

MONITORING REPORT- PROYECTO FORESTAL ALCARAVÁN ORINOQUÍA



Document prepared by CO₂CERO SAS
Date of issue (Version N° 9, 03/05/2024)

Monitoring Report Template (Version 1.0)¹	
Name of project	<i>Proyecto Forestal Alcaraván Orinoquía</i>
BCR Project ID	<i>BCR-CO-CO-14-003</i>
Registration date of the project activity	<i>14/12/2022</i>
Project holder	<i>CO₂CERO SAS</i>
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Version number of the Project Document applicable to this monitoring report	<i>Version N°9 (03/05/2024)</i>
Applied methodology	<i>BCR0001 Quantification of GHG Removals Afforestation, Reforestation, and Revegetation Version 4.0 of February 9, 2024, and BCR Standard.</i>

Monitoring Report Template (Version 1.0)¹	
	<i>From differentiated responsibility to common responsibility version 3.2 of September 23, 2023.</i>
Project location (Country, Region, City)	<p><i>Municipalities of the Orinoquia biome, including Meta and Vichada.</i></p> <p><i>It is currently located in:</i></p> <p><i>Puerto Lleras and Puerto Gaitan in Meta.</i></p> <p><i>Cumaribo in Vichada, Colombia</i></p>
Project starting date	<i>11/04/2018</i>
Quantification period of GHG reductions/removals	<i>The duration of the project will be 20 years, 11/04/2018 to 10/04/2037</i>
Monitoring period number	<i>First</i>
Monitoring period	<i>11/04/2018 to 02/12/2022</i>
Amount of emission reductions or removals achieved by the project in this monitoring period	<i>33,030 tCO₂e</i>
Contribution to Sustainable Development Goals	<p><i>SDG 1.</i> <i>End poverty in all its forms everywhere.</i></p> <p><i>SDG 2.</i> <i>End hunger, achieve food security and improved nutrition and promote sustainable agriculture.</i></p> <p><i>SDG 8.</i> <i>Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all.</i></p> <p><i>SDG 12.</i> <i>Ensure sustainable consumption and production patterns.</i></p> <p><i>SDG 13.</i> <i>Take urgent action to combat climate change and its impacts.</i></p>

Monitoring Report Template (Version 1.0)¹	
	SDG 15. <i>Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss</i>
Special category, related to co-benefits	N/A

Table of contents

1	General description of project	10
1.1	Sectoral scope and project type	11
1.1.1	Scope in the BCR Standard	11
1.1.2	Project type.....	12
1.2	Time limits and analysis periods	12
1.2.1	Project start date.	13
1.2.2	Project quantification period	13
1.2.3	Monitoring periods.....	13
1.3	Project location and project boundaries	13
1.3.1	Spatial boundaries and project location	14
1.2.2	Temporal boundaries	15
2	Title, reference and version of the baseline and monitoring methodology applied to the project.	15
3	Registry or participation under other GHG Programs/Registries	16
4	Identification and description of the baseline scenario and additionality for AFOLU projects.....	16
4.1	Baseline scenario	16
4.1.1	Step 0: Preliminary screening based on the starting date of the A/R project activity 16	
4.1.2	Step 1: Identifying land use alternatives.	17
4.1.3	Step 2: Additionality analysis for Barrier analysis.	20
4.1.4	Step 4: Common practice analysis.....	22
5	Contribution to Sustainable Development Goals (SDG).....	25
6	Compliance with Applicable Legislation.....	29
6.1	National policies and standards	29

10.1	Sectoral rules	30
7	Climate change adaptation.....	34
8	Carbon ownership and rights.....	40
8.1	Project holder	40
8.1.1	Organizational Structure, Responsibilities, and Powers	41
8.2	Other Project participants.....	42
8.3	Agreements related to carbon rights.....	43
8.4	Land tenure	44
9	Environmental Aspects	45
9.1	Increase in forest mass	47
9.2	Wildlife habitat provision.....	48
9.3	Reduction of pressure on natural ecosystems	49
9.4	Soil erosion reduction.....	50
9.5	Biological corridor.....	50
9.6	Flood control.....	51
9.7	Generation of noise and atmospheric pollution due to the use of vehicles and machinery.....	52
9.8	Increased risk of forest fire spread.....	53
9.9	Increase in the outbreak of pests and diseases.....	56
9.10	Actions and corrective measures	57
10	Socioeconomic Aspects.....	58
10.1	Projects basic services.....	62
10.2	Project housing infrastructure.....	62
10.3	Health	63
10.4	Food security	64
10.5	Solid waste management.....	65
10.6	Family quality of life.....	66
10.7	Education.....	67
10.8	Gender equity	68

10.9	Safety at work.....	69
10.10	Public security	69
10.11	Community relationships	70
10.12	Limitation of land use	71
10.13	Change of ownership	72
10.14	Depreciation of the carbon market	72
10.15	Economic growth	73
10.16	Local labor hiring	74
10.17	Employee attrition.....	75
10.18	Actions and corrective measures	76
11	Risk management.....	77
11.1	Reversion risk.....	82
12	Stakeholders' Consultation	83
12.1	Project idea.....	83
12.2	Project socialization.....	84
12.3	Handling of requests, complains, claims and suggestions	85
13	Grouped Projects	85
14	Implementation of the project	86
14.1	Phase	86
14.2	Verification events	86
14.3	Net GHG removals or net GHG emission reductions obtained during the monitoring period	86
14.4	Revision of monitoring plan	86
14.5	Request for deviation applied to this monitoring period	86
14.5.1	Deviations in the implementation of the Climate Change Mitigation Project compared to the PDD.....	86
14.5.2	Methodological deviations	86
15	Monitoring system	87

15.1	Monitoring project boundaries	88
15.2	Monitoring the implementation of project activities	90
15.3	Monitoring crop management and growth.....	92
15.4	Stratification.....	93
15.5	Sampling plots.....	93
15.6	Measurements and estimation of changes in carbon content.....	94
15.6.1	Data and parameters monitored.....	96
15.6.2	Monitoring crop management and growth.....	97
15.7	Monitoring of the evaluation of socioeconomic and environmental aspects	98
15.8	Assignment of roles and responsibilities for monitoring and reporting relevant variables for GHG removal calculations	99
15.9	Monitoring of the assessment of the project's contribution to the Sustainable Development Goals (SDG's).....	100
16	Carbon reservoirs and GHG sources	100
16.1	GHG emission sources	101
17	Eligible areas in the GHG project boundary	102
17.1	Project Eligibility	102
18	Quantification of GHG emission removals	103
18.1	Quantification of GHG removals in the baseline scenario	103
18.2	Leaks	104
18.3	Quantification of removals generated in the Ex-Ante project scenario	105
18.4	Quantification of removals generated in the Ex-Post project scenario.	107
18.5	Comparison of actual emission removals with estimates in the project document ...	109
18.6	Remarks on difference from estimated value in the registered project document....	109
19	Information management	110
20	References	111
21	References and document history.....	114

Initialisms, acronyms, and abbreviations

AFOLU	Agriculture, Forestry and Other Land Uses
AP	Project area (by its acronym in Spanish)
DAP	Diameter of breast length (by its acronym in Spanish)
A/R	Afforestation/reforestation (F/R in Spanish)
GHG	Greenhouse gases (GEI in Spanish)
IDEAM	Instituto de Hidrología, Meteorología y Estudios Ambientales del Ministerio de Ambiente y Desarrollo Sostenible de Colombia
IPCC	Panel Intergubernamental de Expertos sobre el Cambio Climático (IPCC por su sigla en inglés)
MADS	Ministerio de Ambiente y Desarrollo Sostenible
SDG	Sustainable development goals
PDD	Project design document
PEMF	Forest Establishment and Management Plan (by its acronym in Spanish)
PRGEI	Greenhouse Gas Removal Project (by its acronym in Spanish)
UPRA	Unidad de Planificación Rural Agropecuaria

1 General description of project

Proyecto Forestal Alcaraván Orinoquía is an initiative of private participants brought together by CO₂CERO SAS with a total area of 1,100.81 hectares. Its objective consists in removing greenhouse gases (GHG) through 1.094,43 eligible hectares of forest plantations in the Colombian Orinoquía, for twenty (20) years – starting on 11/04/2018, the date in which reforestation activities, management, and increase of carbon reserves began. The Forestry Project is in the Meta and Vichada departments, but it plans to cover a reforestation area in the Casanare department.

CO₂CERO SAS oversees the project, including eight (8) project participants recognized as timber forest producers. Its livelihood will be based on the establishment, maintenance, and strengthening of forest plantation coverage, which will improve the socioeconomic and environmental perspective through the commercialization of wood products for the industrial sector. They will remove GHG emissions in the atmosphere, generating a sense of belonging over their property planted and natural resources.

With the development of the project, we will contribute to the achievement of six (6) sustainable development objectives, developing activities focused on increasing carbon stocks under the axes of Sustainable Economic Development, and Conservation and Environment, reducing poverty, hunger, favoring decent work, resilient communities and protecting the climate and terrestrial ecosystems.

Proyecto Forestal Alcaraván Orinoquía aims to remove 517,005 tCO₂e during its crediting period with a reserve of 20%, and with an annual average of 25,850 tCO₂e, considering the equivalent carbon dioxide (tCO₂e) removal in the carbon of aerial biomass, underground biomass, dead wood, litter, and soil organic carbon reservoirs.

1.1 Sectoral scope and project type

1.1.1 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 ₂ O).	
GHG projects using a methodology developed or approved by BioCarbon Registry, applicable to GHG removal activities and REDD+ activities (AFOLU Sector).	x
Quantifiable GHG emission reductions and/or removals generated by the implementation of GHG removal activities and/or REDD+ activities (AFOLU Sector).	
GHG projects using a methodology developed or approved by BioCarbon Registry, 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.	

The project was developed under the application of the BCR Standard From differentiated responsibility to common responsibility V 3.2, taking into account the conditions under which you want to register a GHG project to demonstrate its mitigation results in the framework of meeting the goals, fulfilling the general requirements as follows.

- The location of the project is within a country, in this case within Colombia,
- The start date is defined in which the removal activities begin, less than five (5) years prior to the start of validation.
- The quantification period, when considering a project in the AFOLU sector, complies with the minimum requirement of 20 years.
- The determination of additionality is based on the application of the guidelines of the methodology BCR0001 Quantification of GHG Removals Afforestation, Reforestation, and Revegetation. V 4.0, by barrier analysis.

- The project complies with applicable legislation and has a document management mechanism that incorporates the relevant legislation and regulations.
- The project demonstrates actions to reduce current and future climate impacts derived from climate change, implementing forestry production systems, with improvements to biodiversity.

Similarly, the project is developed under the BCR0001 Methodology for Quantification of GHG Removals Afforestation, Reforestation, and Revegetation, BioCarbon Registry V 4.0. Taking into account the conditions of the project considered as the most appropriate from the technical aspect, likewise, the parameters and calculation methods are adjusted to the variables found and monitored within the project limits.

