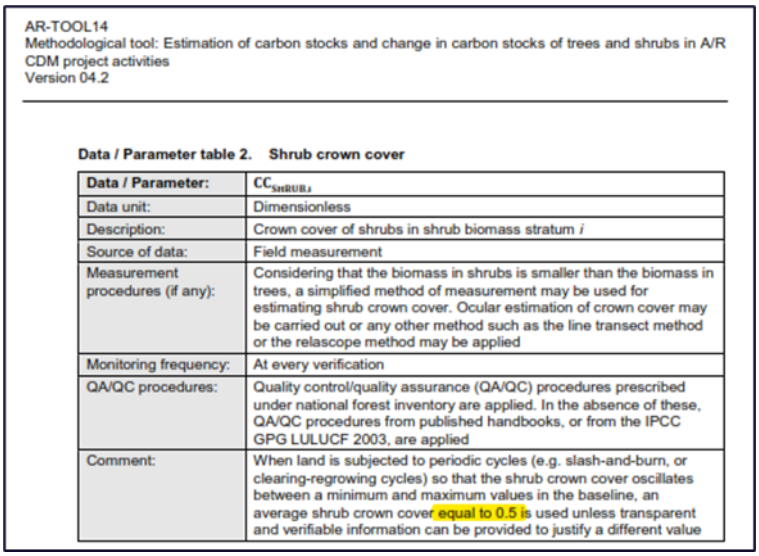
Parameters used in the estimation:

$A_{SHRUB,t}$ = Area of each stratum of the project proposal at *time t (2019).*
Strata
- **Sowing year 2017 148 ha.**
- **Sowing year 2016 440.50 ha.**
- **Sowing year 2015 1,053.2 ha**

BDR_{SF} ***0.10*** Methodological tool default. Page 20 of AR-Tool14.

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

$CC_{SHRUBS,i}$ = **0.5** Default value recommended by the methodological tool. (see Table 2 for tool data and parameters).



AR-TOOL14
Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities
Version 04.2

Data / Parameter table 2. Shrub crown cover

Data / Parameter:	$CC_{SHRUB,i}$
Data unit:	Dimensionless
Description:	Crown cover of shrubs in shrub biomass stratum *i*
Source of data:	Field measurement
Measurement procedures (if any):	Considering that the biomass in shrubs is smaller than the biomass in trees, a simplified method of measurement may be used for estimating shrub crown cover. Ocular estimation of crown cover may be carried out or any other method such as the line transect method or the relascope method may be applied
Monitoring frequency:	At every verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Comment:	When land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the shrub crown cover oscillates between a minimum and maximum values in the baseline, an average shrub crown cover equal to 0.5 is used unless transparent and verifiable information can be provided to justify a different value

b_{Forest} = Biomass present in the tropical rainforest covers of reference for the project areas. This value is assumed to be **231.7** td.m ha-1. Phillips et al, IDEAM, 2014.[9]

3.7.5.1.2 Belowground biomass

It is estimated using expansion factors defined by default in the IPCC 2003 and 2006, and equations for the relationship of underground biomass.

Root-Shoot Ratio	Value	Source
Pinus sp	$RJ = \frac{e^{(-1.085+0.8836*\ln b)}}{b}$	(Yepes A.P., 2011)
Shrubs	0.40	IPCC 2006 Table 4.4

[9] Phillips, J.F., Duque, A.J., Scott, C., Peña, M.A., Franco, C.A., Galindo, G., Cabrera, E., Álvarez, E. & Cárdenas, D. 2014. Technical Contributions of the Forest and Carbon Monitoring System to Colombia's Proposal to Prepare for REDD+: Activity Data and Emission Factors. Technical report. Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM). Bogotá D.C., Colombia. 45 pp.

3.7.5.1.3 Dead wood and litter on the ground.

The estimation of this component makes use of the methodological tool, AR-TOOL12 "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities*".

For the baseline, the same concept of the non-presence or accumulation of leaf litter is based on the periodic burning processes. Instead, project activities promote the formation of a layer of leaf litter that remains on the ground for long periods. Some studies in pine plantations have shown contributions of up to 29% of biomass in the general balance of carbon sinks. This value compared against zero accumulation in the baseline shows the importance of that deposit in the general carbon balances for the project.

The methodological tool recommends two ways to estimate the carbon content in litter and dead wood components. For the current calculation, the conservative method of default factors will be used.

This methodological process assumes that dead wood is not removed and remains on the plantation soil. This is what actually happens in the project activities, the organic matter derived from pruning or self-pruning (e.g. eucalyptus) and due to natural mortality of some individuals is not removed. This matter is left inside the plantations during the rotation cycle. Your way of calculating for dead wood is defined by:

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

Where:

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

Applied values:

DF_{DW} =

Biome	Elevation	Precipitation	DF_{DW}
Tropical	<2000m	<1000 mm yr^{-1}	2%
Tropical	<2000m	1000-1600 mm yr^{-1}	1%
Tropical	<2000m	>1600 mm yr^{-1}	6%
Tropical	>2000m	All	7%
Temperate/ boreal	All	All	8%

6% is assumed according to the methodological tool.

3.7.5.1.4 Litter and fine debris

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

$$C_{LI,i,t} = C_{TREE,i,t} \times DF_{LI}$$

Where:

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

Applied values:

DF_{LI}	=	10% is assumed as the default value, analyzed from scientific literature for Pinos. sp in tropical areas. See analysis Annex Section 3 - Quantification of GHG emissions reduction/Quantifications/Ex post/DFli_Hojarasca.xlsx

3.7.5.1.5 Soil organic carbon (SOC)

In the baseline conditions (see general paragraphs), due to the characteristics of the soils and their management, they have led to significantly low soil organic carbon contents.

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

The conditions of applicability focus on:

a)

- The project areas do not consider wetlands.

- The soils are NOT defined as organic soils.

- The soils were NOT subject to management practices or application of fertilizer amendments that improved productive and organic conditions; on the contrary, they were subjected to periodic burning.

b)

- The project areas are flat areas, and the activities on them help to improve the physical and chemical conditions compared to the state of degradation described in the baseline, and the forestry activities guarantee good management and conservation of the soils in the area. long term. Soil plowing is not carried out, only chiseling activities to open sowing lines, which allows breaking up hard and crusted soils as a result of burning on oxisols.

- Soil preparation activities are carried out in the establishment stage. After this, the soils will not be altered or intervened. Replanting, which is expected to take place after year 18, does not require alterations to the soil. All leaf litter material and minor detritus are left behind as a way to protect and recirculate nutrients to the soil.

Changes in organic carbon contents are defined by:

$$\boldsymbol{SOC_{INITIAL,i} = SOC_{REF,i} \times f_{LU,i} \times f_{MG,i} \times f_{IN,i}}$$

$SOC_{INITIAL,i}$	=	SOC stock at the beginning of the project activity in stratum i of the areas of land, *t* C ha^{-1}
$SOC_{REF,i}$	=	Reference SOC stock corresponding to the reference condition in native lands (i.e., non-degraded, unimproved lands under native vegetation forest) by climate region and soil type applicable to stratum i of the areas of land *t*C ha^{-1}
$f_{LU,i}$	=	Relative stock change factor for baseline land-use in stratum i of the areas of land; dimensionless.
$f_{MG,i}$	=	Relative stock change factor for baseline management regime in stratum i of the areas of land; dimensionless.

$f_{IN,i}$	=	Relative stock change factor for baseline input regime (e.g., crop residue returns, manure) in stratum i of the areas of land; dimensionless.
i	=	*1, 2, 3, …..* strata of areas of land; dimensionless.

For the estimation of this component, using default factors and following the methodological recommendations of conservative values and maintaining transparency of the results, the ARWG SOC tool Multizone tool in Excel format is used "*The approved spreadsheet to facilitate the calculation of "changes in soil organic carbon stocks*."[10]

This process is applied conservatively to the ex-ante and ex post estimates of the project.

3.7.5.2 Ex-ante general balance

Now, according to the project activities and the selected methodology, the removal projections are developed. The results of the ex-ante analysis were developed for all the sinks considered with a projection of 30 years of implementation. It is important to mention that, as indicated in section 3.2.3.1, planting began in 2015, so in the calculations it is necessary to start from this year, however, the reported removals are taken into account from 2018.

The calculations are available in annex Section 3 - Quantification of GHG emissions reduction/Quantifications/Ex ante/ Exante-Alianza-FID.xlsx.

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

Table 17 - Ratio of emissions removed by above-ground and underground biomass sinks

Year	Pinus caribaea		Total (per year)			Total (cumulated)		
	$dC_{AB,k,t}$	$dC_{BB,k,t}$	dC_{AB}	dC_{BB}	dC	C_{AB}	C_{BB}	C
	t CO_2 $(yr)^{-1}$	t CO_2 $(yr)^{-1}$	t CO_2 $(yr)^{-1}$	t CO_2 $(yr)^{-1}$	t CO_2 $(yr)^{-1}$	t CO_2	t CO_2	t CO_2
2018	6,636.3	3,052.7	6,636.3	3,052.7	9,689.0	6,636.3	3,052.7	***9,689.0***
2019	11,096.9	5,104.6	11,096.9	5,104.6	16,201.4	17,733.2	8,157.3	***25,890.4***
2020	15,261.7	7,020.4	15,261.7	7,020.4	22,282.1	32,994.9	15,177.7	***48,172.6***
2021	18,676.2	8,591.1	18,676.2	8,591.1	27,267.3	51,671.1	23,768.7	***75,439.8***
2022	21,185.7	9,745.4	21,185.7	9,745.4	30,931.1	72,856.8	33,514.1	***106,370.9***
2023	22,802.2	10,489.0	22,802.2	10,489.0	33,291.2	95,659.0	44,003.1	***139,662.1***
2024	23,622.3	10,866.3	23,622.3	10,866.3	34,488.5	119,281.2	54,869.4	***174,150.6***
2025	21,260.3	9,779.8	21,260.3	9,779.8	31,040.1	140,541.6	64,649.1	***205,190.7***
2026	22,353.0	10,282.4	22,353.0	10,282.4	32,635.3	162,894.5	74,931.5	***237,826.0***
2027	22,283.0	8,251.9	22,283.0	8,251.9	30,534.9	185,177.5	83,183.4	***268,360.9***
2028	18,797.6	5,917.7	18,797.6	5,917.7	24,715.4	203,975.2	89,101.1	***293,076.3***
2029	19,177.2	5,973.6	19,177.2	5,973.6	25,150.8	223,152.4	95,074.7	***318,227.1***
2030	18,598.2	5,896.6	18,598.2	5,896.6	24,494.8	241,750.6	100,971.3	***342,721.9***
2031	17,585.7	5,627.4	17,585.7	5,627.4	23,213.2	259,336.4	106,598.8	***365,935.1***
2032	16,176.5	5,176.5	16,176.5	5,176.5	21,353.0	275,512.9	111,775.2	***387,288.1***
2033	14,795.9	4,734.7	14,795.9	4,734.7	19,530.6	290,308.8	116,509.9	***406,818.8***
2034	5,206.1	1,666.0	5,206.1	1,666.0	6,872.1	295,515.0	118,175.9	***413,690.9***
2035	1,731.0	617.3	1,731.0	617.3	2,348.3	297,245.9	118,793.2	***416,039.1***

Year	Pinus caribaea		Total (per year)			Total (cumulated)		
	$dC_{AB,k,t}$	$dC_{BB,k,t}$	dC_{AB}	dC_{BB}	dC	C_{AB}	C_{BB}	C
	t CO_2 $(yr)^{-1}$	t CO_2 $(yr)^{-1}$	t CO_2 $(yr)^{-1}$	t CO_2 $(yr)^{-1}$	t CO_2 $(yr)^{-1}$	t CO_2	t CO_2	t CO_2
2018	6,636.3	3,052.7	6,636.3	3,052.7	9,689.0	6,636.3	3,052.7	***9,689.0***
2036	2,753.7	1,266.7	2,753.7	1,266.7	4,020.4	299,999.6	120,059.9	***420,059.5***
2037	6,636.3	3,052.7	6,636.3	3,052.7	9,689.0	306,635.9	123,112.6	***429,748.5***
2038	11,096.9	5,104.6	11,096.9	5,104.6	16,201.4	317,732.8	128,217.1	***445,949.9***
2039	15,261.7	7,020.4	15,261.7	7,020.4	22,282.1	332,994.5	135,237.5	***468,232.1***
2040	18,676.2	8,591.1	18,676.2	8,591.1	27,267.3	351,670.7	143,828.6	***495,499.3***
2041	21,185.7	9,745.4	21,185.7	9,745.4	30,931.1	372,856.4	153,574.0	***526,430.4***
2042	22,802.2	10,489.0	22,802.2	10,489.0	33,291.2	395,658.6	164,063.0	***559,721.6***
2043	23,622.3	10,866.3	23,622.3	10,866.3	34,488.5	419,280.9	174,929.3	***594,210.1***
2044	21,260.3	9,779.8	21,260.3	9,779.8	31,040.1	440,541.2	184,709.0	***625,250.2***
2045	22,353.0	10,282.4	22,353.0	10,282.4	32,635.3	462,894.2	194,991.4	***657,885.6***
2046	22,283.0	8,251.9	22,283.0	8,251.9	30,534.9	485,177.2	203,243.3	***688,420.5***
2047	18,797.6	5,917.7	18,797.6	5,917.7	24,715.4	503,974.8	209,161.0	***713,135.8***
-	507,181.1	210,636.0	713,135.85			713,135.85		

Table 18 - Ratio of emissions removed by sinks shrubs, litter, dead wood and soil organic carbon.