1.1.2 Project type

The Proyecto Forestal Alcaraván Orinoquía is an initiative of the Land Use - Forest Land sectoral area, Sector 14. Afforestation and Reforestation, AFOLU, with a general activity of GHG removals by promoting the increase of carbon stocks and a specific forestry activity, with Commercial Forestry Plantations (ARR).

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	

1.2 Time limits and analysis periods

The project will monitor changes in carbon stocks from above-ground biomass, below-ground biomass, dead wood and leaf litter, and Soil Organic Carbon from commercial forest plantations within project boundaries. Table 1 shows the time limits and the chronological plan related to the Proyecto Forestal Alcaraván Orinoquía.

Table 1. Chronological plan for the Proyecto Forestal Alcaraván Orinoquía

Chronological Plan	
Project Start Date	April 11, 2018
Historical period	April 11, 2013, to April 11, 2018
Credit period	April 11, 2018, to April 10, 2037
Results period	It will depend on the verifications carried out
Duration of the project	20 years
Verification times	Triennial verifications (3 years) are proposed.

Source: (CO2CERO SAS, 2023)

Furthermore, the section that follows presents the Carbon Stocks Increase resulting from the reforestation activities carried out by the project participants. These activities contribute to the removal of GHG emissions.

1.2.1 Project start date.

The project start date is April 11, 2018 (see folder "AUDITORIA_VERIFICACION_2022\9_Project start date\6_purchase invoices_INGCOL.pdf\Page 9"), which marks the start of activities that result in GHG removals effective within the limits of the project.

For the Proyecto Forestal Alcaraván Orinoquía, this date corresponds to the beginning of the planting planning work, including the acquisition of plant material and substrate, supported by a sales invoice from Refocosta to the owner Inversiones Guardabosques de Colombia S.A.S. The above is aligned with the establishment and subsequent execution of reforestation activities with the *Pinus caribaea* in 2018, as stipulated in the BCR Standard and the BCR0001 methodology, five years before the validation process began.

1.2.2 Project quantification period

The project will have a lifetime period of 20 years, in accordance with the BCR Version 3.2 Standard, in which the removals generated by the reforestation activities will be guaranteed, in compliance with the regulatory and legal framework.

1.2.3 Monitoring periods

Triennial verifications are proposed, evaluating the removals generated in those years, with a maximum time lapse of five (5) years, according to the project's own conditions.

1.3 Project location and project boundaries

The project will be implemented in commercial forestry plantations in the Colombian Orinoquia. Below are the location and limits defined for Proyecto Forestal Alcaraván

Orinoquía, considering the methodological and specific requirements of the certification program.

1.3.1 Spatial boundaries and project location

The project is currently located in the eastern part of the country in the Meta and Vichada departments –a total of three (3) municipalities that correspond to Puerto Lleras and Puerto Gaitán in Meta and Cumaribo in Vichada, per Figure 1. Its geographical location is between the North coordinates: 6°5'20.91"N South: 2°49'20.95"NN, East: 73°46'43.87"W, West: 67°22'50.11 "W (WGS_1984 coordinate system).

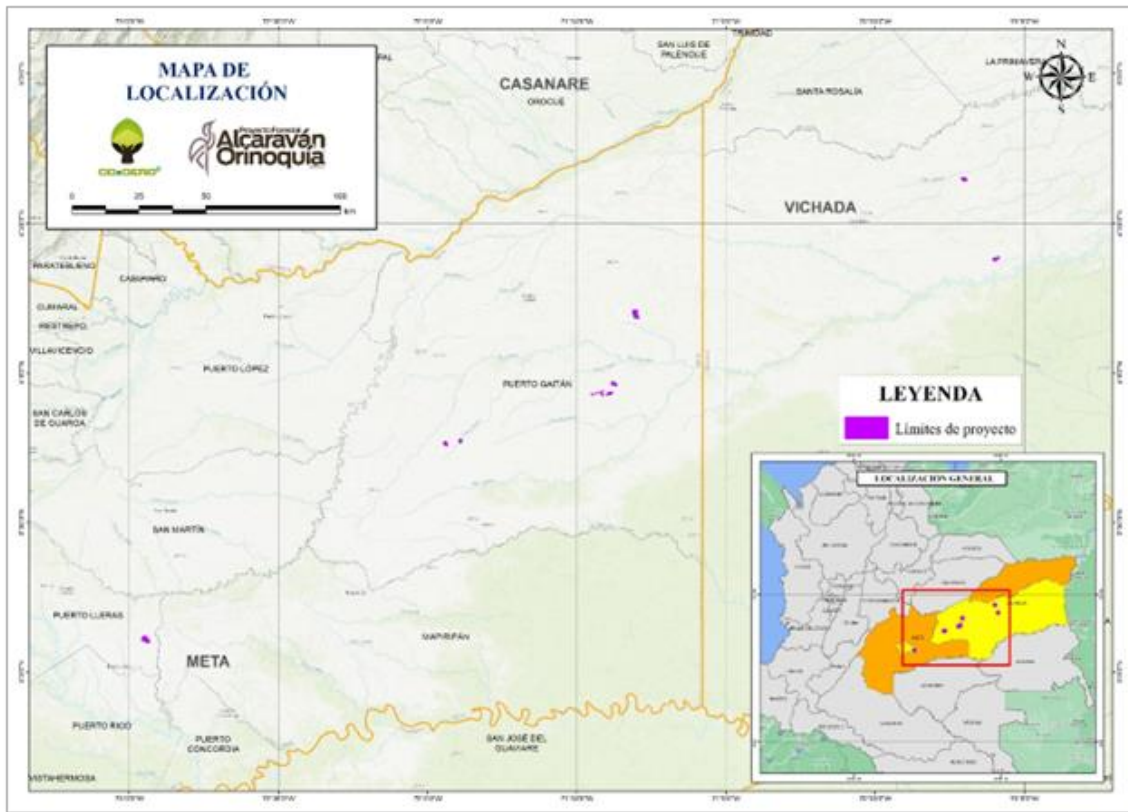


Figure 1. Project Localization.
Source: (CO2CERO SAS, 2022)

The properties of all the participants and their respective locations are described in Table 2. These participants correspond to the links made from the start date of the project until 2022.

Table 2. Location of the Properties Involved in the Project

No.	Participant	Property	Department	Municipality
1	ECOLOGIC SAS	Galapagos	Meta	Puerto Gaitán
2	SULTANA SAS	Sultana	Meta	Puerto Gaitán
3	ENLACE ROJO SAS	Barlovento	Meta	Puerto Lleras
4	ECOSISTEMA PRODUCTIVO MATAEMONTE SAS	Botereña	Meta	Puerto Gaitán
5	LUIS FERNANDO RODRIGUEZ	Naranjales	Meta	Puerto Gaitán
6	INVERSIONES GUARDABOSQUES DE COLOMBIA	La Cabaña	Vichada	Cumaribo
7	CLAUDIA HUERFANO	Villa Claudia	Meta	Puerto Gaitán
8	PUNTA DE GARZAS INVERSIONES FORESTALES	Punta de Garzas	Vichada	Cumaribo

Source: (CO2CERO SAS, 2022)

1.2.2 Temporal boundaries

The project's duration will be 20 years, since April 11, 2018, to April 10, 2037, these dates are the same time in years that the accreditation period of the project. On the other hand, the results of verification period correspond from the project's start date to the final year of the last monitoring plot, which is December 2, 2022.

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

The project was implemented following the guidelines outlined in the Methodological document BCR0001 "Quantification of GHG Removals Afforestation, Reforestation, and Revegetation, BioCarbon Registry, Version 4.0." Considering the project's conditions, which involve commercially managed forest plantations in eligible areas under proper ownership and management, the chosen methodology is the most appropriate from a technical perspective. Similarly, the parameters and calculation methods have been adjusted to the variables found and monitored within the project limits. In addition, the following tools and guides are used:

- Tool Sustainable Development Goals (SDG). Version 1.0. June 2023.
- BCR Tool. Avoiding double counting (ADC). BCR avoid double counting of emissions reductions/removals. Biocarbon Registry. Version 1.0. March 9, 2023.
- BCR Tool. Monitoring, reporting and verification (MRV). BCR carbon credits are quantified, monitored, reported, and verified. Biocarbon Registry. Version 1.0. February 13, 2023.

- No Net Harm Environmental and Social Safeguards (NNH). BCR Tool. BCR project activities do not cause any net-harm to the environment or to local communities and society in general. Version 1.0. March 7, 2023.
- Biocarbon Guidelines. Baseline and Additionality. GHG Projects generate Verified Carbon Credits (VCC) that represent emissions reductions, avoidance, or removals that are additional. Version 1.2. September 27, 2023.
- Permanence and Risk Management. BCR Tool. BCR Project holder take actions to ensure the Project benefits are maintained over time. Version 1.0. March 7, 2023.

3 Registry or participation under other GHG Programs/Registries

N/A

4 Identification and description of the baseline scenario and additionality for AFOLU projects

Below, is the description of the actions undertaken to identify the baseline scenario and demonstrate additionality for the Proyecto Forestal Alcaraván Orinoquía, according to the methodology BCR0001 and the Biocarbon Guidelines Baseline and Additionality. GHG project generate Verified Carbon Credits (VCC) that represent emissions reductions, avoidance, or removals that are additional, version 1.2 provided by BioCarbon Registry.

4.1 Baseline scenario

In this section, the identification of the baseline scenario is carried out for demonstrating additionality, following the criteria described by BioCarbon Registry. The following criterion is selected: (c) changes in carbon stocks within the project boundaries, identifying the most likely land use at the start of the project.

4.1.1 Step 0: Preliminary screening based on the starting date of the A/R project activity

The project's start date is April 11, 2018 (refer to folder *9_Project start date*), which marks the commencement of activities impacting GHG removal within the project boundaries. It corresponds to the initiation of planning work for planting, including the procurement of plant material and substrate. This aligns with the establishment and subsequent execution of reforestation activities by Inversiones Guardabosques de Colombia for *Pinus caribaea* in 2018, as stipulated in the BCR Standard and the BCR0001 methodology, five years before the validation process began.

4.1.2 Step 1: Identifying land use alternatives.

Sub-step 1a. Identify credible alternative land use scenarios to the proposed project activity

To demonstrate the additionality of Proyecto Forestal Alcaraván Orinoquía, it is justified that carbon dioxide equivalent (CO₂e) removals would not have occurred in the absence of the implementation of the initiative according to the most likely use without the project, or due to requirements attributable to actions required by law; thus, generating a positive change to climate change mitigation, based on the evaluation of acceptance by barrier analysis.

To identify the most likely land use scenarios that could arise in the baseline scenario, historical or previous uses are considered according to the covers present within the project area. These scenarios should be traceable, realistic, credible, and in line with national circumstances and policies.

According to the multi-temporal analysis of satellite images for each of the properties and official classified information of the Corine Land Cover methodology modified for Colombia and taking the 2018 land cover layers generated by IDEAM as a base input, the pre-project land cover within the project area is identified. The specific land cover categories are listed in Table 3, following the CORINE Land Cover level III classification.

Table 3. Land cover at the beginning of the project

Cover	Area (ha)	Area (%)
2.3.1. Clean pasture	840.52	76.80%
2.4.4. Mosaic of pasture and natural spaces	253.92	23.20%
Total	1,094.43	100.00%

Source: (CO2CERO SAS, 2023)

According to Table 4, which identifies the land covers in the Baseline scenario, it is clear that the magnitude of carbon dioxide removals produced by Proyecto Forestal Alcaraván Orinoquía, compared to those generated by the covers of the baseline scenario, would not have occurred in the absence of its implementation; supporting such additionality under the premise in which it is demonstrated that no net benefit to the atmosphere would have been generated with respect to its baseline.

Table 4. Removals generated in the scenario without project.

Cover	Carbon stock (tCO ₂ e)
2.3.1. Clean pasture	5,379
2.4.4. Mosaic of pasture and natural spaces	1,473
Total	6,852

Source: (CO2CERO SAS, 2023)

To determine the carbon dioxide removals generated in the area, the Carbon Stock present in covers proposed by (Yepes *et al.*, 2011), for the scenario without a project, a 6,852 tCO₂e potential is established for the lifetime of the initiative. In contrast, for the Ex-Ante removals, a 517,055 tCO₂e potential is recognized, higher by 510,153 tCO₂e, which further reveals the additionality character of the project (see Table 4).

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations

On the other hand, to demonstrate the co-responsibility of the covers present in the baseline scenario and applicable regulation, we established legal and regulatory requirements for an A/R project and the different covers present. This information can be found in *11_Environmental legislation\Environmental legal matrix_AlcaravanOrinoquia.xlsx*. Compliance with legal and environmental requirements will be monitored during each verification, with a maximum interval of five (5) years. This confirms that all covers meet the necessary legal requirements for development in the area.

The most likely land use scenarios were identified according to the territorial dynamics in the Project. As a result of the spatial diagnosis, satellite information verification, and qualified and applied documentation of the project area, we determined the possible land uses in Table 5.

Table 5. Analysis of possible land use scenarios in the territory

Land use	Manifestation	Tendency	Viability
<i>Pastures for livestock</i>	This is the main production activity of the departments of Vichada and Meta. It is manifested in the form of extensive livestock production.	Being the dominant, basic economic activity of the departments, if livestock is present on a large scale within the project area generating changes in natural covers, it would not constitute an environmentally sustainable process, nor a factor of large-scale economic development. This is due to the low capacity of the cattle population and the lack of technological development.	It is not viable as the factors of environmental economic development are extensive, and there is no environmentally sustainable development. Similarly, the difficulties of territorial capacity make technological development impossible.

Land use	Manifestation	Tendency	Viability
<i>Mosaic of pastures, crops, and natural spaces</i>	These are developed through a combined activity of livestock and agriculture, based on monoculture plantations and extensive livestock production.	Being an economic activity that combines pastures with crops, if such a thing occurs on a large scale within the project area, due to its unproductivity by extension, it would not constitute an environmentally sustainable process, nor a factor of large-scale economic development. This is due to the capacity and the difficulties of technological development and inputs.	It is not viable as the factors of economic development are extensive and done in monoculture plantations, without environmentally sustainable development. Similarly, difficulties of territorial capacity make technological development impossible, and the low level associated with its low capture capacity.
<i>Unproductive pastures</i>	It is presented as an unproductive cover for municipal economic development.	An increase in pasture cover contributes to a low GHG removals stock. Therefore, it would not generate perceptible or tangible economic benefits for project participants.	It would not generate an appreciable net benefit to the atmosphere from the removal of GHG emissions. This is in association with its low GHG capture capacity.
<i>Commercial reforestation that may include PRGHG</i>	The project area has a wide cover eligible for the establishment of commercial forest plantations with the objective of removing GHG emissions. Additionally, the participants understand the goods and services derived from there.	The design of strategies for the improvement, increase and removal of emissions through natural carbon pools would reduce the negative effects on biodiversity and natural resources. Furthermore, it would establish new financial mechanisms in the participants that pay for results linked to the ecosystem service generated by their plantations.	The increase and improvement of carbon pools together with other GHG removal activities would generate a net benefit to the atmosphere by favoring carbon capture rates and increasing comprehensive removals within the planted trees sinks.

Source (CO2CERO SAS, 2023)

After identifying the potential land uses within the project boundaries, we evaluated their consistency with the environmental, social, technological, and economic contexts, in accordance with the identified dynamics. A quantification analysis of the viability of the defined land use in each context was conducted to determine which alternative is adequate and additional within the territory, and to generate the greatest net benefit to the atmosphere in terms of removal of emissions.

Table 6. Land use viability rates

Land use	Political – Legal	Environmental	Social	Technological	Economic	Result
Pastures for livestock	3	1	2	2	3	11
Mosaic of pastures, crops, and natural spaces	3	2	2	3	3	13
Unproductive pastures	2	3	2	2	1	10
Commercial reforestation that may include PRGHG	3	3	3	3	2	<u>14</u>

Source: (CO2CERO SAS, 2023)

The impact quantification is given according to the viability of the land use in regards of the political, environmental, social, technological, and economic context. Values were assigned as follows:

1. Is a context that does not show viability for this land use.
2. Is a context that provides the basic elements for land use to manifest.
3. Is a context that provides all the necessary elements for the use of the land to be carried out.

The results of the analysis are shown in Table 6. It highlights the development of a GHG emissions removal project as the most favorable land use option. This initiative demonstrates the reduction of GHG emissions and contributes to a positive impact on the atmosphere. In contrast, the other alternative land uses evaluated in the study exhibit various limitations at different levels.

4.1.3 Step 2: Additionality analysis for Barrier analysis.

Given the criteria for determining the baseline scenario according to the methodological document, the Proyecto Forestal Alcaraván Orinoquía adheres to the barrier analysis criteria.

The demonstration of additionality in the project was conducted by analyzing the most likely land uses identified through spatial analysis. This analysis was specifically aimed at showcasing the barriers and their impact on the project, aligning with the guidelines

outlined in the methodological document, determining that there are barriers that prevent or limit the implementation of the project.

Sub-step 2a, 2b and 2c: Possible project implementation barriers and baseline scenario.

Identifying the commercial reforestation scenario which may include a PRGEI, comparing the possible and alternative uses of the soil, allows to determine and evaluate each of the barriers and sub-barriers established in the BCR0001 V 4.0 Methodology. For this, we used as input the transparent, documented conservative-official documentation of the Mayor's Offices, Governors' Offices, IDEAM, DANE, ICA, MADS, and Scientific Articles, among others. Then, we consolidated the documentation in *Add_AlcaravanOrinoquia_V2.xlsx* in the sheet *Barriers_analysis* (See *2_Additionality*). There we identify that commercial reforestation that may include PRGHG, pastures for livestock and mosaics of pastures, crops and natural spaces are viable alternatives to develop and establishing itself as a baseline scenario. However, from this analysis we found out that this option is the one that presents the greatest number of barriers. Nonetheless, these may be overcome through participation in the carbon market, leaving the least number of barriers once the project is applied.

It is emphasized that the definition of the baseline scenario was selected, in compliance with the guidelines described in the BCR Standard:

- a. Transparently regarding assumptions, methods, parameters, data sources, and factors: For this, we used as input the transparent, documented conservative-official documentation of the Mayor's Offices, Governors' Offices, IDEAM, DANE, ICA, MADS, and Scientific Articles (See "AUDITORIA_VERIFICACION_2022\2_Additionality\Add_AlcaravanOrinoquia_V2.xlsx"),
- b. Considering uncertainty and using prudential assumptions: For this, we used as input the transparent, documented conservative-official documentation of the Mayor's Offices, Governors' Offices, IDEAM, DANE, ICA, MADS, and Scientific Articles (See "AUDITORIA_VERIFICACION_2022\2_Additionality\Add_AlcaravanOrinoquia_V2.xlsx"),
- c. Specifically, for each GHG project activity: Within the barrier analysis, the description is included for GHG Project activity (See "AUDITORIA_VERIFICACION_2022\2_Additionality\Add_AlcaravanOrinoquia_V2.xlsx").
- d. Considering relevant national as also when applicable to sectoral policies and circumstances. A compliance analysis applicable is conducted, and

- for the activity, the use of national circumstances does not apply (See “AUDITORIA_VERIFICACION_2022\11_Environmental legislation).
- e. Maintaining consistency with the emission factors, activity data, projection variables of GHG emissions, and the other parameters used for the construction of the reference scenario: To determine the carbon dioxide removals generated in the area, the Carbon Stock present in covers proposed by (Yepes *et al.*, 2011),
 - f. Implementing procedures to ensure data quality under ISO 14064-2 and the requirements of the selected methodology: The procedures ensuring data quality are located in the folder “AUDITORIA_VERIFICACION_2022\16_Information management.”
 - g. In such a way that no GHG reductions or removals can obtain, due to decreases in an activity outside the project business: In the chapter 4.1.4 Step 4: Common practice analysis, barriers faced by the Project are evident without being registered as an AFOLU activity.
 - h. Covering emissions and removals of all gases, defined in the applied methodologies, included in the project boundary under consideration: The compliance with this section is located in “AUDITORIA_VERIFICACION_2022\7_Project Document\BCR_PDD_Alcaravan_V9.pdf\Chapter Carbon reservoirs and GHG sources.

In *Add_AlcaravanOrinoquia_V2.xlsx*, in the sheet *Barriers_analysis* (See *2_Additionality*), those barriers that will be overcome through the participation in the PRGEI project, thanks to the economic, technical, technological, and accompanying benefits, are justified for the use of land for commercial reforestation that may include PRGEI.

4.1.4 Step 4: Common practice analysis

As a complement to the steps described above, an analysis is carried out of the degree to which forestry activity has already spread in the geographical area of the project activity, highlighting that other registered A/R project activities will not be included in this analysis.

According to the Rural Agricultural Planning Unit, the Orinoquia has a high and medium suitability of just over 2 million hectares for the establishment of forest plantations for commercial purposes and only modest growth has been reported, giving a base of 160 thousand hectares. has currently (FEDEMADERAS, 2023). Being only 8% of the total surface suitable for forest plantations and indicating that in the region it is not a common practice within its economic activities and, this industry represents less than 1% of the national GDP.

This may be because, historically, the development of commercial plantations in Colombia has been suboptimal given the low productivity and competitiveness of the forestry sector in the country, which has prevented full use of the different types of benefits in economic and environmental terms. that offer this type of projects (Marín y García, 2019). Furthermore, wood production costs in Colombia are relatively high; while establishment, land or administrative costs are at a level comparable to other wood-producing countries. With some exceptions, productivity per area is significantly lower in most plantations, resulting in a cost per m³ of wood produced that is 60% higher than international competitors (PROFOR, 2017).

For the analysis that allows demonstrating to what extent similar afforestation activities have been previously implemented or are currently underway, the project called Gaviotas Research Center is presented. It began approximately in the year 1982 and carried out the establishment of 8,000 hectares of commercial forest plantation with Caribbean Pine. This pioneering and innovative project made it evident that the department would transition from being forgotten and unproductive, paving the way for the search for institutional mechanisms to incentivize the forestry sector in the region (Gobernación del Vichada, 2020).