Shrubs		Litter and deadwood				SOC	
		10%		6%			
$C_{SHRUB,\ t}$		*CL*		*CDW*			
Year	*Acumm.*	*Year*	*Acumm.*	*Year*	*Acumm.*	*Year*	*Acumm.*
t CO_2 año		t CO_2 año	t CO_2	t CO_2 año	t CO_2	t CO2/year	t CO2
3,984	*10,164*	663.63	*984.3*	398.18	*590.56*	4,815.7	*12,286.6*
3,984	*14,148*	1,109.69	*2,093.9*	665.81	*1,256.37*	4,815.7	*17,102.2*
3,972	*18,120*	1,526.17	*3,620.1*	915.70	*2,172.07*	4,815.7	*21,917.9*
3,961	*22,081*	1,867.62	*5,487.7*	1,120.57	*3,292.65*	4,815.7	*26,733.5*
3,961	*26,042*	2,118.57	*7,606.3*	1,271.14	*4,563.79*	4,815.7	*31,549.2*
3,961	*30,003*	2,280.22	*9,886.5*	1,368.13	*5,931.92*	4,815.7	*36,364.8*
3,961	*33,964*	2,362.23	*12,248.8*	1,417.34	*7,349.25*	4,815.7	*41,180.5*
3,961	*37,924*	2,126.03	*14,374.8*	1,275.62	*8,624.88*	4,815.7	*45,996.1*
3,961	*41,885*	2,235.30	*16,610.1*	1,341.18	*9,966.05*	4,815.7	*50,811.8*
3,961	*45,846*	2,228.30	*18,838.4*	1,336.98	*11,303.03*	4,815.7	*55,627.4*
3,961	*49,807*	1,879.76	*20,718.2*	1,127.86	*12,430.89*	4,815.7	*60,443.1*
3,961	*53,768*	1,917.72	*22,635.9*	1,150.63	*13,581.52*	4,815.7	*65,258.7*
3,961	*57,729*	1,859.82	*24,495.7*	1,115.89	*14,697.42*	4,815.7	*70,074.4*
3,961	*61,690*	1,758.57	*26,254.3*	1,055.14	*15,752.56*	4,815.7	*74,890.1*
3,961	*65,651*	1,617.65	*27,871.9*	970.59	*16,723.15*	4,815.7	*79,705.7*
3,961	*69,611*	1,479.59	*29,351.5*	887.76	*17,610.91*	4,815.7	*84,521.4*
3,972	*73,584*	520.61	*29,872.1*	312.37	*17,923.28*	4,815.7	*89,337.0*
3,996	*77,580*	173.10	*30,045.2*	103.86	*18,027.14*	4,815.7	*94,152.7*
3,996	*81,575*	275.37	*30,320.6*	165.22	*18,192.36*	1,726.3	*95,878.9*
3,972	*85,548*	663.63	*30,984.2*	398.18	*18,590.54*	434.1	*96,313.1*

Shrubs		Litter and deadwood				SOC	
		10%		6%			
$C_{SHRUB, t}$		CL		CDW			
Year	Acumm.	Year	Acumm.	Year	Acumm.	Year	Acumm.
3,961	89,509	1,109.69	32,093.9	665.81	19,256.35	0.0	96,313.1
3,961	93,469	1,526.17	33,620.1	915.70	20,172.05	0.0	96,313.1
3,961	97,430	1,867.62	35,487.7	1,120.57	21,292.62	0.0	96,313.1
3,961	101,391	2,118.57	37,606.3	1,271.14	22,563.76	0.0	96,313.1
3,961	105,352	2,280.22	39,886.5	1,368.13	23,931.90	0.0	96,313.1
3,961	109,313	2,362.23	42,248.7	1,417.34	25,349.23	0.0	96,313.1
3,961	113,274	2,126.03	44,374.8	1,275.62	26,624.85	0.0	96,313.1
3,961	117,235	2,235.30	46,610.1	1,341.18	27,966.03	0.0	96,313.1
3,961	121,196	2,228.30	48,838.4	1,336.98	29,303.01	0.0	96,313.1
3,961	125,156	1,879.76	50,718.1	1,127.86	30,430.87	0.0	96,313.1

Table 19 - Balance between carbon removals, emissions, leaks and 20% buffer discount.

Year	GHG emission reductions in the baseline scenario	GHG emission reductions in the project scenario		GHG emissions attributable to leakages	Buffer	Estimated Net GHG Reduction
	tCO2e	tCO_2e	$t\ CO_2e$/year	tCO2e	$t\ CO_2e$	$t\ CO_2e$
2018	0	19,550	19,550	0	3,910	15,640
2019	0	46,327	26,777	0	9,265	37,062

Year	GHG emission reductions in the baseline scenario	GHG emission reductions in the project scenario		GHG emissions attributable to leakages	Buffer	Estimated Net GHG Reduction
	tCO2e	tCO_2e	$t\ CO_2e$/year	tCO2e	$t\ CO_2e$	$t\ CO_2e$
2020	0	79,839	33,512	0	15,968	63,871
2021	0	118,871	39,032	0	23,774	95,097
2022	0	161,969	43,097	0	32,394	129,575
2023	0	207,685	45,716	0	41,537	166,148
2024	0	254,729	47,045	0	50,946	203,783
2025	0	297,948	43,218	0	59,590	238,358
2026	0	342,936	44,988	0	68,587	274,349
2027	0	385,813	42,877	0	77,163	308,650
2028	0	422,312	36,500	0	84,462	337,850
2029	0	459,308	36,996	0	91,862	367,446
2030	0	495,555	36,247	0	99,111	396,444
2031	0	530,358	34,803	0	106,072	424,287
2032	0	563,076	32,718	0	112,615	450,461
2033	0	593,751	30,675	0	118,750	475,000
2034	0	610,244	16,493	0	122,049	488,195
2035	0	621,680	11,437	0	124,336	497,344
2036	0	631,863	10,183	0	126,373	505,491
2037	0	647,021	15,157	0	129,404	517,616
2038	0	668,958	21,938	0	133,792	535,167
2039	0	697,643	28,685	0	139,529	558,115

Year	GHG emission reductions in the baseline scenario	GHG emission reductions in the project scenario		GHG emissions attributable to leakages	Buffer	Estimated Net GHG Reduction
	tCO2e	tCO_2e	$t\ CO_2e$/year	tCO2e	$t\ CO_2e$	$t\ CO_2e$
2040	0	731,860	34,216	0	146,372	585,488
2041	0	770,141	38,282	0	154,028	616,113
2042	0	811,042	40,900	0	162,208	648,833
2043	0	853,271	42,229	0	170,654	682,616
2044	0	891,673	38,403	0	178,335	713,339
2045	0	931,847	40,174	0	186,369	745,478
2046	0	969,910	38,063	0	193,982	775,928
2047	0	1,001,597	31,687	0	200,319	801,277
Total	0,0	15,818,775	1,001,597	0.0	3,163,755	801,277
33,387	-					

4 Compliance with applicable legislation

As evidenced in the previous analysis, extensive livestock farming continues to be the most feasible scenario, both from the point of view of public policies, due to the great agricultural vocation of the country, and of the department; Likewise, being one of the most predominant activities in the rural area of the country, this scenario is not affected by investment and cultural barriers (annex: Section 4 - Legislation).

Law	Characteristics	Compliance
Decree 1449 of 1977. Article 3.	It lists actions aimed at the protection of water resources. For this reason, it defines measures for the areas of retreat and protection. 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 in the eligibility analyses, the areas that are within the protection and withdrawal band were considered NOT eligible, even if these areas did not historically present forest cover.
Decree 1791-1996	Any 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 apply for the respective permit from the Corporation, in accordance with the required requirements.	Chapter XI of this decree determines that, for commercial plantations, it is sufficient to develop the registration with the Colombian Institute of Agriculture (see records on annexes Section 2 - General description of the project\Project activities\Forest Records) and the Forest Establishment and Management Plan, presented by the beneficiary of the Forest Incentive Certificate (CIF, see annexes Section 2 - General description of the project\Project activities\Forest Records) will serve for the Corporations to carry out the registration of the plantation. Resolution 0687 of 1997 is incorporated into this decree, which determines the actions by which the forest resource administration regime of the Orinoquia-Corporinoquia Regional Autonomous Corporation is issued.
RESOLUTION NO. 0687 of 22	Whereby the forest resource administration regime of the regional	The project complies with Chapter VIII related to the conditions of commercial forest plantations, and has submitted the required documents (e.g.,

Law	Characteristics	Compliance
December 1997	autonomous corporation of the Orinoquia - Corporinoquia is issued.	establishment and management plan) for the start of activities adjusted to regional standards.
DECREE NO. 4296 OF 2004	Regulations for controlled open burns in rural areas.	The project complies with national and regional regulations, and does not include in its management practices the residue of waste in soil preparation activities, or the burning of waste derived from maintenance.
Resolution 200.41-11-1130 of June 22, 2011. Update 0687 of December 22, 1997. And Resolution 50041131571 of November 6, 2013.	Whereby the forest resource administration regime of the regional autonomous corporation of the Orinoquia - Corporinoquia is issued. In order to guide regional productive development, Corporinoquia 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 *Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A.* has implemented the recommendations of the resolution and its updates by protecting water sources and remaining forests. The project has a registration and monitoring file in the Corporation where compliance monitoring is detailed. Environmental management policies are adopted and presented to the corporation on a regular basis, and their monitoring and follow-up are recorded and included in the project file that rests with the corporation.
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 issued	The project has the respective applications and approvals for the management of water resources and the potential polluting discharges that are generated. It complies with the due withdrawals for the protection of water sources dictated by article 40 of said decree (see previous paragraphs). The documents related to this decree are contained in file number 800.44.2.12.004 of the Corporation related to the forestry project.

Law	Characteristics	Compliance
Ley 1377 of 2010. Articulo 7	The purpose of this Act is to define and regulate forest plantations and agroforestry systems for commercial purposes.	The project conforms to the definition of *Forestry Activity for Commercial Purposes*, specifically complies with Article 4 on the registration of plantations larger than 10 hectares before the Ministry of Agriculture and Rural Development or whoever takes its place, in this case the ICA and has the due registration of all the lots planted in the project (See Annex Section 2 - General description of the project\Project activities\Forest Records) and Article 7, related to the *NON-establishment* of commercial forestry activities, protected forest areas, special management areas or any other category of management, conservation or protection that excludes such activity, as well as strategic ecosystems, such as moorlands, mangroves, wetlands. As a principle of eligibility, no area will be established where at least 10 before presented forest cover, also for the registration it was evidenced that the areas to intervene are not within the lagoon figure of conservation or protection of ecosystems.
LAW 139 OF 1994.	Whereby the Forest Incentive Certificate is created and other provisions are issued.	The project complies with the conditions established by said law, complies with the requirements and submits the documentation to access the CIF, having positive approval.
Document National Council for Economic and Social Policy (Conpes) 3827 of 2015.	Distribution of resources for the certificate of forest incentive for commercial purposes (CIF of reforestation) - valid 2015.	The project proposal complying with Conpes 3827, demonstrates the suitability of the territory for the distribution of resources Effective 2012, for projects that begin this year, with prior approval of the suitability of compliance. In addition, the selected species are within those required in Part III, related to suitable forest species Forest species that have technical support that demonstrate export potential, among others such as: Acacia (*Acacia mangium*), Melina (*Gmelina arborea*), *Pinus* (*patula, caribea, tecunumanii, oocarpa, maximinoii*), *Eucalyptus* (*grandis, pellita, tereticornis*) and Teca (*Tectona grandis*), Caucho (*Hevea brasiliensis*) and Guadua (*Guadua angustifolia*).

Law	Characteristics	Compliance
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 Conpes Document 3724 that allocated the resources under the procedures described and defined prior to Decree 2448 of 2012.
Resolution 1447 of 2018.	Which regulates the system of monitoring, reporting and verification of mitigation actions at the national level referred to in Article 175 of Law 1753 of 2015, and other provisions are issued.	This resolution establishes the deadlines for the registration of initiatives with RENARE. In September 2019, the project initiative submitted formal registration to the Ministry of Environment and Sustainable Development (see annex Section 4 – Legislation/C.3. RENARE). In response, it was argued that the RENARE platform should not be launched, so registration should be done at the time of its operation. All processes will be fulfilled as soon as it is fully operational. See letter submitted for registration (see annex Section 4 – Legislation/C.3. RENARE). Currently, after the platform is fully functional, the project is registered in the Feasibility Phase (see RENARE platform[11]) In addition, it establishes the development of the Baseline analysis for emission removal projects (art. 35). This baseline analysis can be verified in section 6.2 hereof.

[11] http://renare.siac.gov.co/GPY-web/#/gpy/datbasreg/13/1721

5 Carbon ownership and rights

5.1 Project holder

Organization	**Alianza Fiduciaria S.A**
Contact person	Francisco José Schwitzer Sabogal
Job position	Legal Representative Alianza Fiduciaria S.A
Address	Race 15 # 82 – 99, Torre Alianza, Bogotá D.C., Colombia
Phone number	(+57) 6 44 77 00
Email	grupolhs@grupolhs.com

5.2 Other project participants

Organization	**Grupo LHS - Andalucia and Galicia Trust.**
Contact person	César David Ardila Otero
Job position	Environmental Director
Address	Race 86 No 51 – 66 Of 204, Bogotá D.C., Colombia
Phone number	(601) 3456777 Ext 127
Email	cesar.ardila@grupolhs.com

5.3 Agreements related to carbon rights

The properties where the project is located are both under the control of the company ALIANZA FIDUCIARIA S.A., which has the entire rights of the territory and therefore, the entire management of carbon rights. The information and evidence of the land tenure can be found in section 5.4 of this document.

Additionally, in accordance with the requirements of; standard BCR, the project has certification, issued by the Ministry of the Interior, which clarifies that the project area does not register the presence of ethnic communities (see annex Section 10 - Consultation with stakeholders\ Certificad_MINTERIOR_No comunidades_FID.pdf)

5.4 Land tenure (Projects in the AFOLU sector)

The Andalucía and Galicia properties are registered under public instruments of the municipality of Puerto Carreño (Vichada) with the following real estate registration numbers (see annex Section 5 - Carbon ownership and rights\Ownership).

Table 20 – Real State Registration of the two properties where the Project is located

Property	Real estate registration
Galicia	540-1856 (Previous La Pringosa Property)
Andalucía	540-1925 (Previous Tatacoa Property)

As established in these documents, governance and the area under control are in coordination with ALIANZA FIDUCIARIA S.A. The legal ownership documents are confidential in nature and are presented in Annex Section 5 - Carbon ownership and rights\Ownership. (Ownership to the auditing and certifying entities of the project).

The due demonstration of land tenure (see annex Section 5 - Carbon ownership and rights\Ownership), the proposal to develop commercial forestry activities on the project properties and include the benefits from the sale of the environmental service of carbon capture by the new forests (see Anexos\B. Registros Forestales\CIF\Contratos CIF).

6 Climate change adaptation

In accordance with (Andrade, y otros, 2013) cited by (Cisneros Ramirez & Amezquita Picon, 2015) forest plantations have a diversity of approaches that allow them to improve their adaptation capacity, as the process of genetic material and silvicultural treatments compared with natural forests can be adjusted more easily.

In that same sense, (Chaparron Pinzón , y otros, 2007) highlights that forest plantation projects, in addition to the other categories of CDM forestry projects, generate positive impacts on biodiversity and ecosystems, in addition to contributing to the conservation of water resources and the improvement of soils.

Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A. consists of a forest plantation through which GHG reductions are generated and that also has the characteristics of a commercial plantation CDM project, it is possible to carry out the following analysis in accordance with the established in section 10.8 of the BCR Standard v3.2:

- The project is in line with the with the National Climate Change Policy, whose objective is to promote climate change management that contributes to advancing a path of climate-resilient and low-carbon development (IDEAM, 2018), this being a project framed in strategies for the reduction of GHG emissions.
- The project improves conditions for the conservation of biodiversity and its ecosystem services, and its activities generate sustainable and low-carbon productive landscapes, taking into account that it is a commercial plantation developed in a non-forest area.
- The project integrated actions that assist in the efficient use of soil, including, land use consistent with land vocation and agroecological conditions that increases competitiveness by reducing vulnerability to climate change, as the project activities description evidence (see section 2.3).
- The project proposes areas with restoration processes in areas of special environmental importance, taking into account that part of the areas of the properties where the project is developed correspond to protection areas because they are riparian forests (see annex Section 1 - Project type and elegibility\Elegibility).
- The project develops forest production systems more adapted to high temperatures, droughts or floods, to improve competitiveness, income and food security, especially in vulnerable areas, taking into account that it is developed in an area where the main activity is extensive livestock farming, which favors the risk of drought and soil degradation due to erosion.
- The project develops comprehensive actions that help the efficient use of land, since the conservation of the natural riparian forest covers existing on the properties where the project is developed is contemplated.
- The project generates a reduction in GHG emissions from agricultural activities, compared to the scenario without the project, taking into account that the baseline scenario corresponds to extensive livestock farming.
- The project develops actions directly related to adaptation measures to climate change, taking into account that a forest plantation is established on two properties that have riparian forests associated with bodies of water, so the development of the project contributes to their conservation.