Also, in 2004, with the signing of the "Sectorial Competitiveness Agreement for the Forest Chain of the Orinoco Region," reforestation began to gain strength and to be carried out continuously in the department. This was due to the implementation of national incentives such as the Forest Incentive Certificate (CIF), created by Law 139 of 1994, as an economic recognition from the state to the reforester or investor for the environmental and social benefits (ONF Andina, Banco Mundial, Departamento Nacional de Planeación, 2018. Cited in (Gobernación del Vichada, 2020)). he CIF was granted between the years 2004-2016 and focused on favoring forestry projects in the departments of Vichada, Antioquia, Meta, and Córdoba. These departments were considered nationally to have appropriated 50% of the CIF resources. However, between 2017-2019, the Ministry of Agriculture and Rural Development did not open calls for proposals, which means that forestry entrepreneurs at the national level have not had access to this economic benefit (Gobernación del Vichada, 2020).

Another line of action in the department of Vichada is the Wood Exploitation, where it is observed that the forestry sector has embraced the proposal of ONF Andina, the World Bank, and DNP. They propose the construction and operation of a plant in the municipality of La Primavera for the production of sawn, dried, and pre-sized wood. This would be complemented by the production of plywood and the utilization of waste for electricity generation. However, technical and feasibility studies are required for the construction of these processing plants, based on business plans developed by entities that allow co-financing their construction and the improvement of road, energy, and technological infrastructure (Gobernación del Vichada, 2020).

To conclude the description in the Vichada Departmental Development Plan (2020-2023), for the agriculture sector, a mitigation measure is established: the promotion of plantations of permanent crops with high biomass (forestry, cocoa, and rubber). These should be developed in phases, starting with scalable and replicable pilot projects and a subprogram that incentivizes the establishment of forest plantations with native species, through governmental entities that may face barriers due to changes in policies, applicable regulations, and delays in objectives as evidence of compliance. It is observed that the initiatives are still in preliminary phases with an uncertain development timeline to begin generating economic and social benefits for plantation owners, continuing with a disadvantage in the utilization of timber products.

For the Meta department, the Departmental Development Plan (2020-2023) is analyzed, where it is mentioned that, although the country recognizes its potential in the agricultural sector and considers it one of its main sources, it is still not fully utilized. In this sense, the National Development Plan 2018-2022 Pact for Colombia, Pact for Equity specifies for the region the "low utilization of agricultural and forestry potential" and highlights it as a challenge to overcome. This document focuses on alignment with the Regional Green Business Program Orinoquia Region of 2014, where it is determined that the department has two companies in the sustainable agricultural sector and, concerning companies with non-timber forest products, one is located in the department (Asamblea Departamental del Meta). In conclusion, the analysis shows that there is a lack of support for similar activities regarding timber production or agroforestry systems in the region that generate economic incentives for plantation owners.

Taking advantage of the existing production potential, Colombia has the potential to significantly improve its "performance" with respect to productivity, following what is described by PROFOR (2017), which is why forest plantations must involve different alternatives within their economic activities such as they are A/R projects that have the objective of removing greenhouse gases from the atmosphere and generate economic benefits, making the development of forest plantations viable. The implementation of the commercial reforestation initiative with a Project GHG, benefiting from the incentives derived from the sale of carbon credits, will reduce the impact of the identified barriers, thus justifying the project's existence.

From the identification of the barriers present in the scenario with project, we identified seven (7) sub-barriers, primarily related to investment and technology; with the implementation of the Project GHG, we will have the possibility of overcoming six (6) of these barriers, particularly those related to investment. Through the commercialization of carbon credits, we can generate private investment interest without necessarily relying on economic assistance, allowing for quicker capital returns. This would facilitate access to credits thanks to the visibility of the international market. It also allows access by the medium-sized forestry companies that are members of the project. They can establish

mechanisms of technical accompaniment through authorized and specialized technical personnel, suitable for the establishment and management of the plantation. This has a positive impact in terms of other possible land uses, thanks to the training carried out for local workers (See *12_Forest management establishment plan*).

It is important to note that we have observed a growth in the carbon market, such observation has been carried out in accordance to the international emission reduction goals for each nation based on the United Nations Framework Convention on Climate Change principles and its Kyoto protocol. The initiatives of developing countries take an important position within the processes of mitigation of the effects of climate change, characteristic of reforestation activities, as well as favoring financing processes (UNFCCC, 2020).

In this context, forestry activities for GHG removal gain value as alternatives and mechanisms to remove these gases from the atmosphere, through commercial forest plantations and other tree-based production systems (crops with planted trees). Moreover, these activities contribute to the economic strength, permanence and increase of the technical capacity of the associated community regarding reforestation activities.

5 Contribution to Sustainable Development Goals (SDG)

The sustainable development goals constitute the global goals for the eradication of poverty, protection of the planet and ensuring the well-being of humanity, by demonstrating measurable progress by 2030. Sustainability is a fundamental axis in the implementation of actions that are transversal to the three pillars of these objectives, within which equity is proposed in social, environmental, and economic terms.

Proyecto Forestal Alcaraván Orinoquía is proposed as a suitable solution to address national challenges, rural needs, and contribute to achieving specific sustainable development goals. This initiative focuses on activities that aim to increase carbon storage, promote sustainable economic development, and conserve the environment. It demonstrates contributions to six out of the fifteen specific targets set within the sustainable development goals framework.



End poverty in all its forms everywhere

By enhancing capacities in initiative management, financial management, and leadership, we aim to strengthen secure land tenure rights by providing appropriate legal documentation and considering the rights associated with land ownership.



End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Through the consolidation of productive chains associated with timber and non-timber forest products that have emerged from the installation of forest plantations, we intend to improve the level of productivity within the production units. This will be achieved through training activities focused on poultry management, forestry practices, and the utilization of technological tools for optimized work.



Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all

The activities of establishment, management and protection of forest plantations and beekeeping seek to involve through employment generation, equity to the resident population of the municipalities belonging to the project. We aim to improve sustainable production chains and existing economic activities through the evaluation of their productivity, processes and goals achieved, strengthening, and projecting their behavior into the future.



Making cities and human settlements inclusive, safe, resilient, and capable of sustainable production.

Reforestation activities will promote responsible production and consumption, through training in the management and use of pesticides, solid waste, environmental education talks, and management of agricultural machinery.



Take urgent action to combat climate change and its impacts

Through the implementation of commercial reforestation areas, the project has generated recovery, rehabilitation, conservation, increases and improvement of carbon sinks. This has favored carbon capture, the generation of microclimates, and the establishment of biological corridors and habitats for faunal species. Additionally, the planted areas serve as physical

barriers to safeguard the riparian forest and its associated water flows, contributing to the overall landscape preservation.

Protect, restore and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss



The establishment of forest species adapted to the soils of the Orinoquía is encouraged. It facilitates the permanence of natural ecosystems for the transit and permanence of associated animal species. Moreover, the project will constitute the essential pillars for sustainable forest management, monitoring of covers, stopping deforestation and degradation activities, providing commercial timber raw material, and stopping the loss of biodiversity. It has a direct effect on the mitigation of adverse effects or natural phenomena associated with soil degradation and desertification. On the other hand, the production is supported by beekeepers, who take advantage of the beekeeping product and in turn strengthen the ecosystem benefits through the pollination of species, inside and outside the project area.

The establishment, management, and protection activities of the Proyecto Forestal Alcaraván Orinoquía contribute positively to the achievement of sustainable development goals. These contributions can be observed in Table 7 and the report *13_Monitoring report\03_SDG\BCR TOOL SDG_Alcaravan_V4.xlsm*. The report provides information on the specific sustainable development goals, indicators, baselines, annual and overall targets, activity types, and project contributions. Supporting documentation can be found in the mentioned file, organized by SDG number, with each folder containing documents related to specific indicators, reference values, and verification years.

Table 7. SDG Results for the monitoring period.

SDG	Global indicators	Results for the monitoring period
1. End poverty in all its forms everywhere	1.4.1 Proportion of population living in households with access to basic services	18% of employees have access to basic services.
	1.4.2 Proportion of total adult population with	100% of the properties have ownership of carbon rights

SDG	Global indicators	Results for the monitoring period
	<p>secure tenure rights to land, with legally recognized documentation and who perceive their rights to land as secure, by sex and by type of tenure</p> <p>1.5.4 Proportion of local governments adopting and implementing local disaster risk reduction strategies in line with national disaster risk reduction strategies</p>	<p>33.33% of the municipalities belonging to the Project have a Disaster Risk Management Plan (PDGRD)</p>
2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture	2.4.1 Proportion of agricultural area under productive and sustainable agriculture	7.8% of the municipalities that are part of the project are under productive and sustainable agriculture
8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	<p>8.3.1 Proportion of informal employment in non-agriculture employment, by sex</p> <p>8.5.1 Average hourly earnings of female and male employees, by occupation, age and persons with disabilities</p>	<p>27% of the number of employees with formal employment (2018) compared to the largest number.</p> <p>\$4,075 COP corresponds to the SMLV hourly value of 2017 and was the reference value taken; this is paid to the majority of workers within the project. A projection of the increase is made that corresponds to the value given by the government and the CPI.</p>
12. Ensure sustainable consumption and production patterns	12.6.1 Number of companies publishing sustainability reports	1 participant has sustainability reports
13. Take urgent action to combat climate change and its impacts	13.2.2 Total greenhouse gas emissions per year (tCO _{2e})	27786900000000, 20762859599499 and 3000 were obtained, which correspond to total emissions generated in Colombia according to the BUR, for the years without data (after 2020), it was taken into account according to an emission rate considered after 10 years before.

SDG	Global indicators	Results for the monitoring period
		Release of CO ₂ e generated by 1 head of cattle in every 10 ha, present in the areas before planting.
	13.3.1 Number of countries that have integrated mitigation, adaptation, impact reduction and early warning into primary, secondary and tertiary curricula	5 educational talks and training with a sustainable development focus.
15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	15.1.1 Forest area as a proportion of total land area	100% of eligible project areas
	15.2.1 Progress towards sustainable forest management	

Source: (CO2CERO SAS, 2022)

6 Compliance with Applicable Legislation

In order to establish, implement and maintain procedures to identify, access and monitor the applicable legal requirements, we have implemented the established legal and regulatory requirements for the execution of an ARR project. This information can be found in the document titled *11_Environmental legislation\Environmental legal matrix_AlcaravanOrinoquia.xlsx*. Compliance with legal and environmental requirements will be monitored during each verification, with a maximum of 3 years, complying with the item a) The project holder shall demonstrate that the project activities do not violate local, state/provincial, national or international regulations or obligations de la tool “No net harm environmental and social safeguards (NNH), version 1.0”. Presented below are the environmental legal requirements that apply to the project.

6.1 National policies and standards

- National Code of Renewable Natural Resources and Environmental Protection (Decree-Law 2811 of 1974)

It regulates the management of forest soils by their nature and the forests they contain, which for the purposes of the code are called forest areas (Article 202).

Chapter II of Title III of the Code establishes matters relating to forest exploitation. The title is later regulated by D.1791/96.

The project manager, and each of the project participants, are responsible for carrying out an annual review of the Forest/Non-Forest areas, in order to comply with everything related to the forest areas, within the limits of the project.

- National Forestry Development Plan (CONPES Document 3125 of 2001)

It was designed with the purpose of improving the management of forest resources, enhancing the living conditions of the populations that have historically been occupying the country's forest lands, and offering viable productive alternatives that contribute to the economic development of the country and the peace process, as well as to meet international commitments in this regard.

The project constitutes a regional productive activity, generating development in the project areas. The project manager periodically reviews the standard, considering the obligations arising from any change or related regulation.

10.1 Sectoral rules

- Law 1377 of 2010

This law focuses on regulating commercial reforestation activities, specifically defining and establishing regulations for forest plantations and agroforestry systems intended for commercial purposes.

Applicability: This project follows the parameters defined for commercial plantations in Law 1377 of 2010:

1. Registration: Forest plantations have the respective registration in the ICA or are in the process of obtaining them (See *11_Environmental legislation\Records ICA*).
2. Free use and mobilization: Since the plantations have not been used yet, this permit has not been requested at this point.
3. Protection of natural forests and strategic ecosystems: The commercial plantation of the project proponents meets this parameter, which is verified in the project eligibility analysis (See Figure 6).

Potential areas for developing commercial reforestation activities: More than 50% of the plantations have been established in areas with low or no suitability for the development of commercial reforestation activities.

- Decree 2803 of 2010

It regulates Law 1377 of 2010, regarding the registration of forest crops and agroforestry systems for commercial purposes, protective-producing plantations, and the mobilization of forest products.

Applicability: The plantations present in the project area are commercial and include Eucalyptus, Acacia and Pine species, which have been registered according to the procedure described in Decree 2803 of 2010 (See *11_Environmental legislation\Records ICA*).

- Law 299 of 1996

The conservation, protection, propagation, research, knowledge, and sustainable use of the resources of the Colombian flora are strategic for the country and constitute a priority within the environmental policy.

Applicability: The water margins and the natural forest cover in the project area are protected, including the gallery forests and all the vegetation present 30 meters on each side of the water sources, as shown in Figure 2. Those areas intercepted with this margin are ineligible.

- Resolution 1447 of 2018

It regulates the national-level system for monitoring, reporting, and verifying mitigation actions as stated in article 175 of Law 1753 of 2015. It also includes additional provisions.

Applicability: The project is in the process of certification with the BCR0001 V4.0 Methodology of the BioCarbon Registry. However, according to the resolution, the reference scenario is a type of baseline that represents GHG emissions measured in tons of CO₂e that would occur in the absence of policies, plans, strategies, or initiatives for GHG mitigation in the period in which climate change goals or commitments are established. As for the baseline, the decree defines it as the scenario that represents the GHG emissions that would occur in the absence of a mitigation initiative.

Currently, the only approved reference scenario for Colombia is the Amazon biome reference scenario. This scenario does not include reforestation activities and additionally, only covers reduced emissions for the period 2013-2017. The project is a reforestation activity that is not found within the Amazon biome. Therefore, it complies with the provisions of the resolution under the technical parameters defined for this type of initiatives.

- Decree 926 of 2017

This decree modifies the epigraph of Part 5 and adds Title 5 to Part 5 of Book 1 of Decree 1625 of 2016, which serves as the sole regulatory document in tax matters. Additionally, it adds Title 11 to Part 2 of Book 2 of Decree 1076 of 2015, which serves as the sole regulatory document in the environment and sustainable development sector. The purpose of these modifications is to regulate paragraph 3 of article 221 and paragraph 2 of article 222 of Law 1819 of 2016.

Applicability: The project will be certified through the BCR V3.2 Standard and the BCR0001 V 4.0 methodology. It also can be used by passive agents of the national territory for the non-causation of the carbon tax, since it complies with the characteristics of GHG removals to certify the carbon neutral condition:

1. It comes from a GHG mitigation initiative developed in the national territory: The project is carried out in the departments of Meta and Vichada.
 2. It comes from GHG mitigation initiatives formulated and implemented through certification programs or carbon standards, which must have a platform for public registration of GHG emission reductions and removals.
 3. It was generated from the implementation of a methodology developed by certification programs or carbon standards.
 4. It does not come from activities that are developed by mandate of an environmental authority to compensate for the impact produced by the work or activity subject to an environmental authorization: The project proponents do not carry out reforestation as compensation for other activities.
 5. It is certified by the certification program or carbon standard.
- Decree Law 2811 of 1974

This decree determines the forest reserve areas (protective and producing) and prohibits the allocation of vacant lands in them, except for reasons of public utility and social interest. It also defines forest uses (persistent, unique, and domestic).

Applicability: The project area is not within the protective and producing forest reserve areas (See Figure 2).

- Law 1333 of 2009

This Law establishes the environmental sanctioning procedure.

Applicability: According to what was indicated by the project proponents and the environmental legal analysis carried out, the area of influence of the project has no environmental sanctioning process in force.

- Single Regulatory Decree 1076 of 2015 (MADS)

By means of which the Single Regulatory Decree of the Environment and Sustainable Development Sector is issued. The Decree defines the following:

Forest plantations play a fundamental role as sources of renewable energy and supply of raw materials. They maintain ecological processes, generate employment and contribute to national socio-economic development, which is why their implementation should be encouraged and stimulated.

Forest plantation companies: These are those dedicated to the establishment and management of forest plantations.

Industrial or commercial Producing Forest Plantations: These are those that establish themselves in producing forest areas with the sole purpose of allocating them to forest use.

Applicability: The project collects forest plantations for timber and protection purposes, which are developed under current standards and regulations. Similarly, the project proponents do not have water concessions.

- ARTICLE 2.2.1.1.12.2. Of the Single Regulatory Decree 1076 of 2015

As of October 8, 1996, it is mandatory to register all forest plantations, living fences, windbreaks, and shade barriers with the respective corporation overseeing the area. The project activities align with the requirements stated in the regulation.

Applicability: To demonstrate that the project complies with the environmental restriction zones described in Decree 1076 of 2015 of the Ministry of Environment and Sustainable Development, a map was made (See Figure 2) in the following areas are shown:

- Areas registered in the RUNAP (Single National Registry of Protected Areas, 2018).
- Forest reserves designated under Law 2 of 1959, including any exclusions up to 2018.
- Wetland areas of international importance subscribed to RAMSAR.

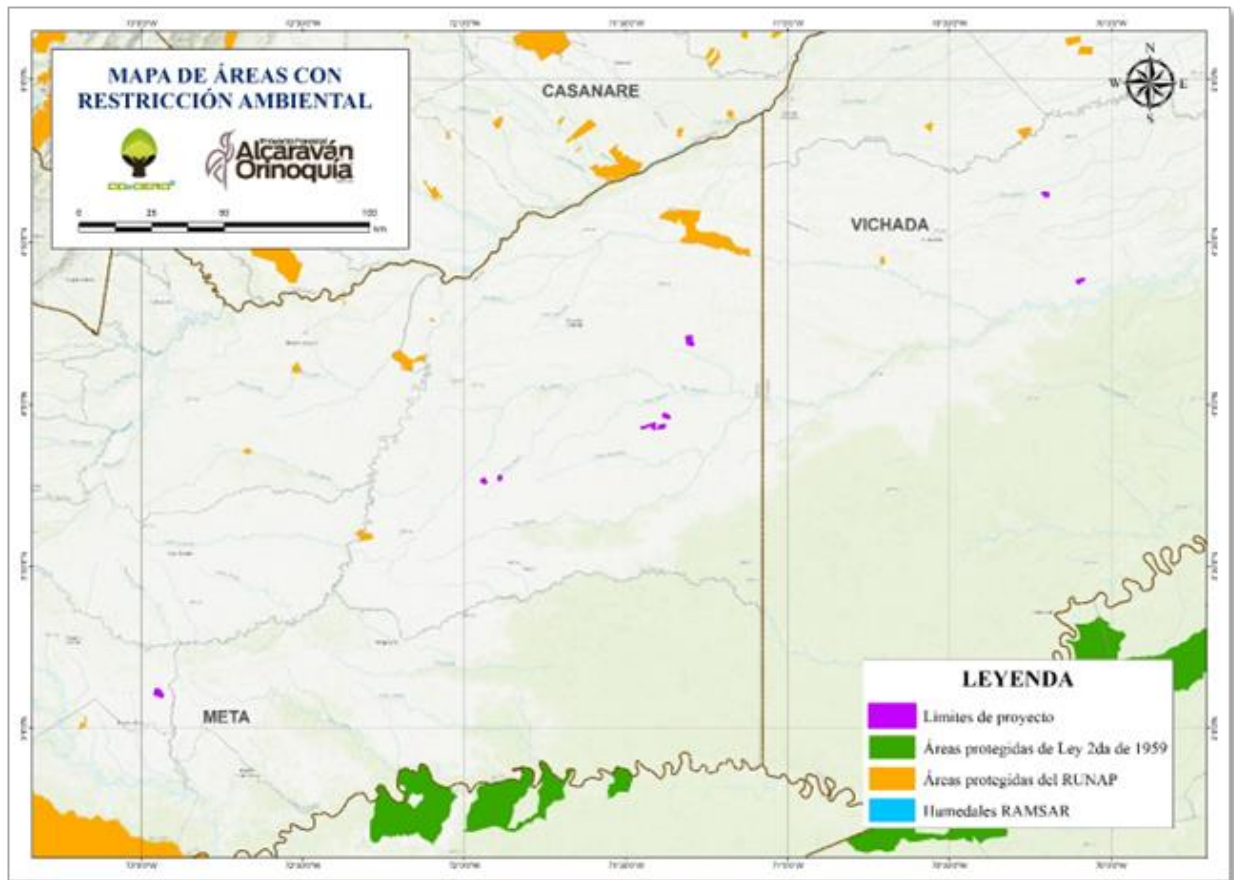


Figure 2. Map of Areas with Environmental Restriction.
Source: (CO2CERO SAS, 2022).

- Resolution 500.41.13-1571

This resolution modifies resolution 200.41.11-1130 of 2011, which establishes the general criteria for the implementation of forestry, agricultural, and agro-industrial projects within the jurisdiction of CORPORINOQUIA.

Applicability: The criteria under which forestry activities are developed for the forestry projects involved are identified in the management plans and eligibility analysis

7 Climate change adaptation

The United Nations Framework Convention on Climate Change (UNFCCC, 2002) defines climate change in Article 1 as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." Based on this definition, compliance actions are proposed in the development and

implementation of the Proyecto Forestal Alcaraván Orinoquía, following the guidelines set out in the national and international framework for climate change adaptation.

Continuing with the above approach, it is important to mention that the Proyecto Forestal Alcaraván Orinoquía aligns with the National Climate Change Policy (2017), promoting the increase of carbon reserves and contributing to mitigation actions. In this way, it supports its objective of advancing towards a climate-resilient and low-carbon development path (Murillo, 2016).