7 Risk management

For the identification and management of project risks, it was adopted the methodology proposed by the PMBOK Project Management Fundamentals Guide (PMBOK, 2013), taking into account the requirements established by the BCR Tool: Permanence and Risk

Management v1.0. In this process, the identification, evaluation and design of mitigation strategies related to both anthropogenic, financial and social risks that may affect the development of the project were carried out.

On the other hand, it is important to clarify that, and as identified in the ex-ante balances of reduced emissions of the project, a minimum value of **20%** for reserves is conservatively assumed for the registration and verification of the project.

Objective

The objective is to publicize the results of the process carried out for risk management of the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A., identify the measures and actions required to control and eliminate sources of risk before they begin to affect compliance. of the project objectives, this will be done under the guidance of the PMBOK project management fundamentals.

Figure 24 - Risk Management according to the Project Management Fundamentals Guide (PMBOK)

Identification and classification of the risks

The process began with a joint review with the participation of representatives from different areas of the company such as projects, Legal, Communities, HSE, Purchasing, Contracting, Finance and Physical Security, where as a result of the meeting an initial list of possible risks was obtained. to materialize for the project. Therefore, as a result of the risk identification and validation exercises, the registered risks were defined according to the following classification:

Table 21 – classification of the risks

Type	ID	Category	Risk Event
Specific risks	1	Anthropic	Deficiency in communication routes
	2		Conflicts in the change of activities by cattle ranchers in the area

Type	ID	Category	Risk Event
	3		Damage to seedlings due to cattle entering replanted areas
	4		Damage to the delimitation infrastructure of the replanted areas and their fire control stations
	5		Risks associated with the management of the occupational safety of personnel linked to the project
	6		Lack of technical assistance
	7	Environmental/Natural	Pest presence affected throughout the project establishment
	8		Wildfires
	9		Affected by natural phenomena (El Niño) where periods of rain and drought intensify
	10		Low soil fertility
	11		Increasing the physicochemical and biotic properties of the project's area of influence
	12	Economic/Financial	Lack of credit for agricultural development
	13		Impetus for the development of new economic activities
	14	Participation Partners	Social conflict due to the presence of ethnic communities
	15		Shortage of trained labor in the area for afforestation activities
	16		I refuse to implement good agricultural practices that allow the sustainable management of plantations
	17	Legal	Delays or denial of applications and approvals for water resources management and the potential pollutant discharges they generate
	18		Obtaining environmental and operating permits
Systemic risks	1	Economic/Financial	Increase in production costs
	2		Shortages of fertilizer and pesticide products
	3		Delays in the approval and granting of established disbursements
Escalation and Operation Risks	1	Anthropic	Deficiency in communication routes
	2		Conflicts in the change of activities by cattle ranchers in the area
	3		Damage to seedlings due to cattle entering replanted areas
	4		Damage to the delimitation infrastructure of the replanted areas and their fire control stations

Type	ID	Category	Risk Event
	5		Risks associated with the management of the occupational safety of personnel linked to the project
	6		Lack of technical assistance
	7	Environmental/Natural	Pest presence affected throughout the project establishment
	8		Wildfires
	9		Affected by natural phenomena (El Niño) where periods of rain and drought intensify
	10		Low soil fertility
	11		Increasing the physicochemical and biotic properties of the project's area of influence
	12	Economic/Financial	Lack of credit for agricultural development
	13		Increase in production costs
	14		Shortages of fertilizer and pesticide products
	15		Delays in the approval and granting of established disbursements
	16		Impetus for the development of new economic activities
	17	Participation Partners	Social conflict due to the presence of ethnic communities
	18		Shortage of trained labor in the area for afforestation activities
	19		I refuse to implement good agricultural practices that allow for the sustainable management of plantations
	20	Legal	Delays or denial of applications and approvals for water resources management and the potential pollutant discharges they generate
	21		Obtaining environmental and operating permits

Risk assessment and analysis.

For the risk analysis process, the following matrix was used:

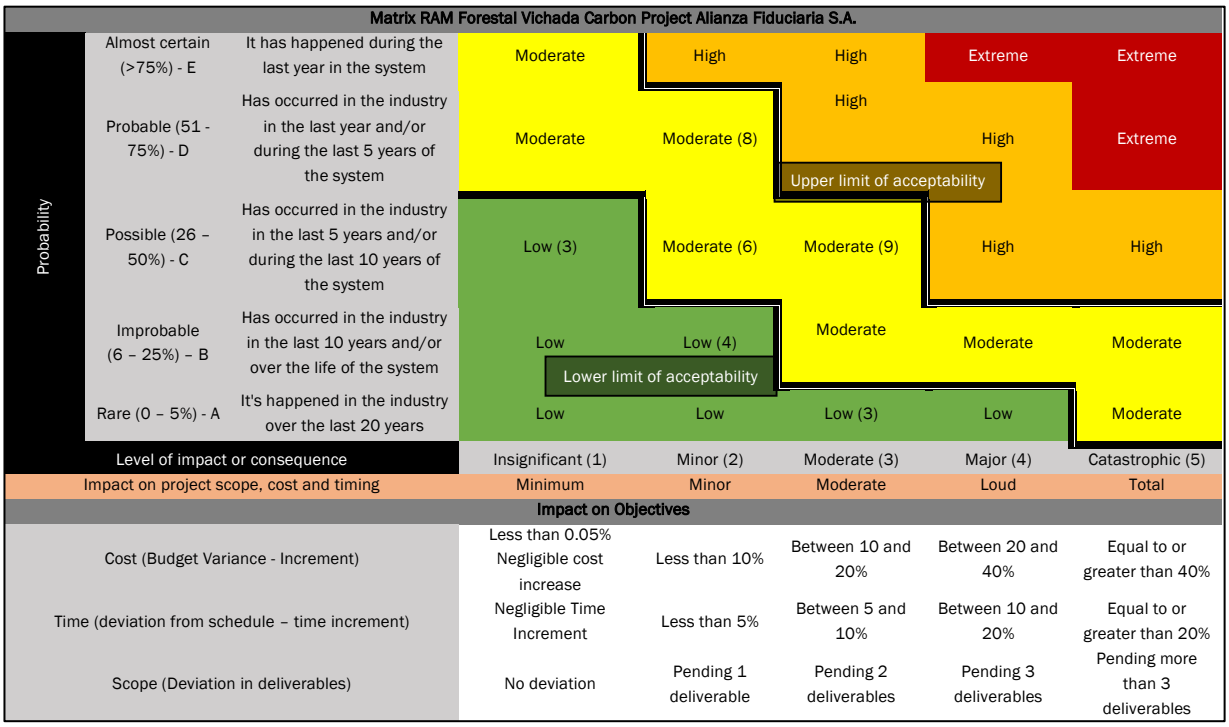


Figure 25 - Risk matrix assigned for the Project

Taking into account the classification of risks and the matrix presented above, the following table shows the result of the qualitative analysis for the project risks.

Table 22 - Risk assessment for the project.

ID	Category	Risk Event	Inherent Risk
1	Anthropic	Deficiency in communication routes	**Moderate**
2		Conflicts in the change of activities by cattle ranchers in the area	**Low**
3		Damage to seedlings due to cattle entering replanted areas	**Moderate**
4		Damage to the delimitation infrastructure of the replanted areas and their fire control stations	**Low**
5		Risks associated with the management of the occupational safety of personnel linked to the project	**Low**
6		Lack of technical assistance	**Low**
7	Environmental/Natural	Pest presence affected throughout the project establishment	**Moderate**
8		Wildfires	**Moderate**

ID	Category	Risk Event	Inherent Risk
9		Affected by natural phenomena (El Niño) where periods of rain and drought intensify	**Moderate**
10		Low soil fertility	**Moderate**
11		Increasing the physicochemical and biotic properties of the project's area of influence	**Moderate**
12	Economic/Financial	Lack of credit for agricultural development	**Low**
13		Increase in production costs	**Moderate**
14		Shortages of fertilizer and pesticide products	**Moderate**
15		Delays in the approval and granting of established disbursements	**Low**
16		Impetus for the development of new economic activities	**Moderate**
17	Participation Partners	Social conflict due to the presence of ethnic communities	**Low**
18		Shortage of trained labor in the area for afforestation activities	**Low**
19		I refuse to implement good agricultural practices that allow for the sustainable management of plantations	**Low**
20	Legal	Delays or denial of applications and approvals for water resources management and the potential pollutant discharges they generate	**Moderate**
21		Obtaining environmental and operating permits	**Low**

When reviewing these results, it can be concluded that in terms of inherent risks, of the 21 events identified and assessed, 43% constitute Moderate risks (11), 48% are Low risks (10) and 10% correspond to opportunities (2).

Within the identification of risks, two opportunities were evident that drive the development of the project with each of the components of the system:

- Opportunity 1: Increase in the physicochemical and biotic properties of the project area of influence (O11)
- Opportunity 2: Boost for the development of new economic activities (O16). In this case, it is highlighted that according to the financial report and cash flow of the project, the project investment is viable taking into account that its cost/benefit ratio was 2.60 (see Annexes\Section 7 - Risk management\Internal Risk\ INFORME FINANCIER VICHADA.docx).

In this sense, the map of inherent risks (before controls and improvement actions) is shown in the following figure:

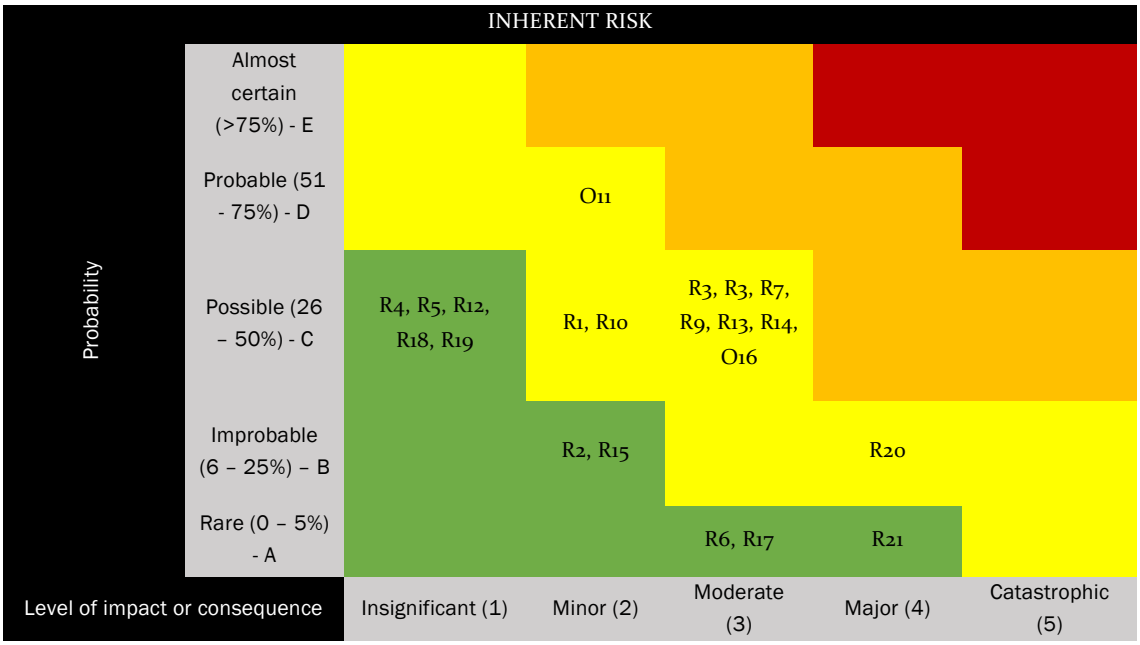


Figure 26 - Map of inherent project risks

General risk management

The treatment plan consists of designing and implementing actions that reduce threats and improve business opportunities, within the development of the project. This plan is aimed at treating risks by priority, executing activities and resources on the schedule, in the budget and in the project management plan.

The strategy is aimed at treating all inherent risks that are above an acceptable level, that is, extreme, high and some moderate, in order to bring them or bring them closer to that acceptable level or a lower level. For inherent risks prioritized as low, it is not necessary to design and implement specific treatment plans, but rather to maintain these risks at the desired levels and incorporate them into the project's risk monitoring and follow-up program.

In this sense, the purpose of this section is to provide guidelines that allow defining the most appropriate actions for the treatment of the inherent risks detected.

According to the results obtained and the characteristics of the project, the risk treatment strategy that will be used during the development of the project is established taking into account that all risks with extreme and high category must be mitigated and avoided, those of moderate category should be mitigated and those in low category should be monitored.

Through this assessment, we can help determine the different strategies or actions to manage the risk, depending on the criticality in which the risk is qualified or valued, without it being a limitation to define other actions in its administration.

The four treatment strategies that were considered are expressed based on the priority level of inherent risk identified and assessed, as follows:

Table 23 - Project Risk Treatment Strategies

Priority	Qualification	Treatment Strategy
1	Extreme	Mitigate – Avoid: Requires immediate action to resolve, mitigate or avoid extreme risk
2	High	Mitigate – Avoid: Requires immediate action to resolve, mitigate or avoid the high risk
3	Moderate	Mitigate – Transfer: Requires implementation of other improvement actions to optimize risk
4	Low	Accept – Monitor: Requires continuation of the current risk management process and monitoring

For the implementation of these strategies in the project, the following criteria or concepts were considered:

Avoid risk:

This action consists of not carrying out or withdrawing the activities causing the risk, in which their additional treatment is not effective in terms of benefit/cost for the company. As the title indicates, this action also consists of changing the project plan to protect the objectives that could be impacted by the materialization of the risk. The most common measures used for this purpose are, among others:

- Reduce the scope
- Add resources
- Allocate more time
- Avoid unknown contractors
- Obtain more information
- Hire experts

Reduce risk

This action has to do with taking measures to reduce the probability of the risk occurring or its magnitude of impact, or possibly both. To achieve this, the following measures can be implemented, among others:

- Adopt simpler processes
- Perform more tests
- Select more stable suppliers

Transfer the risk

This action consists of taking measures aimed at transferring to a third party the responsibility for risk management and/or the obligation for the financial consequences of the risk in the event of its occurrence. Transfer of risk will be considered through the following alternatives:

- Establish "outsourcing" by hiring suppliers for the processes that are intended to be outsourced.
- Buy insurance policies that provide protection
- Design hedging operations
- Performance bonuses
- Guarantees and fines
- Subcontracts

Accept the risk

This action consists of accepting the risk given that its level of criticality is within the defined acceptable risk levels or because the required treatments are not technically feasible, or their implementation does not represent a greater benefit in relation to its cost. This type of action includes contingency measures, which can be:

- Active, which consists of establishing a reserve that includes time, money or resources to address the accepted risks. This reserve is determined by the impacts of the risks that are going to be assumed.
- Passive, which consists of not taking any action, and if the risk materializes, the project team will be in charge of managing it reactively with the existing contingency plan.