The alignment of the Proyecto Forestal Alcaraván Orinoquía with the specific objectives of the National Climate Change Policy (2017) includes:

Table 8. Alignment of the Proyecto Forestal Alcaraván Orinoquía with the specific objectives of the National Climate Change Policy (2017)

Objective	Compliance	Indicator	Compliance with the objective
1. Guide climate change management in priority development areas where territorial and sectoral decisions intersect, impacting the most vulnerable systems and significant sources of emissions, integrating both greenhouse gas (GHG) adaptation and mitigation towards a low-carbon and climate-resilient development path: urban development, rural development, mining-energy development, and strategic	<p>The departments associated with the project (Vichada and Meta) are part of the Regional Climate Change Node of the Orinoquia, established by Decree 298 of 2016. These nodes were created to promote, support, and facilitate the implementation of policies, strategies, plans, programs, projects, and measures related to climate change at the regional level.</p> <p>From the commercial reforestation activities registered as the ARR project, strategies are developed that contribute to the management and achievement of national goals regarding climate change, promoted from various sectors and territories of the country. It is important to note that these</p>	<p>SDG 1.4.1 Proportion of population living in households with access to basic services</p> <p>SDG 13.2.2 Total greenhouse gas emissions per year</p>	<p>See folder "13_Monitoring report\03_SDG\SDG 1\1.4.1", "1_Agreements" and "5_Carbon calculation\Ex-Post"</p> <p>Decree 298 of 2016</p>

Objective	Compliance	Indicator	Compliance with the objective
infrastructure development	strategies are developed in collaboration with public and private actors at both local and national levels. These activities focus on economic development through ecosystem services, which not only result in greenhouse gas removals but also generate employment in the AFOLU sector and financial viability through sustainable forest management practices, including long-term commitments to maintaining these carbon reservoirs.		
2. Guide climate change management towards the management and conservation of ecosystems and their environmental services, aiming to achieve synergistic objectives with the reduction of population vulnerability and their economic activities	The implementation of commercial reforestation activities registered under the ARR project generates synergy in reducing the vulnerability of the surrounding population by increasing employability since its establishment for specific activities such as land preparation, planting of individuals, pest and disease management, fertilization, irrigation, etc.	<p>SDG 1.4.1 Proportion of population living in households with access to basic services</p> <p>SDG 8.5.1 Average hourly earnings of employees, by sex, age, occupation and persons with disabilities</p>	See <i>7_Project Document/BCR_P DD_ Alcaravan_V9.pdf/ 10.2 Project socialization</i> and "13_ Monitoring report\03_SDG\SDG 1\1.4.1 and "SDG 8\8.5.1"
3. Create enabling conditions for science, technology, information, and innovation	The Proyecto Forestal Alcaraván Orinoquía, is registered on the Global Carbon Trace platform, where fundamental project information is deposited,	See in https://globalcarbontrace.io/projects/53	

Objective	Compliance	Indicator	Compliance with the objective
necessary to advance towards a climate-resilient and low-carbon development path.	making it entirely public and enhancing traceability of the procedures developed. This allows any interested user to access the information, showcasing the greenhouse gas removal quantification mechanisms under parameters that ensure compliance with basic carbon principles.		
4. Generate the institutional changes necessary to increase the effectiveness of climate change management.	The Proyecto Forestal Alcaraván Orinoquía, aligns with this objective by communicating with the relevant environmental authorities through socialization and necessary requests to comply with applicable regulations.	Evidence of compliance in "11_Environmental legislation\3_Socialization\ Resp_MinAmbiente.pdf", "11_Environmental legislation\Environmental legal matrix_ AlcaravanOrinoquia.xlsx" and "11_Environmental legislation\2_Records ICA"	

Source: Adapted by (CO2CERO SAS, 2023).

In order to comply with what is described in the BCR Standard, specifically item a), consider one or more of the strategic lines proposed in the National Climate Change Policies and/or aspects outlined in the regulations of the country where the project is implemented. Furthermore, the project is integrated with the strategic lines of the National Climate Change Policy (2017) mentioned below::

- Low Carbon and Climate-Resilient Rural Development: Promoting the planting of tree species adapted to the soils of the Orinoco, creates climate-resilient forest production systems consistent with the region's ecological conditions and facilitates the preservation of natural ecosystems for the movement of associated species and adaptation to climate change. It generates species resilient to high temperatures, droughts, or floods, which are monitored in accordance with the mitigation measures outlined in the project's risk management (See 10.18 Actions and corrective measures).
- The aligns with the national objectives and item c) implemented activities that generate sustainable and low-carbon productive landscapes of BCR Standard.

- Ecosystem Management and Conservation and Their Ecosystem Services: Contributing to the reduction of ecosystem degradation and fragmentation while enhancing the capacity to provide ecosystem services, such as providing habitat for species categorized as threatened according to the IUCN characteristics of the region (See 7_Project Document\BCR_PDD_Alcaravan_V9.pdf/Characteristics and Conditions Prior to Starting the Project/sections on flora and fauna described by municipality) and carbon capture through greenhouse gas removal (See *Quantification of removals generated in the Ex-Ante project scenario*).

Furthermore, in 2020, Colombia submitted its updated Nationally Determined Contribution (NDC) to the United Nations, outlining its commitments to mitigate and adapt to climate change by 2030 (WWF, 2021). These commitments include a 51% reduction in greenhouse gas emissions and a cap on gross deforestation not exceeding 50,000 hectares annually.

The Proyecto Forestal Alcaraván Orinoquía positively contributes to the aforementioned goals, as it reduces pressure on natural forests and serves as a carbon sink. The project aims to remove approximately 517,005 tCO₂e over its 20-year lifespan, with an annual removal of 25,850 tCO₂e. This is a reliable indicator of its contribution to climate change (Refer to folder 7_Project Document\BCR_PDD_Alcaravan_V9.pdf).

It's worth noting that the project follows key principles for climate change management and adaptation, including relevance, comprehensive coverage, coherence, accuracy, transparency, and a conservative approach, as outlined in ISO 14064-2 and described in the standard's version 3.2. Furthermore, the departments associated with the project (Vichada and Meta) are part of the Regional Climate Change Node of the Orinoquia, established by Decree 298 of 2016. These nodes were created to promote, support, and facilitate the implementation of policies, strategies, plans, programs, projects, and measures related to climate change at the regional level. The project, through its greenhouse gas mitigation actions, contributes to the action plan generated by the node and supports the fulfillment of climate change adaptation within the municipalities.

On the other hand, according to Corporinoquia (2001), anthropogenic processes, primarily the colonization and expansion of the national agricultural frontier in the municipalities of Puerto Gaitán and Puerto Lleras, are leading to the destruction of habitats native to the region, contributing to biodiversity loss and the loss of ecosystem services. Climate change adaptation seeks to improve the conservation conditions of these two factors (Uribe, 2015). This is why the project's activities serve as a means to counter these adverse factors that harm the territory and contribute to the conservation of species located within the project's boundaries. This, in turn, improves connectivity between ecosystems and natural coverages (Gurrutxaga & Lozano, 2007), and

contributes to the mitigation of global climate change through greenhouse gas capture. Additionally, the project constitutes essential pillars for sustainable forest management and the monitoring of vegetation cover, providing marketable raw materials within the local market and directly affecting the mitigation of adverse effects or natural phenomena associated with soil degradation and desertification (Prado, 2019).

In conclusion, the project will achieve the restoration, rehabilitation, conservation, increase, and improvement of carbon reservoirs through commercial reforestation activities. This benefits carbon capture, the creation of microclimates, the establishment of biological corridors, and habitat provision. Forest plantations will also act as protection for riparian forests and their associated watercourses and for the overall landscape (Pirard, Del Secco, & Warman, 2016), fulfilling item b) improve conditions for the conservation of biodiversity and its ecosystem services, in the areas of influence, outside the project boundaries, i.e, natural cover or environmentally key areas, biological corridors, water management in watersheds, among others.

It is emphasized that, due to the focus of the commercial reforestation activity where the ARR project is implemented, the item d) propose restoration processes in areas of specific environmental importance, does not apply. Additionally, to fulfill items e) design and implement adaptation strategies based on an ecosystem approach mentioned in the BCR Standard and f) strengthen the local capacities of institutions and/or communities to take informed decisions to anticipate negative effects derived from climate change (recognition of conditions of vulnerability); as well as to take advantage of opportunities derived from expected or evidence changes, The objective 1 of the National Climate Change Policy (2017) is aligned, as seen in Table 8. Furthermore, actions are established to anticipate negative effects resulting from climate change, as described in 11 Risk management.

Finally, the following actions or measures to adapt to climate change are included:

- a. Agricultural, forestry, and fisheries production systems better adapted to high temperatures, droughts, or floods, to improve competitiveness, income, and food security, especially in vulnerable areas: Promoting the planting of tree species adapted to the soils of the Orinoco, creates climate-resilient forest production systems consistent with the region's ecological conditions.
- b. Integrated actions that assist in the efficient use of soil, including, i.e, the conservation of existing natural cover, land use consistent with land vocarion and agroecological conditions, family farming, and agricultural technology transfer that increases competitiveness by reducing vulnerability to climate change: It aligns with objective 1 of the National Climate Change Policy (2017), being located in the Orinoquía regional climate change node, as described in the Table 8.

- c. Reduction of GHG emissions from agricultural activities, compared to the non-project scenario: As described in *7_Project Document/BCR_PDD_Alcaravan_V9.pdf/chapter 3.3 Identification and description of the baseline scenario and additionality for AFOLU projects*, the baseline scenario corresponds to pastures for livestock as the main productive activity of the region; through the implementation of the Proyecto Forestal Alcaraván Orinoquía, plantings of commercial forest species are generated, resulting in effective greenhouse gas removals.
- d. Actions causally related to climate change adaptation measures, such as use and management of seeds resistant to temperature change, water management through rainwater harvesting, recycling, drainage, and irrigation, reforestation of watersheds to prevent erosion, soil management with practices that reduce compaction, and techniques to reduce fertilizer use: Through environmental and socioeconomic evaluation, measures are established to generate actions for climate change adaptation. Among these measures are solid waste management and techniques to reduce the use of agrochemicals in the Project area, through diagnostics, training, and sustainable forest management (See Table 23 and Table 44).

8 Carbon ownership and rights

The Proyecto Forestal Alcaraván Orinoquía is owned by CO₂CERO SAS, a private company that offers innovative solutions to different actors in the environmental and agricultural sector in Colombia, along with eight (8) reforestation initiatives in the Orinoquía region.

8.1 Project holder

CO₂CERO SAS is the entity proposing the project (see Table 9), a private company offering innovative solutions to different actors in the environmental and agricultural sectors in Colombia. Some of the services it offers include the development of carbon projects in the forestry sector and other land uses, the execution of sustainability consultancies associated with workshops planting, green markets, calculation of the carbon footprint, environmental education, and sustainability certifications accompaniment.