Detailed treatment actions

In accordance with the characteristics of the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A. and the classification of the specific risks obtained, the

improvement actions that must be implemented to bring the specific risks classified as moderate to lower levels as shown below:

Table 24 - Improvement actions for risks associated with the project.

ID	Risk Event	Inherent Risk	Improvement Actions
1	Deficiency in communication routes	**Moderate**	Request for raw materials, equipment, machinery in advance of the activity so that it is not delayed or affected, routes for personnel who live in places far from the project area
2	Damage to seedlings due to cattle entering replanted areas	**Moderate**	Have insurance that covers these damages, personnel available to monitor these areas and a well-structured delimitation infrastructure
3	Pest presence affected throughout the project establishment	**Moderate**	Insurance that covers crops, periodic review of the condition of crops and application of pesticides according to pest control
4	Wildfires	**Moderate**	Comprehensive insurance, frequent watering of areas prone to fires, policies of not using cigarettes, cigarette butts, matches, bottles, glass, garbage or other elements that cause fire, among other fire control actions
5	Affected by natural phenomena (El Niño) where periods of rain and drought intensify	**Moderate**	Secure all risks, keep an emergency plan active and in place that provides, for example, meeting points, that water outlet channels are free and unobstructed, and that there are irrigation areas in case of drought
6	Low soil fertility	**Moderate**	Verify that there is good irrigation drainage, adequate machinery, crop rotation, and incorporation of protection crops that add organic matter to the soil
7	Increase in the physicochemical and biotic properties of the project's area of influence*	**Moderate**	These are considered opportunities, so the project will tend to enhance them
8	Promotion for the development of new economic activities**	**Moderate**	
9	Delays or denial of applications and approvals for water resources management and the potential	**Moderate**	Make requests in advance and check their status persistently in case corrections need to be made

ID	Risk Event	Inherent Risk	Improvement Actions
	pollutant discharges they generate		

The beginning of the implementation of these improvement actions is to mitigate in case of materialization or transfer immediately and gradually. Once these actions are carried out, these risks are expected to decrease in level.

7.1 Reversal Risk

As detailed previously, the upper Orinoquia region of Colombia has a series of environmental limitations for the development of agricultural activities, and the culture of burning makes commercial agricultural crops even more vulnerable when these burning activities are carried out without control.

In view of these two key aspects, which threaten the effectiveness of carbon removals by the project, the following actions are proposed:

Risk due to non-adaptation of species to regional conditions.

- Establish species with known and recommended technological packages for the region. This activity is supported by the technical concepts issued by FINAGRO for the financing of forest plantations with commercial species, based on the technical requirements imposed by the National Forestry Incentive Certificate.
- It is proposed to follow up on the development of the plantations, making the necessary replanting interventions in the initial stages of the plantation, trying to maintain a balance in the density of individuals per hectare.
- Take the necessary measures in a timely manner when an established species does not present the expected development (e.g.: survival less than 40%, average annual increase less than 50% of the reported, high incidence of phytosanitary or genetic problems). In these cases, it is recommended to evaluate the limitation and make a change of species for the identified area, which must have its own technological package.
- Obtain certified seeds that meet high quality standards and, in particular, come from stands with the same environmental conditions as those of the Orinoquia.
- Implement silvicultural management activities in a timely manner.

Risk of loss due to fire.

When these are of anthropogenic origin and are part of the culture of burning to renew pastures, their occurrence is reduced by maintaining a dialogue with the nearby neighbors of the properties. It should be noted that there are no livestock on the properties, but the neighbors continue with this activity.

- A forest fire prevention and mitigation plan will be implemented to avoid losses in the stands and natural forest areas. Intensify fire monitoring during periods of major drought in the region and during periods of major lightning strikes in the region. The project has a monitoring scheme based on the country's official information. This makes it possible to evaluate the degree of occurrence of a potential fire according to the environmental conditions identified, which together with the anthropogenic burning activities maximize the possibility of fire occurrence in the stands.
- There should be a high resilience capacity to the occurrence of a fire, based on information that will be monitored when a fire occurs. The results of a fire, its intensity and strength, can result in the loss of a plot, or simply affect the development temporarily and the plantation can recover. In the event of an evaluation that shows a total loss, it is recommended that the site be reconditioned and replanted as soon as possible, and that an evaluation of what happened be carried out in order to implement corrective actions when necessary.
- Control of residues from pruning, thinning and cleaning. Avoid exposing them to possible incineration, resulting in uncontrolled fires (it should be noted that burning this material is not permitted by national environmental legislation and is not part of the plantation preparation and management activities).

All of these actions are subject to monitoring and reporting and must be reported to the environmental authorities when the losses are due to fires.

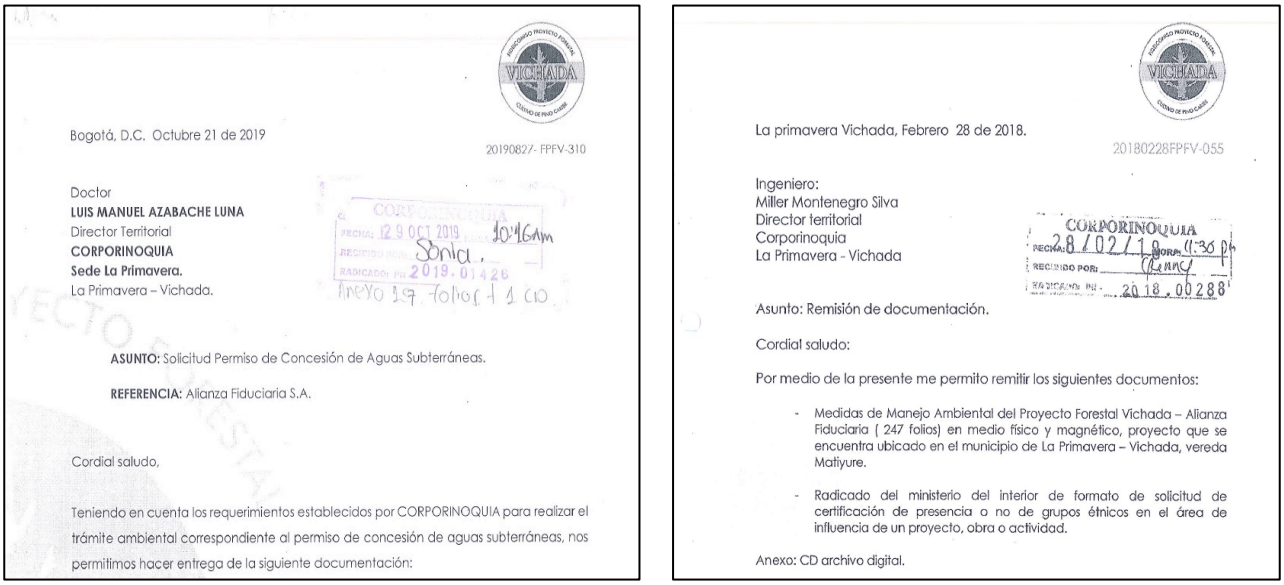
When losses are due to pests, diseases, or lack of species adaptation, they will be documented and reported to the project's quality control unit (technical team) and to the entities that promote forestry development in Colombia, such as the ICA, FINAGRO, and the Ministry of Agriculture.

8 Environmental Aspects

In this way, an Environmental Management Plan has been presented to the Corporinoquia corporation, which includes aspects related to monitoring and tracking (Annex Section 8 - Environmental Aspects) of the biotic components. This allows for an evaluation of its status in the baseline and how the project activities can generate

positive or negative impacts on this environment and specifically on the pre-existing forested areas.

The environmental management plans and measures have not yet been approved, so the actions are carried out in compliance with the regulations and their evaluation by the corporation is awaited.



Bogotá, D.C. Octubre 21 de 2019

20190827- FPFV-310

Doctor
LUIS MANUEL AZABACHE LUNA
Director Territorial
CORPORINOQUIA
Sede La Primavera.
La Primavera – Vichada.

ASUNTO: Solicitud Permiso de Concesión de Aguas Subterráneas.

REFERENCIA: Alianza Fiduciaria S.A.

Cordial saludo,

Teniendo en cuenta los requerimientos establecidos por CORPORINOQUIA para realizar el trámite ambiental correspondiente al permiso de concesión de aguas subterráneas, nos permitimos hacer entrega de la siguiente documentación:

La primavera Vichada, Febrero 28 de 2018.

20180228FPFV-055

Ingeniero:
Miller Montenegro Silva
Director territorial
Corporinoquia
La Primavera - Vichada

CORPORINOQUIA
RECIBIDO POR:
2018.00288

Asunto: Remisión de documentación.

Cordial saludo:

Por medio de la presente me permito remitir los siguientes documentos:

- Medidas de Manejo Ambiental del Proyecto Forestal Vichada – Alianza Fiduciaria (247 folios) en medio físico y magnético, proyecto que se encuentra ubicado en el municipio de La Primavera – Vichada, vereda Matiyure.
- Radicado del ministerio del interior de formato de solicitud de certificación de presencia o no de grupos étnicos en el área de influencia de un proyecto, obra o actividad.

Anexo: CD archivo digital.

Figure 27 - Image of the letters requesting approval of Environmental Management measures.

Regarding the biotic component, it is intended to track and monitor it, which will only be implemented when the corporation approves the documents delivered for the environmental management measures, abiding by its recommendations for the monitoring of this component.

Colombia approved the CITES convention through Law 17 of 1981, the administrative authority is the Ministry of the Environment, the scientific authorities were appointed by decrees 1420 of 1997 and 125 of February 3, 2000 and are: Biological Resources Research Institute Alexander von Humboldt (IAvH), Amazon Institute of Scientific Research (SINCHI), Institute of Marine and Coastal Research (INVEMAR), Institute of Environmental Research of the Pacific (IIAP), Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) and the Institute of Natural Sciences at the National University of Colombia.

The species covered by CITES are included in three appendices and are located in these according to the degree of protection they need. Appendix I includes species that are in danger of extinction; trade in these is authorized only under exceptional circumstances.

Appendix II includes species that are not necessarily classified as endangered, but their trade must be controlled to prevent their use from threatening their survival. Appendix III includes species that are protected in at least one country, which has requested assistance from other CITES parties to control their trade.

Although the project has not yet implemented its biodiversity monitoring measures, it stands out how the forest core projects associated with this initiative are advancing in their implementation, managing to identify a series of fauna species with some degree of threat (Table 25).

These results serve the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A. as a baseline for when monitoring actions are developed and recorded.

Table 25 - Preliminary Fauna Inventory

No.	Group	Common name	Specie	IUCN Threat Category	CITES
1	**Birds**	Pajuil	*Crax alector*	LC	No
2		Crab duck	*Dendrocygna*	LC	III (Denmark)
3		Mirla	*Columba sp.*	LC	No
4		Parrots	*Especie sin*	-	-
5		Eagle	*Spizaetus ornatus*	LC	II
6		Grey Heron	*Ardea alba*	LC	III (Denmark)
7		Jay	*Cacicus cela*	LC	No
1	**Mammals**	Lion	*Puma concolor*	NT	I
2		Chigüiro	*Hydrochoerus*	LC	No
3		Deer	*Mazama americana*		
4		Armadillos	*Dasypus*	LC	No
5		Anteater	*Myrmecophaga tridactyla*	VU	II
6		Danta	*Tapirus terrestris*	EN	II
7		Araguatos	*Alouatta seniculus*	LC	II
8		Corn monkey	*Cebus apella*	LC	II
9		Porcupine	*Coendou*	LC	No
10		Wild rabbit	*Sylvilagus sp.*	LC	No
11		Limpet	*Cuniculus paca*	LC	III (Austria, Honduras)
12		Ñeque o guatín	*Dasyprocta*	LC	III (Austria, Honduras)

No.	Group	Common name	Specie	IUCN Threat Category	CITES
13		Pacifiers or martejas	*Metachirus nudicaudatus*	LC	No
1	**Reptiles**	Black Guide	*Eunectes murinus*	DD	II
2		Partridge Guide	*Boa constrictor*	EN	II
3		Four Nose	*Bothrops atrox*	-	No
4		Rattlesnake	*Crotalus durissus*	LC	III (Austria, Honduras)
5		Coral	*Micrurus sp.*	-	No

Landscape Ecology

Felines are classified as an umbrella species, which means that from the presence of feline populations in an area it can be inferred that there is sufficient prey to feed these carnivores and associated biodiversity under favorable conditions. Large cats are generally the first to disappear from ecosystems, due to their requirements (large areas for movement, numerous prey) and their low reproductive rate, for this reason their presence can indicate the good state of conservation of the ecosystems.

Due to the great importance of this species, areas have been identified where it is located and through which it moves, called: The Jaguar Corridor. The most important area of this corridor is located in the middle and northern Magdalena of the Orinoquia. The corridor corresponds to a tenuous line in these areas of Colombia and requires a great conservation effort by the competent authorities and residents. Failure to protect the areas of the corridor can lead to the loss of connectivity, not only of the populations of the north and east of the country, but also, among jaguar corridors of Central and South America.

The eastern corridor is identified and monitored through multiple samplings with interviews and camera traps to detect the presence of jaguars and delimit the local extinction limit. The most important corridors in the plains are the gallery forests along the Meta, Casanare and Arauca rivers. Taking into account this, and many other attributes of the biodiversity of the area in which the Reforestation project is developed, hunting of ANY species of fauna is prohibited as a measure to protect biodiversity and contribute to the conservation of the Jaguar corridor.

On the other hand, it is important to clarify that for the development of this section, in conjunction with section 9, the BCR No Net Harm tool was used, so taking into account the information indicated in each of these sections, the following statements are made:

- The project activities do not violate local, state/provincial, national, or international regulations or obligations (as it is evidenced in section 0).
- The project identifies environmental and social effects resulting from its implementation.
- The project conducts the assessment and the risk management (as it is evidenced in section 7).

8.1.1 General Social And Environmental Characteristics Of The Area In Which Forestry Activities Are Developed

The Department of Vichada is the second largest department in Colombia with a territorial area of 105,947 km², occupying 8.7% of the national territory. Located in the east of the country, in the Orinoquia 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 (UNAL, 2018).

Its capital 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 km² 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, 2018).

It has a participation in the national GDP of 0.12%; The economy of the department is based mainly on: 52.2% on 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, 2018).

The Department's economy is based 57% on the agricultural sector, livestock, hunting, forestry and fishing. In livestock farming, the vaccine stands out, which is developed on the entire surface covered by natural savannahs, mainly in the municipality of La Primavera.

8.1.1.1 Weather

The average altitude of the Municipality is 117 m high, corresponding to the warm thermal floor (Municipal Administration La Primavera, 2016). 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 (Figure 28); which end up becoming limiting factors for agricultural development due to excesses or deficits of water.

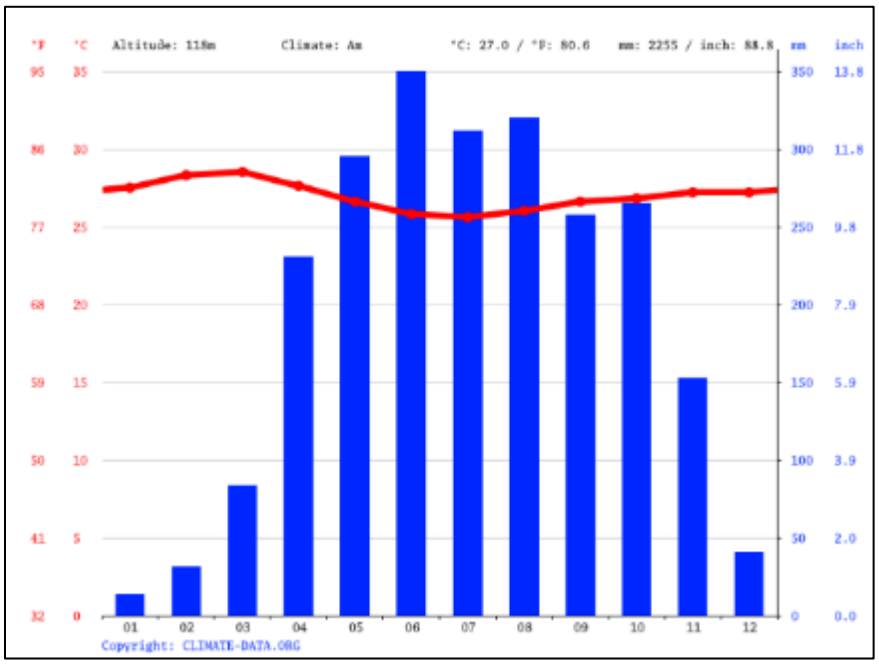


Figure 28 - Distribution of rainfall throughout the year in the municipality of La Primavera, Vichada.

Note: 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.

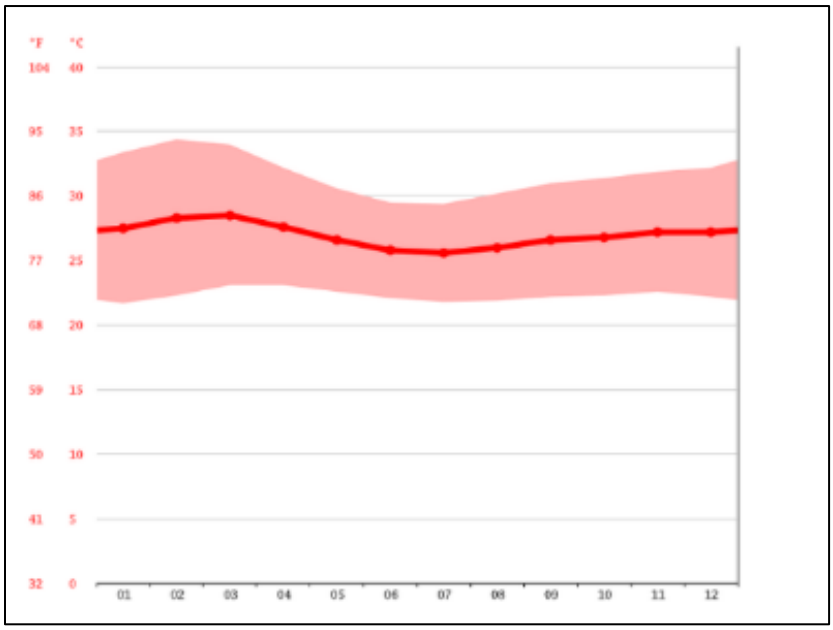


Figure 29 - Behavior of the average temperature over a period of one year for the municipality of La Primavera Vichada.

Note: 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.

8.1.1.2 Soil conditions

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 taken advantage of if appropriate agronomic practices are carried out to improve the conditions of the soils in which there are low contents of organic matter, high acidity and in some sectors aluminum toxicities, this large amount of land is seen with potential for expansion. in soybean, corn and rice crops for agro-industrial development and extensive livestock farming as the main livestock production (UNAL, 2018).

The department of Vichada has an area of 100,242 km^2, 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. of adaptation to the environmental offer of the territory. Species like *Acacia mangium, Pinus Caribaea, EucaIiptus grandis, EucaIiptus peIIita, EucaIiptus tereticornis and Pinus oocarpa*, among others, stand out.

8.1.1.3 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, since they are crossed by numerous rivers, canals, streams and other minor streams, among which the Meta River stands out for its flow and importance, which serves as a natural limit 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 sub-basins 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 its main tributaries is the Bita River that 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 at its source and with close proximity to the Caño Lobo and the Elbita River which flows into the Tomo River (Figure 30 and Figure 31).

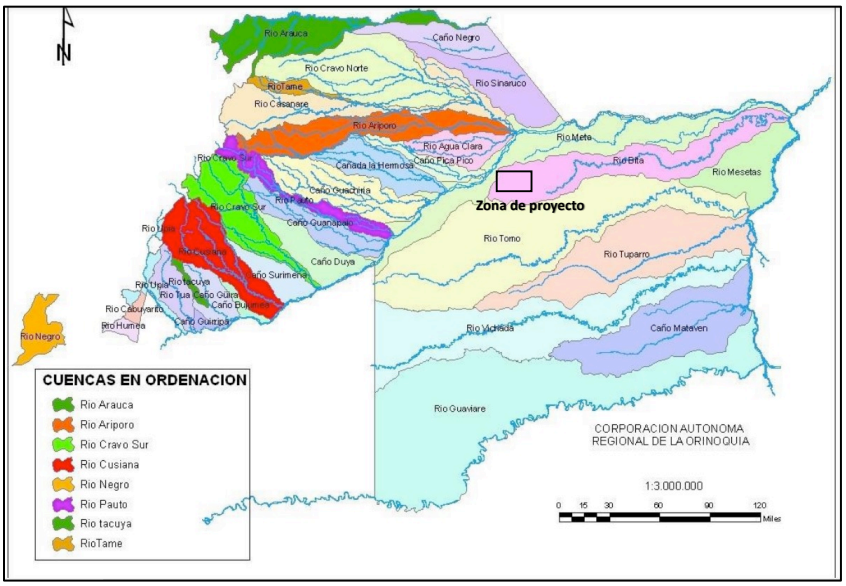


Figure 30 - Hydrographic basins of the jurisdiction area of Corporinoquía (CORPORINOQUÍA, 2013)

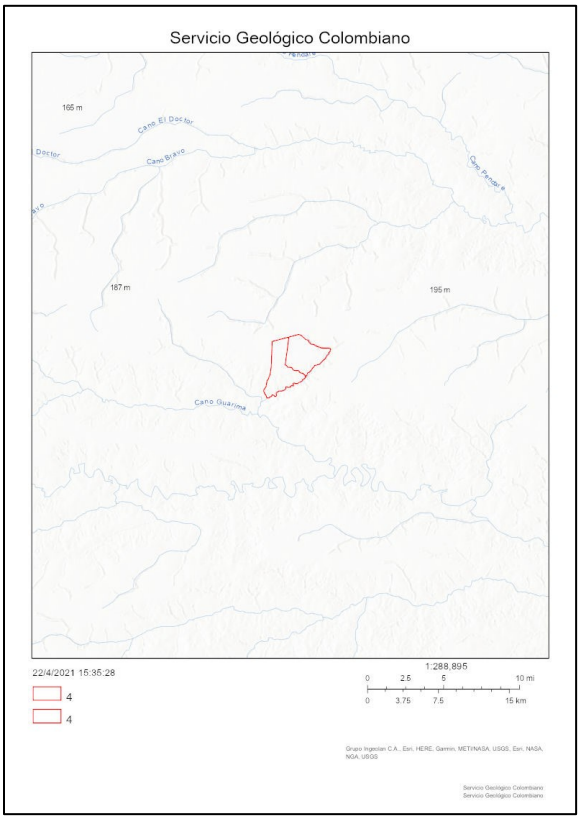


Figure 31 - Main channels around the project area (SGC)

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. Along its route from west to east, more than 200 km are navigable in winter, mostly by small boats. As tributaries it has numerous channels, including: El Bravo, Pendare, Cabrillas, Avión and Tres Matas (Government of Vichada, 2013). The presence of a rich biodiversity makes this Subbasin of vital importance for natural conservation within the rural area of the municipality, therefore, expanding the reserve conservation zones will result in not only an environmentally strategic area, a point of local development from activities such as ecotourism.

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 (Vichada Departmental Government, 2008).

The Guaviare River, located in the south of the department, is another fluvial limit of the Orinoquia. Its origin is in the Eastern Mountain range, 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 sectors of its course. Figure 32 shows the density of the Vichada water network (Ecofondo, 2005).

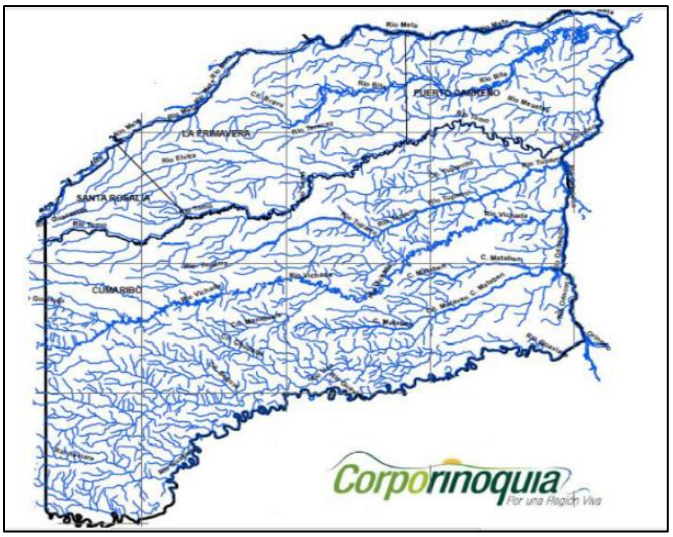


Figure 32 - Main water currents of Vichada (CORPORINOQUÍA, 2013)

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, as a consequence of the lack of an adequate hydroclimatic monitoring network and the difficulty of 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 , 2008).

8.1.1.4 Physiography, topography and geology

According to the physiographic and landscape analyzes in the Region, it is inferred that in the municipalities of La Primavera, Puerto Carreño, Santa Rosalía and approximately 50% of the territory north of the municipality of Cumaribo, there is a high plain physiographic subprovince, This is located between 90 and 120 meters above sea level, and has a very gentle inclination towards the east of the country, it is also known as the overflow plain of the rivers coming from the Eastern mountain range (CORPORINOQUÍA, 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 clogged drainage axes known as estuaries (CORPORINOQUIA, 2017). Likewise, within the high plain, the following great landscapes are contemplated:

- The structural-erosion Altillanura that consists of an almost flat undulating terrain with some terraces.
- Residual plateau of the shield, which consists of the flat plain with artificial soils (alluvial colluvium).
- Depositional - erosional high plain that is made up of deposits of sand, silt, clay and gravel, they 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 (CORPORINOQUÍA, 2013).

The topography is mostly made up of savannahs, strips of forest slopes and galleries. 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 called the Alluvial Plain of the poorly drained Orinoquia, the Altillanura of the well drained Orinoquia, 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.

8.1.1.5 Geology

In general, for the Orinoquia region, the soil typology and its 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 Floodable (Malagón Castro, 2003).

In addition to the aforementioned characteristics, there is the continuous burning that is carried out in the project areas to promote the regeneration of pastures for livestock. These generate progressive degradation that also affects soil fertility. On the other hand, the most common use of the land was extensive livestock farming, this led to processes of erosion and soil compaction. Likewise, the introduction of non-native grasses for cattle grazing generated deterioration in biodiversity and soil degradation. Due to the above and if livestock activities had continued, the soils would not have the capacity to develop regeneration processes of the native flora.

8.1.1.6 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 forest of gallery provides biomass, significantly increases moisture content and the soils present humric 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 year-1) in herbaceous savannahs, 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 (Malagón Castro, 2003).

The rainy season influences the loss of the few soluble or exchangeable elements in the soil, generating high acidity. The pH of the soil is generally lower than 5.0 and in dry seasons the polymerization of humic substances is favored, such as the hardening of horizons and cementation (petroferrous materials) from the dehydration of iron compounds. The alteration in the flat or dissected plain not affected by hydromorphism, presents an advanced degree, manifested in the mineralogical composition of sands and silts. In the clay fraction, kaolinite, iron and aluminum oxyhydroxides integrated 2:1:1 predominate, with interlaminar aluminum, pyrophyllite and gibbsite (Malagón Castro, 2003).

This 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 much smaller 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, Escobar, Toledo, Fisher, & Mesa, 2001).

Figure 33 - 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[12].

The effect of the marked climatic seasonality, its relationship with tropical savannah vegetation and the establishment of humus has generated, in conjunction with advanced alteration, characteristics of very low fertility, both current and potential, which leads to specific agronomic practices based in establishing, maintaining, and improving varieties of plants adapted to these conditions (Cortés 1982, cited by Malagón 2004). In particular, a soil analysis carried out for the El Deseo farm of the Organization La Primavera S.A. subproject is presented in Table 26.

Table 26 - IGAC soil analysis, El Deseo property

Description	Characteristics	Percentage (%)
Particle size	Arena	45.60
	Limo	36.30
	Clay	18.10
Texture	Franca	
pH		5.00
Exchangeable acidity	A.I	0.79 meq/100g
% Acidity Saturation Interchangeable	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

[12] 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 ferruginous stone) and forms a hard layer or hard concretions.
http://www.fao.org/tempref/fi/cdrom/fao_training/fao_training/general/x6706s/x6706s01.htm

Description	Characteristics	Percentage (%)
Base Saturation Percentage		4.70%
Phosphorus		Undetected

These results are consistent with those reported by Rippstein et al (2001) for the Colombian highland, specifically for the undulating highland (Table 27).

Table 27 - Textural and chemical properties for soils from the undulating highlands in Colombia

Element	Dry Savannah and Undulating Highlands
Clay (%)	30.4
Arena (%)	41.9
Limo (%)	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

8.1.1.7 Ecosystems

The Eastern Plains of Colombia correspond to an extensive savanna that starts from the foothills with the Eastern mountain range, 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 km^2, in which three large landscapes can be identified (CORPORINOQUÍA, 2013):

- The plain foothills
- The floodplain
- The flat and undulating plateau

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 4,000 mm of annual precipitation80. The second landscape is the region located to the 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 Eastern Mountain range 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 corresponds to the tropical savanna 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 importance of fire in the evolution of these savannas can be verified by the existence of woody species of a pyrophilous nature (*Curatella Americana, Byrsonima crassifolia, Bowdichia virgiliodes, Xylopia aromatica, Miconia sp.*) (Alvarado, 1991). Below is a general description of the ecosystems present in the region:

General landscape of the Colombian highland

Gallery forests

Savannahs with various grasses

Figure 34 - Images of the coverage 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 highland forests and 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, gallery or riparian forests develop. These formations are important from an ecological point of view as they serve as corridors for the dispersion 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*. The main tree species present are: *Terminalia amazonica, Tabebuia serratifolia, Ceiba pentandra, Jacaranda copaia, Hymenaea courbaril, Enterolobium schomburgkii, Parkia pendula, Callophyllum sp., Inga sp., Spondias mombin, Guatteria sp., Bombacopsis quinatum*, among others (Alvarado, 1991).

On the other hand, regarding 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).

9 Socio-economic aspects

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 be used for other projects, the local demonstration of how reforestation activities contribute economically to development. sustainability of the region, 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 require training and qualification of personnel, promoting new labor skills to the community.