Table 9. Project Manager Information

Individual or organization	CO ₂ CERO S.A.S
Contact Person	EDGAR MAURICIO RODRÍGUEZ
Job position	Legal Representative
Email	info@co2cero.co

Address	Carrera 45 A No 104B – 16, Bogotá
City and Country	Bogotá D.C., Colombia
Cellphone Number	601+ 604 72 79

Source: (CO2CERO SAS, 2022)

8.1.1 Organizational Structure, Responsibilities, and Powers

Below is the organizational structure, responsibilities, and powers of CO₂CERO SAS.

8.1.1.1 Responsibilities

- Establishes rules and conditions that must be considered in managing and commercializing in the market, the Carbon Credits generated by the climate change mitigation projects.
- Regulates the remuneration and the payment method in favor of CO₂CERO for executing the activities established in the agreements between the parties.
- Maintains—in its structure—the technical, organizational, and administrative conditions related to the mitigation project operation, necessary for the Climate Change Mitigation Project to always comply with the certification requirements indicated by the entity(ies) validating, verifying, and certifying the project to periodically obtain the certification of the new Carbon Credits.

Figure 3 shows the organizational structure related to the GHG mitigation project.

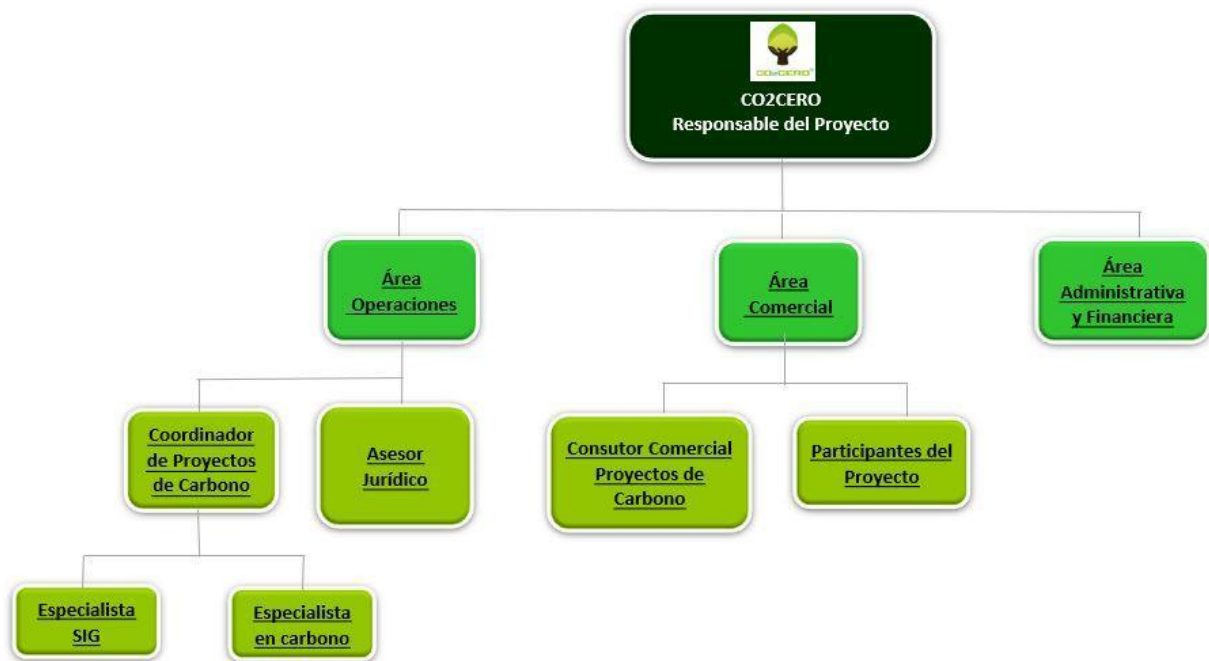


Figure 3. Organizational Structure Carbon Projects Area
Source: (CO2CERO SAS, 2022)

8.2 Other Project participants

Proyecto Forestal Alcaraván Orinoquía has eight (8) reforestation initiatives in the Orinoquía region. Below is the general information of all the participants:

Table 10. Proyecto Forestal Alcaraván Orinoquía Participants

Organization Name/Participant	Legal Representative Name	Email	Address	City and Country	Cellphone Number
ECOLOGIC SAS	Mauricio Rodríguez Castro	info@co2cero.co	Carrera 45 ^a No 104B – 16	Bogotá D.C., Colombia	6016047279
SULTANA SAS	Pablo Macias	pablo.macias@eco-logic.com.co	Cra 45 ^a No. 104B - 16	Bogotá D.C., Colombia	3505475219
ENLACE ROJO SAS	Néstor Elberto Hurtado	nelhuca1964@hotmail.com	Cll 160 No. 58 75 TO 9 AP 102	Bogotá D.C., Colombia	3112362605
ECOSISTEMA PRODUCTIVO MATAEMONTE SAS	Jerónimo Torres Santiago	mataemonte@unicorn.com.co	Cll 12 B No. 27 32	Bogotá D.C., Colombia	3164704581
LUIS FERNANDO RODRIGUEZ	Luis Fernando Rodríguez	portalelectronico@pressaplique.com	Cll 64 No. 113 ^a -32	Bogotá D.C., Colombia	3124541813
INVERSIONES GUARDABOSQUES DE COLOMBIA SAS	William Alonso López Rivera	ingcolsas@hotmail.com	Cll 32 No. 34-15	Bogotá D.C., Colombia	3107791130
CLAUDIA HUERFANO	Claudia Huérfano	huerfanoclaudia@gmail.com	Av 23 No. 15-23	Acacias, Colombia	3202342074
PUNTA DE GARZA INVERSIONES FORESTALES	María Sandy Bravo	Normac17@hotmail.com	Cra. 47 No. 106-08	Bogotá D.C., Colombia	3118648015

Source: (CO2CERO SAS, 2022)

The project participants are legal constituted persons or legally established entities that demonstrate land use rights in the properties involved in the project. Their responsibilities are outlined below:

- Provide CO₂CERO the forest establishment and management plans, financial analyses, and all other aspects related to their plantations, that's necessary for the formulation and monitoring of the Climate Change Mitigation Project.
- Provide CO₂CERO the list of annual forest activities, indicating the planted species, the coordinates of the plot where the planting was done, as well as the area and the establishment dates.
- Send the information related to disturbances occurred during that period, disturbances defined as any event that affected the plantation, including fires,

pests, acts of violence, illegality, or criminal activities. Also, it shall report the area that was affected and the actions taken to prevent its recurrence. In applicable cases, provide copies of the report files with the relevant authorities.

- Contribute with the necessary aspects to carry out, on their properties, the conformity assessment body audits related to the reviews or recertifications required for the operation of the forest plantation certification and the Climate Change Mitigation Project certification.
- Comply with and adopt the instructions provided in the audit finding issued by CO₂CERO and CAB, within deadlines set by the auditors in accordance with the regulations of CAB or the project document prepared by CO₂CERO, as applicable.
- Submit a written report within a maximum period of seven (7) calendar days following the occurrence, imposition of any lien, seizure, filing of a lawsuit, or any other precautionary, measure ordered within a judicial or administrative process concerning to the property, plantation, machinery, or improvements that are part of the project, as soon as it becomes known to them.
- Provide all the information and documentation that CO₂CERO may require, related to the project and Climate Change Mitigation Project or of a legal nature that may become necessary, for the purpose of conducting the marketing management.

8.3 Agreements related to carbon rights.

Project participants are governed by a contract for the linking, administration, and marketing of carbon credits. The contractual purpose is to establish the rules and conditions that shall be considered for CO₂CERO to link Proyecto Forestal Alcaraván Orinoquía, manage it, and commercialize the carbon credits that the plantation sells in the market. Likewise, the remuneration and payment method payable to CO₂CERO SAS –for executing the activities established in the contract, will be regulated.

Proyecto Forestal Alcaraván Orinoquía allows linking autonomous and independent forestry projects if they meet the Greenhouse Gas Emission Compensation scheme (GHG) requirements of the forestry sector –designed and certified. After linking new forestry projects to the GHG Removal Project, the VVB will conduct the necessary validations to issue the verification statement –regarding the carbon amount sequestered by forest plantations, which may subsequently be sold on the market as goods called "CARBON CREDITS", so that third parties can offset the greenhouse gas emissions they generate.

Activities in Proyecto Forestal Alcaraván Orinoquía, and, therefore, the removals that will be counted as carbon credits, shall be part of continuous actions, guaranteeing their presence in the short, medium, and long term. The person in charge of the project and

the participants of the Greenhouse Removal Project (PRGEI, for its acronym in Spanish) shall guarantee the forestry activity continuity for the project timeframe, per the conditions of the BCR V 3.2 Standard, and the BCR0001 V 4.0 Methodology. On the other hand, after linking new plantations to the PRGEI, the VVB will validate and verify the carbon reserves, which can later be sold on the market. Contracts signed between the parties are in folder *1_Agreements*, in which the business and commercial relationship between the person in charge of the project and the other participants is recorded.

8.4 Land tenure

Land tenure rights are verified under the administrative management process, based on the "*Legal requirements and land tenure*" procedure, part of CO₂CERO SAS management system. This procedure ensures that all land within the project boundaries has land use rights for no less than the project timeframe.

The *15_Land tenure* folder subfolders contain the project participants, where the supports of their land tenure for all are recorded. The ownership, real estate registrations, and granting of the property's designation used for Proyecto Forestal Alcaraván Orinoquía, according to all the participants, are shown in Table 11.

Table 11. Land Ownership in Participants' Properties

Participant	Property	Property Certificate/Deed	Property Designation
ECOLOGIC SAS	Galapagos	234-6076	Owner
SULTANA SAS	La Sultana	234-8705	Owner
ENLACE ROJO SAS	Barlovento	236-29048	Owner
ECOSISTEMA PRODUCTIVO MATAEMONTE SAS	La Porfia La Botereña	234-9602	Shared Ownership
LUIS FERNANDO RODRIGUEZ	Naranjales	234-28921	Owner
INVERSIONES GUARDABOSQUES DE COLOMBIA SAS	La Cabaña	540-1819	Owner
CLAUDIA HUERFANO	Villa Claudia	234-12891	Owner
PUNTA DE GARZA INVERSIONES FORESTALES	Punta de Garzas	540-1324	Owner

Source: (CO₂CERO SAS, 2022)

9 Environmental Aspects

Complying with the provisions of the tool “No net harm environmental and social safeguards (NNH), version 1.0”, in section b) which describes “Identify environmental and social effects resulting from the implementation of the project and c) Conduct the assessment and the Risk management to identify environmental and social effects of the project activities, in order to analyze the foreseeable effects on biodiversity and ecosystems within the project boundaries, an environmental assessment was conducted based on effect categorization using the methodology developed by Conesa (2010). This methodology assigns an importance value to each effect using value scales for the criteria established by it, allowing them to be classified into different ranges based on their nature. The parameters of this methodology were adapted to fit the specific characteristics of the project.

Table 12. Description of the classification for the purposes of the Proyecto Forestal Alcaraván Orinoquía.