In addition, the project activities have promoted employment in the region, there is no consolidated information on these activities, but it is estimated that one job is generated for every 10 hectares. In this way, for the 1,641.70 hectares established by the Project, a little more than 164 jobs have been generated in forestry activities. As described in the opening paragraphs, the rural population with work capacity for the territory is low, and all of them must be counted. In addition to technical labor training, personnel have been qualified in aspects of occupational safety and good management of natural resources (Table 28, see annex Section 9 - Socioeconomic aspects).

Table 28 - List of trainings and people who participated in them.

Training	Quantity	People
Workplace Accidents	1	6
Waste Management	1	6
Order and Cleanliness	1	4
Mechanical risk. Hand Care	1	5
Natural resources	1	5
Efficient Use of Water and Paper	1	4
Total	**6**	**30**

9.1 Social and economic aspects of the department

9.1.1 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 km². 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 35).

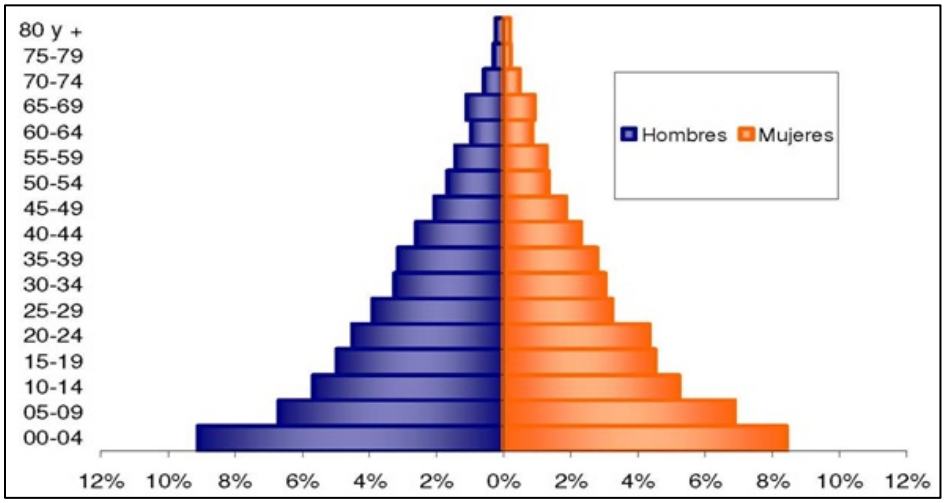


Figure 35 - Population distribution years prior to the start of project activities (DANE, 2010)

According to the pyramidal shape of the population graph, a progressive population is assumed, where young people strongly dominate.

After implementation, for the year 2016, the population was estimated at 73,702 inhabitants, that is, an increase of 31% in a period of six years, with an estimated 0.73 inhabitants per km², still low for the size of the territory.

Inhabitants in the Vichada department.

- No. Headquarters Inhabitants: 30,660
- No. Inhabitants Rural Area: 43,042
- Total: 73,702

Of these inhabitants, the percentage of the working-active population is maintained, surely due to the majority trend of young population that was present prior to 2010.

However, as shown in Table 29, the young population begins to decrease and the adult population. It could be interpreted 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, which is why the contribution to the generation of employment in the rural sector is a great contribution of the project to the development of the territory.

Table 29 - Age distribution for the department of Vichada, year 2016[13]

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

Now, a more detailed look at the municipality of La Primavera, where the project activities are focused, reflects that despite being the second largest municipality in Colombia (larger even than other departments in the country), it only has the 21.5% of the population of Vichada, with a total of 15,886 inhabitants (Table 30), of which an estimated 16% is indigenous. And the average number of people per square kilometer is 0.74, which is consistent with the departmental average.

Table 30 - Population distribution for the different municipalities of Vichada.

Inhabitants by department										
Municipalities	Distribution by age range						Distribution by sex		Total	% of total Muni.
	<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

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

Inhabitants by department										
Municipalities	Distribution by age range						Distribution by sex		Total	% of total Muni.
	<1 year	1-4	5-14	15-44	45-59	>60	Men	Women		
%	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	

9.1.2 Population distribution

According to (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 the colonizing population, immigrants from the rest of the country and ethnic groups. According to (DANE, 2010) cited in the Geographiando 2.0 portal, the total projection of the indigenous population for the department in 2012 is 27,596 inhabitants, concentrated especially in the Municipalities of Santa Rosalía, Carreño and especially in Cumaribo, where the largest masses of natural tropical forest of Vichada in the Orinoquia-Amazon transition. In the municipality of La Primavera, for its part, for the years prior to the start of activities, there was a low indigenous population, specifically 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 36).

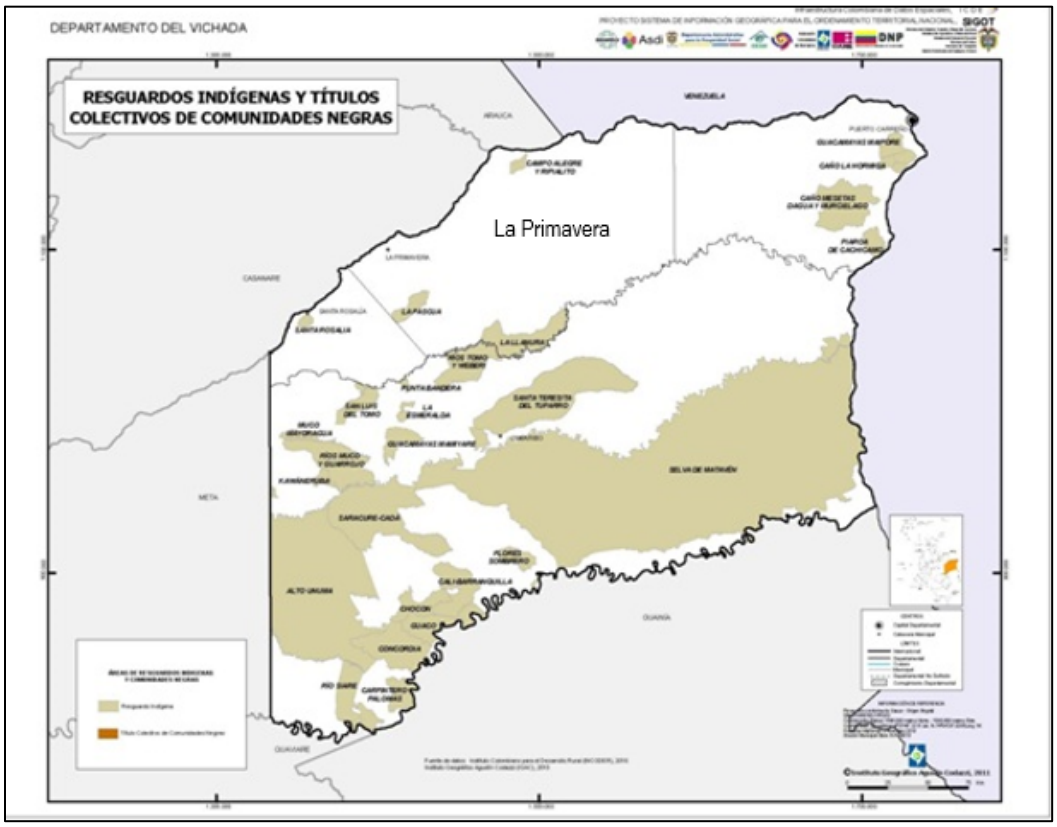


Figure 36 - Distribution of the indigenous population in the Department of Vichada. (IGAC, 2010)

9.1.3 Economy and society

Livestock is the first link in the economy of the municipality of La Primavera; it is estimated that more than 50% of the livestock in the department are in the Municipality. For 2014, a number of 125,750 head of cattle was estimated. An extensive activity where it is estimated that only 3% of the properties dedicated to livestock farming have implemented pasture improvement (Municipal Administration La Primavera, 2016). 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 de la Hoz, 2003). contributing only 1% of the country's bovine heads. Although livestock activity is

the main 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.

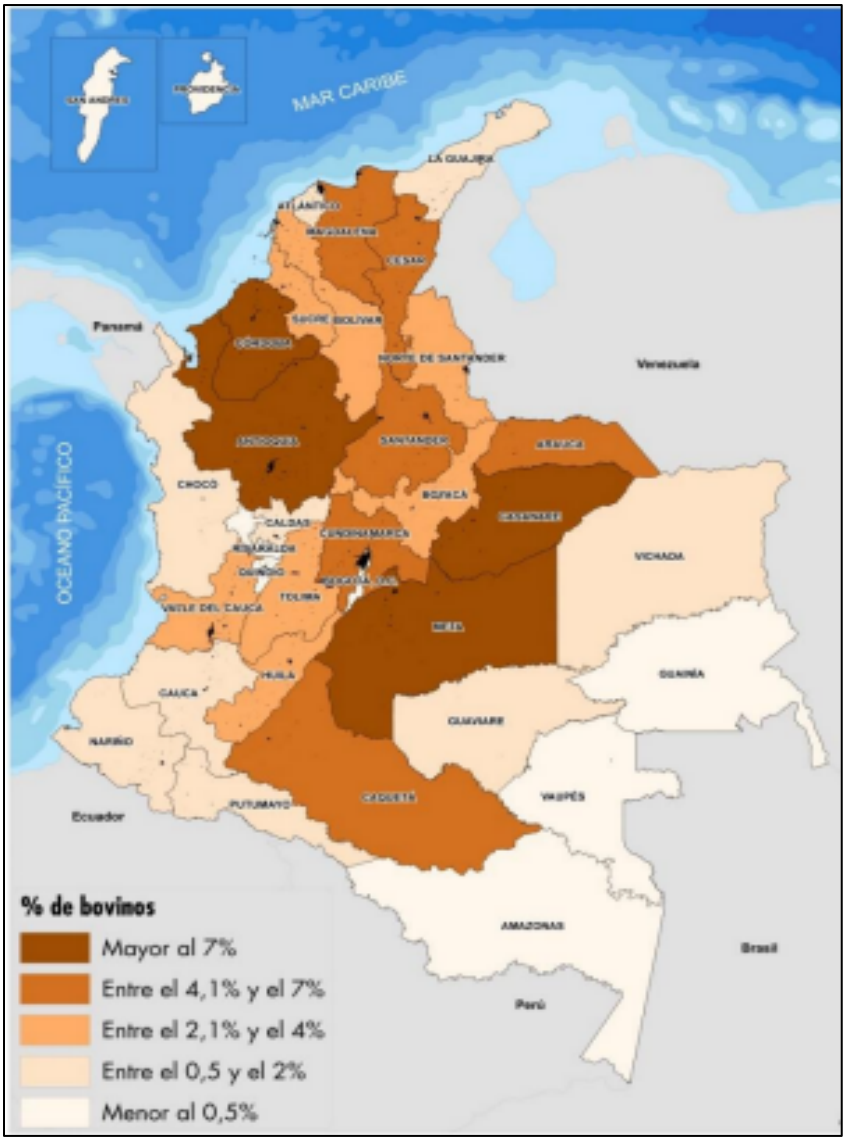


Figure 37 - Contribution of bovine heads by department to the national inventory (DANE, 2015)

Other sources of income are related to the production of cotton, corn, and banana, whose production is achieved with traditional systems and a minimum of technique 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 between 66% to 100% for the period 2005-2010, 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 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.

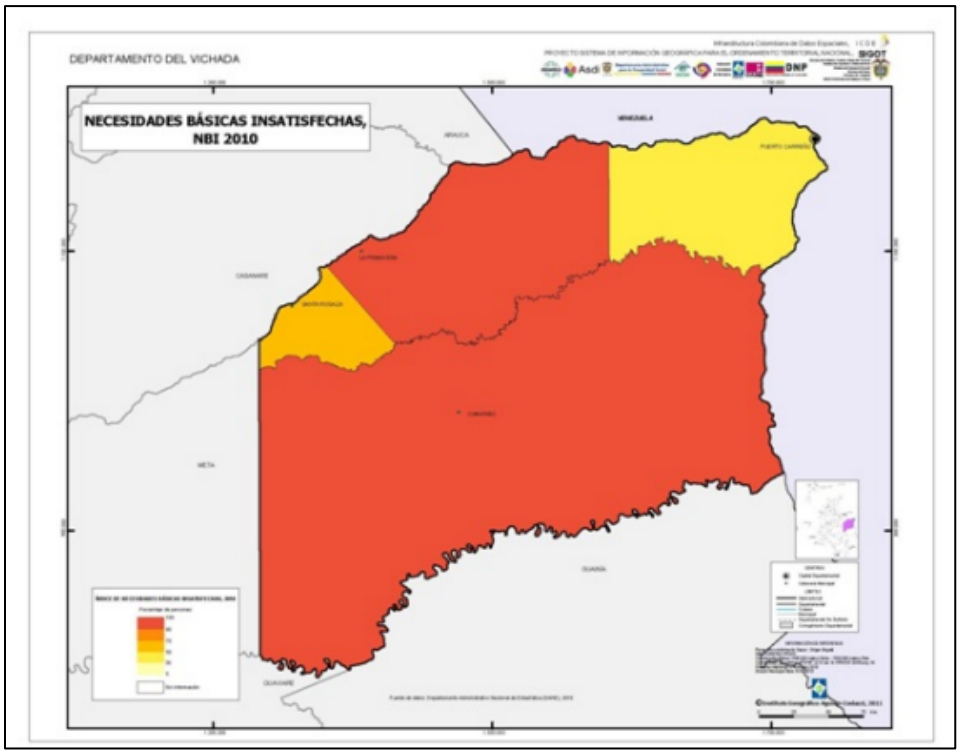


Figure 38 - Unmet basic needs in the department of Vichada, 2010 (Source: https://www.colombiaenmapas.gov.co).

9.1.4 Living Conditions Index. 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 furthest 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.

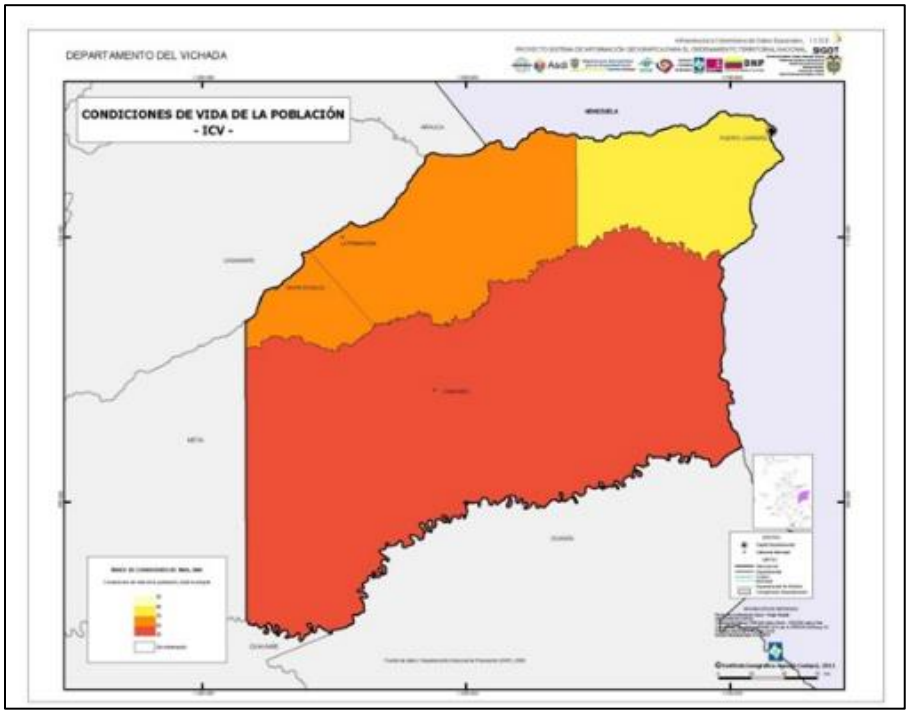


Figure 39 - Living conditions of the population of Vichada. In yellow the best conditions and in red and its transitions the worst living conditions (Source: https://www.colombiaenmapas.gov.co).

9.1.5 Expected Social Benefits

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 be used for other projects, the local demonstration of how reforestation activities contribute economically to development. sustainability of the region, 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 require training and qualification of personnel, promoting new labor skills to the community.

10 Consultation with interested parties (stakeholders)

No specific consultations have been developed taking into account that the owners are fully aware and have control of all the families that inhabit the project area, since they

are project workers who are allowed to live in while they are part of the work activities of the project. project. These families are notified of the project activity. Additionally, it is important to mention that the residents of the project area are notified of the project initiative and do not present any objection, however, the telephone number and contact email were shared with them in case they wanted to present any complaint, suggestion, or claim. Annex: Section 10 -Consultation with stakeholders

10.1 Summary of comments received.

The project was in public consultation period during 24/02/2022/ - 26/03/2022 and did not receive any comment during its public consultation.

10.2 Consideration of comments received.

Not applicable.

11 Sustainable Development Goals (SDGs)

There was applied the BCR SDGs tool v1.0 to identify the project's contribution to the sustainable development goals (annex: Section 11 - SDGs), obtaining the following outcomes:

Table 31 – SDG Contributions of the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A.

Number of SDGs to contribute	Target related	Justification	Contributing Activities	Consolidated Media	Annex related
SDG 8 – Decent work and economic growth	8.5 - By 2030, achieve full and productive employment and decent work for all women and men, including young people and people with disabilities, as well as equal pay for work of equal value	The project contributes to the objective in question because it hires personnel to carry out the project activities, contributing to the economic growth of the region.	Contracting	**2018-2019**, generation of 164 jobs	Section 9 - Socioeconomic aspects \Hiring
SDG 12 – Responsible consumption and production	12.2 - By 2030, achieve sustainable management and efficient use of natural resources	The development of the project as such contributes to the objective in question because it is framed in the strategies of responsible production and consumption, being a forest plantation. In addition, it should be noted that there was no project of this category in the area.	Implementation and development of the project / Training	**2018-2019**, execution of 1 project (the present) with the modality of sustainable consumption and production; realization of 18 trainings	Section 9 - Socioeconomic aspects\ Trainings
SDG 13 – Climate action	13.1 - Strengthen resilience and adaptive capacity to climate-related risks and natural disasters in all countries	The project contributes to the goal in question because its main objective is to replace greenhouse gases.	Implementation and development of the project / Removal de GEI	**2018-2019**, execution of 1 project that contributes especially to the reduction of fires; removal of 31758 tons CO_2 eq.	Section 3 - Quantification of GHG emissions reduction\ Quantifications and see section 6

Number of SDGs to contribute	Target related	Justification	Contributing Activities	Consolidated Media	Annex related
SDG 15 – Life on land	15.1 - By 2020, ensure the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and the services they provide, in particular forests, wetlands, mountains and arid areas, in line with the obligations under international agreements 15.2 - By 2020, promote sustainable management of all types of forests, end deforestation, restore degraded forests and increase afforestation and reforestation globally	The project contributes to the objective in question because it carries out the reforestation and recovery of an area where the soil was previously degraded and had extensive livestock use	Reforestation / Plantation management and control / Reforestation	**2018-2019**, 10% increase in the proportion of forest area for reforestation activities; 53.6% increase in the proportion of sustainably managed forest area; 80.67% of rehabilitated areas (in relation to the total project area)	

12 REDD+ Safeguards (For REDD+ projects)

Not applicable, since this is not a REDD+ project.

13 Special categories, related to co-benefits (optional)

Not applicable.

14 Grouped projects (if applicable)

Not applicable since this is not a grouped project.

15 Other GHG program

The project is not registered or seeking registration under other GHG programs.

16 Double counting avoidance

The project is not seeking certification, nor has it been or is it registered under any other standard. In addition, a search for other initiatives in the project area was conducted in standard platforms such as BioCarbon Standard, Verra, CERCARBONO, Plan Vivo Foundation, Gold Standard and Climate Action Reserve, where it was found that the project is bounded to the south by the BCR project, whose ID is BCR-CO-261-14-001, and that the following initiative registered in the BioCarbon Standard are located within 20 km of the project: PCR-CO-630-142-001 to the northwest.

Table 32 - Nearby carbon projects

Standard	Project ID	Project Name
BioCarbon Standard	BCR-CO-261-14-001	Project for Forestry Restoration in Productive and Biological Corridors in the Eastern Plains of Colombia
	PCR-CO-630-142-001	Proyecto Forestal Fundación Obra Social Redentorista Señor de los Milagros

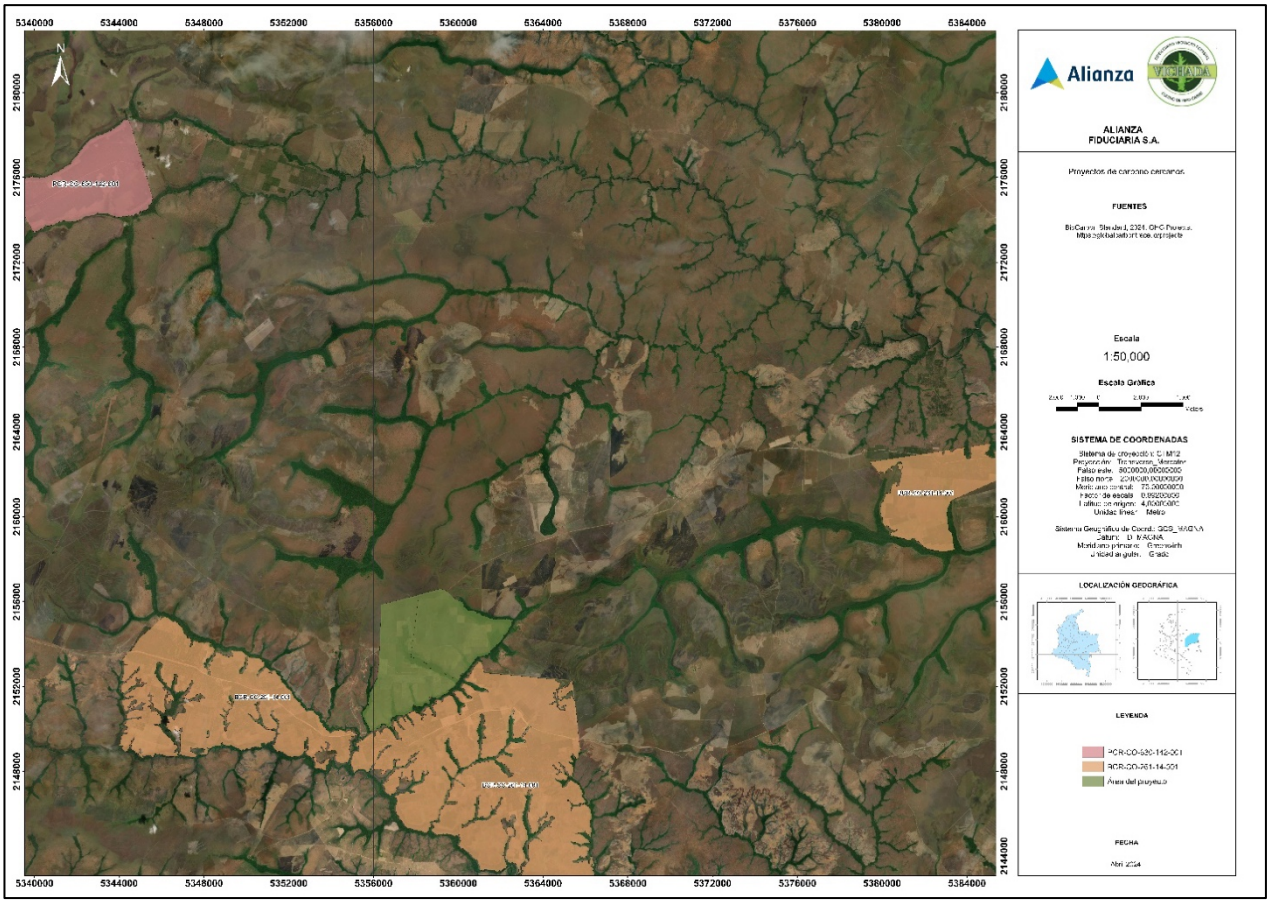


Figure 40 – Overlapping analysis.

17 Monitoring plan

To implement the Proyecto de Carbono Forestal Vichada Alianza Fiduciaria S.A., the following methodology has established a series of procedures to guarantee clear accounting of the greenhouse gases that would be mitigated, in this case the CO_2 captured and fixed forest covers that are growing. Therefore, the implementation of monitoring after the project is approved and established is based on:

17.1 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, 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 CO2, such as fires, pests, etc. Finally, it must be taken into account that the control areas are those actually planted, that is, areas that do not have forest cover 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 ex ante phase.

17.2 Monitoring of the 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 actually 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 CO2 capture, for which the change of species is necessary to give 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 in a timely manner, 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.

17.3 Forest management monitoring.

These activities undoubtedly also affect the greenhouse gas balances that are to be mitigated, given that poor stand 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), thinning, or 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 as a result 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 key when performing reduced emissions assessments. It is recommended to develop stratifications based on aspects such as: species, sowing date, 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, site qualities, among others that make stratification reformulate.

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

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

In turn, 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, 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.

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

- Low
- Regular
- Half
- High.

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.

Table 33 - Variables for monitoring project areas

Variable	Observation
Stratum ID	Stratum, considering those initially established and the changes that may occur with the progress of the project.
Coordinates of polygons or parcels.	To control planted areas. They should be in longitude and latitude.
A_{it}	Polygons of planted areas, at time t, and within a definite stratum j.
A_T	Total area that corresponds to the sum of all the lots that are part of the project.
Adist	Areas altered by natural or human disturbances (harvesting, thinning).

Table 34 - Variables for monitoring the forest establishment.

Variable	Observation
Localization	Geographical position where each activity takes place.
Aikt	Area intervened by activity
Site Preparation	Preparation of sites at the beginning of the project in ha.
Biomass removed prior to establishment.	Only tree biomass is considered for site preparation emissions.
Species	Species that are actually planted by stratum.
Survival check I, j, k.	Survival after planting.
Plantation	Date of planting of the lots.

Table 35 - Variables for monitoring forest management

Variable	Observation
Prepared area $_{i,j,t}$	Area cleaned prior to establishment. These areas generally correspond to the same areas that are planted.
Biomass removed in soil preparation.	Biomass removed during cleaning.
Planted area $_{(i),j,t}$	Areas under control that are effectively planted
Fertilized area	Fertilized area, in order to establish good management procedures, but it is not considered as emissions.
Areas Cleaned	Area that is subjected to cleaning where the stands are established.
Pruned area	Area where stands are pruned.
Thinning area	Halfway area
Biomass removed by thinning or its percentage	It can affect the carbon contents of stands and needs to be monitored.
Harvested area	Areas that complete their rotation cycle.
Harvested Volume	Reported harvest volumes by species.
Reestablished Areas	Amount of area replanted and year, to start a new rotation.
Riot area	Area affected by disturbances such as fires, plagues, mortality, etc. The survey is done with GPS.

Other elements to monitor are aspects related to the social and biodiversity component.

Basically, these elements are based on:

-**Social:** impact on the generation of jobs in the project area and its compliance with national hiring standards, and training for the qualification of personnel. Likewise, do 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.

-**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 to 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. For the project and following the environmental requirements of the Corporinoquia environmental corporation, through file number 800.44.2.12.004 of the corporation, periodic monitoring is carried out of compliance with the biodiversity component in the areas of influence of 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 accumulated data for each monitoring period and throughout the execution of the proposed project activity.

17.4 Proposal for the implementation of the monitoring plan for changes in carbon content in established stands

- **Verification of species and strata:** The stands involved in the project are verified against the species and strata predefined in the project and will be stored in the database, according to the stand model to which they belong.

- **Survival:** This is quantified in the field through sampling in temporary circular survival plots, with an area of 200 m² (Figure 41). Survival monitoring is carried out approximately three months after the plots are planted. It is established that, if a survival of less than 90% of the initial amount planted is detected, the missing material must be replanted with the same species, seeking to keep the plots homogeneous in age and development. The estimate is made through a simple count of the individuals within each plot, verifying their state of vitality; Then the density of living individuals is determined and finally compared with the initial establishment density.

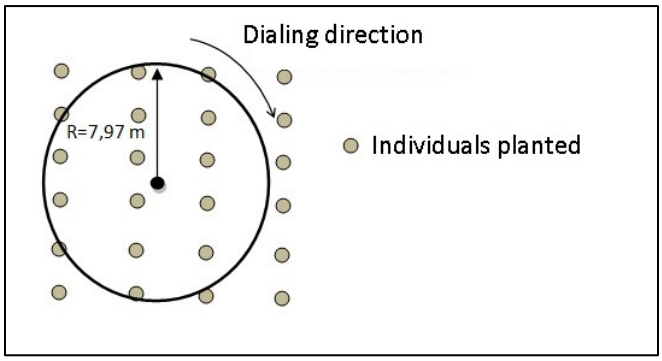


Figure 41 - Scheme of the temporary survival monitoring plot.

17.5 Monitoring of net removals by sinks and data acquisition

The monitoring of this component is carried out through temporary or permanent plots, in which the dynamic growth process of the plantation is evaluated, in order to estimate the carbon content present in the above-ground and underground tree biomass of the project. The inventory of the plots allows evaluating 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 input to validate the volumetric equations by species, or to reformulate new equations that allow the volume to be modeled more realistically. achieved by the species planted for the project area.

Below are some of the most important parameters to monitor:

17.5.1 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 stratum.

17.5.2 Monitoring of the strata.

The areas of the previously defined strata will be periodically monitored according to the criteria established in the monitoring of the scope of the project (previous paragraphs), seeking to identify parameters of changes in the initially established areas, and promoting the unification of strata considered as dissimilar in the phase. ex ante. According to the changes in carbon accumulation in each monitoring period, a new stratification may be proposed that groups stand with similar accumulations and other aspects in common. If a pre-sampling is developed before the first monitoring, then the results of this will allow a re-stratification, based on changes such as:

- Age
- Forestry management
- Possible variation in carbon capture
- Cost effectiveness in the monitoring process
- Disturbances (pests, fires, pathologies, etc.)

Some changes in the parameters defined above are only detected after the development of the first monitoring, such as carbon capture.

17.5.3 Monitoring changes in carbon contents.

17.5.3.1 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 monitoring intervention group. 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.

17.5.3.2 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 using cost-effectiveness criteria, 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[14]:

Steps:

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

Parameters:

A: Total project area; ha
I: Stratum
Ai: Area of each stratum i; ha
AP: Monitoring plot area; ha
sti: standard deviation of the estimate by stratum i

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

$$N = \frac{A}{AP}; \qquad N_i = \frac{A_i}{AP},$$

[14] Calculation of the number of sample plots for measurements within A/R CDM Project activities. ver 02.

where:

N: maximum number of possible plots in the project area
Ni: maximum number of possible plots in the area of stratum i.

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

$$E_1 = Q_1 * p$$

Where:

Q1: Estimated average value for the amount of volume or biomass in the project. Q, t ha^{-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:

$$n = \frac{\left(\sum_{i=1}^{m_{PS}} N_i \cdot st_i\right)^2}{\left(N \cdot \frac{E}{z_{\alpha/2}}\right) + \left(\sum_{i=1}^{m_{PS}} N_i \cdot (st_i)^2\right)}$$

Where:

n: total number of plots in all strata of the project
$z_{\alpha/2}$: value of the z statistic, for $\alpha = 0.05$ (indicated for a 95% confidence level), $z_{\alpha/2} = 1.9599$

- Estimate the number of plots per stratum assuming equal establishment costs:

$$n_i = \frac{\sum_{h=1}^{m_{PS}} N_i \cdot st_i}{\left(N \cdot \frac{E}{z_{\alpha/2}}\right)^2 + \left(\sum_{i=1}^{m_{PS}} N_i \cdot (st_i)^2\right)} \cdot N_i \cdot st_i$$

where:

st_i: standard deviation of the estimate for stratum i
i: 1, 2, 3, … L strata of the project
n_i: number of plots in stratum i.

The number of plots per stratum for the project can be determined using the tool generated by Winrock International[15].

17.5.3.3 Type of plots

The shape of the monitoring plots is rectangular with a size of 500 m² of area (20 x 25 m) in all systems (Figure 42). If situations arise in which a plot of these dimensions cannot be established, the shape of the plot will be adjusted ensuring that the area of 500 m² is maintained.

[15] Winrock Terrestrial Sampling Calculator.
ww.winrock.org/ecosystems/files/Winrock_Sampling_Calculator.xls

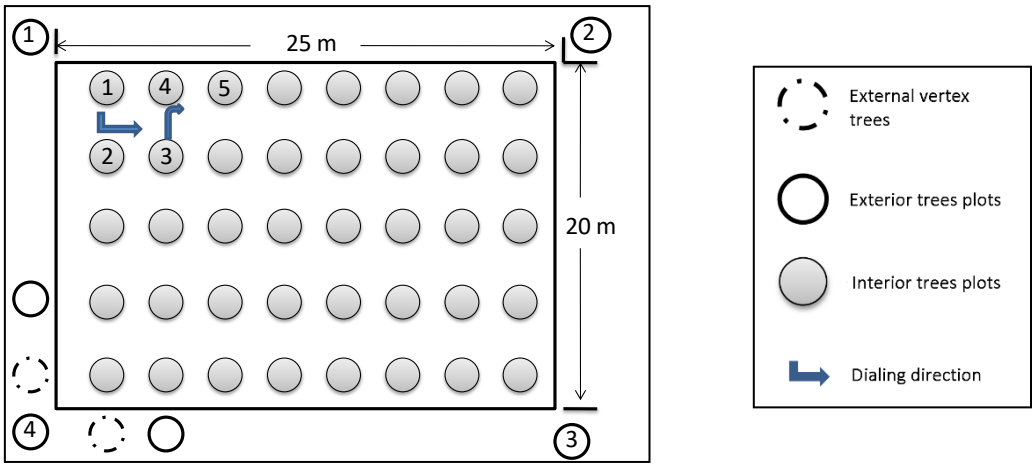


Figure 42 - Survey of monitoring plots. The dimensions correspond to 25m x 20m, for an area of 500m²

17.5.3.4 Location and survey of the plots

After having carried out the distribution of the plots systematically on a map of the established coverage, with the geographical points 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 in the audit process. This point will be called vertex one and in a clockwise direction the initial lateral corridor of 25m is established, until vertex 2 is located and so on (see Figure 42). 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.

17.5.3.5 Measurement and estimation of carbon content over time

Estimates of removals will be made using the equations available in the scientific literature for environmental conditions similar to 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 dendrometry 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 underground biomass. However, new values reported by the literature or estimated under conditions and species similar to 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 (Annex Section 17 - Monitoring plan).

17.5.3.6 Quality assurance and control in monitoring procedures.

The procedures established by the project will be followed, which guarantee 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 analyzes 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 in accordance with 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 (dendrometry 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 dendrometry variables (height, diameters, circumference at chest height), guarantee the standardization of procedures. The training of said personnel will be in charge of a forestry engineer and supported by technicians, who will be in charge of directing the monitoring teams.

The need to make adjustments to said protocols will be periodically evaluated, without generating alterations in the values of measurements made previously. This in order to adjust the protocol each time to the condition of the region, planting dynamics and incorporation of areas under control that will enter 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 must 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

- Plot survey

- 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:

$$Measurement\ error(\%) = \frac{Data1 - Data2}{Dato2} * 100\%$$

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 task and its analysis will be carried out by personnel trained in estimating 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 enter between 10 and 20% 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:

$$Measurement\ error(\%) = \frac{Number\ of\ errors\ identified}{Total\ number\ of\ the\ checked\ sample} * 100\%$$

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.

17.6 Variables to be Monitored.

Data/Parameters	A_{PLOT}, i, $A_{SHRUB,i}$, Ai
Data Unit:	Has
Description:	Area of the sampled plot; Stratum Area
Source of data:	Field Measurement
Measurement procedures:	The 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.
Frequency of monitoring	At each check
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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/Parameters:	*To*
Data Unit:	Ha
Description:	Stratum *I* Area
Source of data:	Field Measurement
Measurement procedures:	The 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.
Frequency of monitoring	Each verification (minimum every 2 years, maximum 5 years)

Data/Parameters:	*To*
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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
Feedback:	-

Data/Parameters:	*APLOT,i*
Data Unit:	Has
Description:	Total area of the sample plots in stratum *i*
Source of data:	Field Measurement
Measurement procedures:	The 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.
Frequency of monitoring	Each verification (minimum every 2 years, maximum 5 years)
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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
Feedback:	-

Data/Parameters:	$a_{p,i}$
Data Unit:	m^2
Description:	Selected leaf litter sampling area in plot *p* in stratum *i*
Source of data:	Measurement
Measurement procedures:	The 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.

Data/Parameters:	$a_{p,i}$
Frequency of monitoring	Each verification (minimum every 2 years, maximum 5 years)
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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
Feedback:	A reference of 0.50 to 1^{m2} is often used for sampling of the selected leaf litter. In case of not having primary information, information from scientific literature may be used for the similar conditions of the project

Data/Parameters:	CC_{SHRUB}, i
Data Unit:	No dimensions
Description:	Shrub cover in stratum *i* of shrub biomass
Source of data:	Field Measurement
Measurement procedures:	Considering that biomass in shrubs is smaller than biomass in trees, a simplified method could be used to estimate canopy cover in shrubs. A visual estimation of coverage could be carried out either by any method such as the transect method or by using the relascope method.
Frequency of monitoring	Each verification (minimum every 2 years, maximum 5 years)
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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
Feedback:	When the land is subjected to a periodic cycle (e.g. slash and burn or clear-regeneration) the shrub cover ranges between maximum and minimum values at baseline, on average the shrub cover is equal to 0.5 of the estimated biomass, unless the information provided is verifiable and transparent to justify a different value.

Data/Parameters:	$B_{LI\_WET,p,i}$
Data Unit:	Kg
Description:	Wet weight of leaf litter sample collected from plot *p* of stratum *i*; kg
Source of data:	Field Measurement on Sampling Plots
Measurement procedures:	The 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.
Frequency of monitoring	Each verification (minimum every 2 years, maximum 5 years)
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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.
Feedback:	-

Data/Parameters:	DAP
Data Unit:	cm or any unit of length as specified
Description:	Diameter at chest height of a tree. To determine this, equations (1) and (2) are proposed, DBH could be any diameter or dimension measurement (e.g., basal diameter, root neck diameter, basal area, etc.) used as a data source for the model.
Source of data:	Field Measurement on Sampling Plots
Measurement procedures:	The 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.
Frequency of monitoring	Each verification (minimum every 2 years, maximum 5 years)
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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/Parameters:	DAP
Feedback:	-

Data/Parameters:	*Dn*
Data Unit:	Cm
Description:	Diameter of the *n* piece of dead (fallen) wood that intersects (or falls) with the transect. This applies to debris sampling
Source of data:	Field measurement along linear transects in sample plots
Measurement procedures (if any):	The 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.
Frequency of monitoring	Each verification (minimum every 2 years, maximum 5 years)
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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
Feedback:	-

Data/Parameters:	*H*
Data Unit:	Meter (m)
Description:	Tree Height
Source of data:	Field Measurement on Sampling Plots
Measurement procedures:	The 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.
Frequency of monitoring	Each verification (minimum every 2 years, maximum 5 years)

Data/Parameters:	*H*
Procedures QA/QC	Quality control/quality assurance (QA/QC) procedures prescribed 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
Feedback:	-

Data/Parameters:	*T*
Data Unit:	Year
Description:	The length of time between successive carbon storage estimates.
Source of data:	Time Logged
Measurement procedures:	N/A
Frequency of monitoring	-
Procedures QA/QC	-
Feedback:	If two of the successive estimates of carbon storage are taken to different points in a time in a year t2 and t1 (e.g., in April in year t1 and in September in year t2), then a fraction of value could be assigned to T

17.7 Information Control and Quality Assurance

This procedure is developed through the application of the following 7 steps:

Figure 43 - Protocol for taking and storing information.

1. Identification of the need: At this point, the best way to collect information is established to solve a need that can be of various types and respond to different areas

of the organization, such as accounting, GIS, SST, Environmental, Commercial, Legal:

- physical or field; photos, GPS surveys, sampling, preparation of studies, among others, plot surveys.
- external information: such as certifications, records of work performed, satellite images, contractor documents, purchasing supports.
- internal information; balance sheets, reports, analysis, studies, among others.

2. Gathering information: Once it is established how the need is satisfied, we proceed to identify the necessary resources:
   - Economical
   - Equipment
   - Ideal human resource
   - Logistic
   - Delivery medium
3. Review of information in the office: All information is centralized in the company's facilities in Bogotá after it has been obtained, this is because these facilities are where the resources for its review and storage are available.
   - All information related to the operation of the projects is admitted by the corresponding agency for analysis and review.
   - This review is carried out by personnel specialized in its management, applying concepts appropriate to the nature of the information.
   - It is carried out in order to determine that it responds to the identified needs.
4. Information organization: The information is organized differentiated by project prepared in each department, creating subfolders by theme on the computers available in the Bogotá office for each department. This is by relating the created versions in the file names and eliminating previous ones that are not valid. Once the information is organized, it is archived in two components, physical and digital.
5. Physical file: The physical file is located in the organization's Bogotá office, where each document is related by topic and project with a faithful copy of the input or document prepared, respecting the validity of the document in filing order.
6. Digital file: To complement the integrity of the physical file, since some data is of digital origin, in each department there is complete custody of the information differentiated by project and with thematic sub-classification. This is the most complete file that serves as support and information consultation.
7. Back up: Information backup is done in two ways.

- Copy to external disk: Every month a backup is made to a large-capacity external disk, which is kept in a location outside the office facilities in Bogotá, whose custody is directly in charge of the establishment's Management.
- Cloud copy: On cloud servers, project data is temporarily backed up during execution. Once the processes are completed, they are backed up in the office and on external magnetic media and are deleted from the server.

With this process, the project built a database of information extracted from the Technical, Legal and Carbon components, which was separated into folders to associate it with the monitoring indicators of the current project. This information has been separated by folders, with the latest versions. However, complementary information rests in the digital files of the companies that are part of the project and is duly protected and supported to prevent its loss. The folders and attachments are located in the cloud, shared in GOOGLE DRIVE files, for access when required by the audit. The use of this archiving tool allows you to give differentiated permissions to whoever accesses the information, it also generates reports of the modified files, aggregates giving a report of who made the change, and safeguards a temporary file until the administrator approves the changes or deleting files or folders.

In this folder system, there are scanned legal documents, technical work information and field forms completed and duly scanned in digital formats. Likewise, it was available:

- Spatial analysis to verify the areas of the project that are planted and receive maintenance or interventions such as pruning, thinning, among others. With date and updated versions. The CDM unit of the La Primavera Forest Project is responsible for the analysis and custody of the base information. Which feeds the databases related to Productive Forestry Technical aspects, Carbon Technical aspects and the necessary support to guarantee Financing agreements such as the CIF.
- Analysis of carbon estimates and balances: include statistical analyzes by stratum.
- The database delivered for the project will be the same ones that will be continually updated and fed under the BCR.

17.7.1 Definition of adjustments in DAP measurement.

During the cold evaluation that was carried out on the forest inventory, only the change in the measurement tool of diameters at breast height was identified. Originally, the use of diameter tapes was recommended, however, due to logistical problems, the measurements had to be carried out with normal measuring tapes, which have a precision of 1 mm and are made of nylon material. To down-adjust this measurement due to NOT using the recommended tool, DAP values were adjusted to integer values below the original measurement in circumference value (e.g. if the circumference value was between 15.1 to 15.9, the value was left at 15.0, always the integer value downwards).

No additional measurement errors or misuse of equipment were identified during this monitoring period.

17.7.2 Analysis of the entered information.

All data were verified and corrected before analyzing the information. Among errors identified, although infrequently, was the indifferent use of the comma as a decimal separator, when it should be a period in the database. This was corrected.

Statistical analysis.

No outliers were identified by stratum and the significant difference between them was assessed through the use of statistical packages (see annex Section 3 - Quantification of GHG emissions reduction\Quantifications\Ex post\ Ex-post 2018 – 2019.xlsx). The due uncertainty analysis associated with the analyzes was applied and the discounts recommended by the methodological tool were made.

The Units in charge of safeguarding the information were divided into three:

1- Technical field unit and silvopastoral activities:
They are in charge of monitoring forestry work, implementing forest inventories and monitoring biodiversity according to the corporation's standards, thereby documenting the actions and providing support for them.

This unit and its team safeguard information in physical and digital format, which is shared with the central unit in Bogotá.

2- Legal unit:

In charge of contracts and legal aspects related to the project. This unit will focus on agreements or contracts for reduced emissions transactions. Links the information to the transactional records following the proper registry protocols and will deliver the information to the RENARE platform due the national laws (most updated Res 1447/2018).

3- Carbon technical unit:

It is in charge of carrying out spatial analyzes related to the areas, forest coverage, and specializing the project areas.

- In order to avoid double accounting of reduced and marketed emissions, an agreement has been signed with BioCarbon Standard that will guarantee proper coding of each transaction carried out and ensure accounting. Likewise, the project will comply with National regulations, specifically resolution 1447 of 2018, where it is required not only to register the project in its general conditions, but also to ensure each transaction developed.

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