Classification	Description by classification	Type of Classification	Scale
Intensity of the Effect	Environmental effects are not significant, i.e., when the consequences of the effect generate minimal modifications to the environmental component and maintain the characteristics of the analyzed environment.	Low	1
	The effect is significant, generating modifications to the environmental components, as there is a partial alteration in the analyzed environment, modifying some of its characteristics.	Medium	3
	The effect significantly alters the environmental components, mostly or completely modifying the set of characteristics of the environment.	High or total	5
Extension of the effect	The effect occurs very localized compared to the total affected area > 100 ha	Point-specific	1
	If the effect manifests in a larger area where a specific activity is carried out ≥ 100 ha and ≤ 1000 ha	Partial	3
	If the effect manifests in a larger area where the specific and partial activity is carried out < 1000 ha	Extensive or Total	5

Classification	Description by classification	Type of Classification	Scale
Persistence of the effect	The manifestations of the effect last for less than < 1 year.	Momentary	1
	The manifestations of the effect last for a period of one to ten years 1-15 years.	Temporary	3
	The manifestations of the effect persist for a period longer than > 15 years.	Permanent	5
Timing of the Effect	If the effect of an action takes more than 15 years to manifest	Long-term	1
	When the time elapsed between the appearance of the action and the beginning of the effect occurs within a period of 1-15 years	Medium-term	3
	When the time elapsed between the appearance of the action and the beginning of the effect is less than 1 year.	Short-term	5
Reversibility of the Effect	Returning to original conditions takes less than 1 year.	Short-term	1
	It takes between 1-15 years to return to the original conditions.	Long-term	3
	Returning to original conditions takes more than 15 years.	Irreversible	5

Source: (CO2CERO SAS, 2022). Adapted from Conesa. (2010).

For the Proyecto Forestal Alcaraván Orinoquía, seven (7) criteria were analyzed for negative effects and five (5) for positive effects. For the latter, there is no rating for recoverability and reversibility criteria, as indicated by Conesa's methodology (2010). The criteria evaluated for all effects included their nature, intensity, extent, persistence, and timing. The explanation of these criteria, as well as the ratings assigned to each effect, can be found in the folder (13_ Monitoring report\04_NNH\01_Environmental aspect and Table 12.

Table 13. Rating and environmental importance level of the effects determined in the environmental assessment.

Effect	Rating	Environmental level of importance
Increase in forest mass	33	Positive: High
Provision of habitats for wildlife	27	Positive: High
Reduction in pressure on natural ecosystems	25	Positive: Medium
Soil erosion reduction	33	Positive: High
Flood reduction	27	Positive: High
Biological corridor	33	Positive: High

Effect	Rating	Environmental level of importance
Generation of noise and atmospheric pollution due to the use of vehicles and machinery	-19	Negative: Irrelevant
Increased risk of forest fire spread	-39	Negative: Critic
Use of agrochemicals	-29	Negative: Moderated
Outbreaks of pests and diseases	-23	Negative: Moderated

Source: (CO2CERO SAS, 2022).

Finally, for the Proyecto Forestal Alcaraván Orinoquía, six (6) positive effects and three (3) negative effects were determined, with five (5) positive effects classified as having a high level of environmental importance and one (1) with a medium level of environmental importance. Similarly, for the negative effects, one (1) was deemed irrelevant, two (2) were moderate, and one (1) was critical in terms of their level of importance (Table 13). Below are the effects observed in the Proyecto Forestal Alcaraván Orinoquía according to the environmental assessment.

9.1 Increase in forest mass

Currently the Meta department has approximately 22,7750 hectares of commercial forest plantations that has been increasing year by year due to the region's development and the relatively low land costs compared to the national average (Soler, 2018). Additionally, the Agustin Codazzi Geographic Institute (IGAC) states that 77% of the department consists on areas for conservation and forest development, equivalent to 6,602,299 hectares

For this reason, the increase in forest mass in the department contributes to maintaining good land use practices and preventing the overuse of land for inappropriate purposes. Furthermore, the establishment of plantations within the department helps achieve the goals set by the department itself in the Comprehensive Agricultural and Rural Development Plan with a territorial approach, wich aims to increase agro-industrial crop production by 40% by 2038 (ADR, 2019).

Table 14. Rating of the increase in forest mass effect.

Criterion	Rating
Character	1
Intensity	5
Extension	5
Persistence	5
Moment	3
Total	33

Environmental level of importance	Positive: High
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Source: (CO2CERO SAS, 2022)

Based on the information provided and as observed in Table 14, it is established that the increase in forest mass becomes a positive effect on the project's own activities. Additionally, it presents an extension of 1,094.43 hectares planted with three different strata, with a duration of 20 years, making it a persistent effect.

9.2 Wildlife habitat provision

Gurrutxaga and Lozano (2010) state that due to the constant increase of forest plantations worldwide are attributed, from a management perspective, a fundamental role in biodiversity conservation, as they increase the supply of habitats and function as feeding, shelter, and establishment of numerous wildlife species.

Similarly, according to Gurrutxaga y Lozano (2007), the plantations contribute to reducing the soil erosion and improving water quality in rivers, which facilitates the expansion of species that depends on forests and, consequently, promotes the interconnection of forested areas in territory.

Table 15. Rating of wildlife habitat provision effect.

Criterion	Rating
Character	1
Intensity	3
Extension	5
Persistence	5
Moment	3
Total	27
Environmental level of importance	Positive: High

Source: (CO2CERO SAS, 2022)

It is worth noting that although plantations are important for biodiversity conservation, they are homogeneous formations that do not provide the same quality of habitat for wildlife species as forests (Lantschner & Rusch, 2014), For this reason, the intensity for this factor is rated as medium, as it generates a partial alteration in the environment in terms of habitat supply, as mentioned by Gurrutxaga y Lozano (2007), Some species adapt better to plantation conditions, while others need to inhabit forests.

Furthermore, the extent plays a fundamental role. These same authors mentioned that the size of forests plantations determines the number of species they can contain and indicate that larger plantations provide greater species richness. In this case, there are approximately 1,094.43 reforested hectares, establishing the project as extensive.

Additionally, it is established that the benefits will be obtained in the medium term because the establishment stage cannot be considered as contributing to wildlife habitat provision since it does not present the structure or function required for specific species habitat. As seen in Table 15, It was determined that the effect of wildlife provision is positive and has a high benefit for the environment.

9.3 Reduction of pressure on natural ecosystems

Natural ecosystems have undergone significant transformations due to practices such as deforestation, livestock farming and agriculture. In an attempt to reduce the impacts of this practices and restore the vegetation cover in degraded areas, commercial reforestation plants have been implemented (Lentijo & Kattan, 2005). Historically, conservation efforts have primarily focused on establishing protected areas. Therefore, it is necessary for areas used for productive activities, such as plantations, to also be involved in strategies to achieve this goal (Lantschner & Rusch, 2014).

Based on the above, plantations are a factor that favor the conservation of ecosystems, and although planning is necessary to fulfill this objective, the reduction of natural forest degradation is currently associated to some extent with the expansion of commercial plantations (Pirard, Del Secco, & Warman, 2016). This is why the reduction of pressure on natural ecosystems has a moderate intensity, helping to conserve these ecosystems an strengthening their function by maintaining biodiversity. Similarly, the value obtained from timber production is an efficient way to protect specific portion of forest. This is why the extent of commercial plantations plays an important role. More planted hectares generate more timber supply and, consequently, less deforestation of natural forests (Pirard, Del Secco, & Warman, 2016). In the case of Proyecto Forestal Alcaraván Orinoquía, there are 1,100 hectares of three different strata established providing a high volume of timber from different species.

Table 16. Rating of the effect of reducing pressure on natural ecosystems

Criterion	Rating
Character	1
Intensity	3
Extension	5
Persistence	5
Moment	1
Rating	25
Environmental level of importance	Positive: Medium

Source: (CO2CERO SAS, 2022)

It is important to mention that since timber harvesting will occur after the 20-year duration of the project, the moment when the reduction of pressure on natural ecosystems will be

reflected in long term. Finally, it is confirmed that this effect generates a benefit for the environment; however, due to the characteristics mentioned earlier, it has a moderate intensity.

9.4 Soil erosion reduction

Forest plantations protect the soil through the coverage they provide because they generally require more than 18 years to be harvested, thus ensuring the permanence of vegetative cover. The Proyecto Forestal Alcaraván Orinoquía is planned to last for 20 years, which will guarantee that forest plantations prevent soil erosion in the planted areas, also facilitating rainwater infiltration and avoiding runoff (CORMA, 2021).

Additionally, these plantations improve soil quality by reducing erosion and, consequently, nutrient loss, making the land more productive (Prado, 2019). However, these benefits do not occur instantaneously; it is necessary to wait for the plantation to establish itself and undergo effective growth, making it a medium-term benefit.

Table 17. Rating of the effect of reducing soil erosion.

Criterion	Rating
Character	1
Intensity	5
Extension	5
Persistence	5
Moment	3
Rating	33
Environmental level of importance	Positive: High

Source: (CO2CERO SAS, 2022)

Taking into account the above, it is established that the intensity of the benefits due to the soil erosion reduction effect is high, as it improves soil properties and enhances their productivity (Prado, 2019), as well as the reduction of erosive processes in land exceeding an area of 1,000 hectares. Therefore, it is noted that this effect, due to the benefits it generates, is categorized as positive and receives a score of 33 points, indicating a high impact (Refer to Table 17).

9.5 Biological corridor

The fragmentation processes are considered for the scientific community as one of the main causes of the global crisis provoked in biodiversity loss. This highlights the importance of plantations as biological corridors that act as extensions of forest fragments, aiding in the conservation of forest patches and the maintenance of their biodiversity (Gurrutxaga, Vicente; Lozano, Pedro, 2007).

Additionally, the authors Gurrutxaga and Lozano (2007) state that plantations provide the expansion of habitat for species with forest requirements, thus promoting ecological connectivity in the territory. In general, the dimensions and extent of forest plantations have a greater impact on forest connectivity than agricultural matrices (Gurrutxaga & Lozano, 2010).

Table 18. Rating of the effect of forest plantations as biological corridors.

Criterion	Rating
Character	1
Intensity	5
Extension	5
Persistence	5
Moment	3
Rating	33
Environmental level of importance	Positive: High

Source: (CO2CERO SAS, 2022)

For these reasons, forest plantations as biological corridors exhibit high intensity, causing small forest patches to increase their conservation value and regulating the fragmentation of territories, thus altering the dynamics of the environment (Gurrutxaga, Vicente; Lozano, Pedro, 2007). Similarly, it ensures greater mobility of species such as small mammals, birds, and carnivorous species that require large expanses to move (Bustamante et. al., 2007).

As with previous effects, the benefits of this effect will occur in the medium term because it is necessary for the plantation to have a favorable structure to achieve the objective of connectivity with different patches of forest cover. Finally, based on the previous information and as shown in Table 18, it is established that the effect of the forest plantations in the project as biological corridors generates high benefits for the environment.

9.6 Flood control

Reforestation and afforestation have a positive effect in minimizing water-related issues such as avalanches, soil erosion, and floods (Prado, 2019), as they tend to reduce the surface water velocity, facilitating its infiltration into the soil. This control over runoff is what helps regulate flow rates and reduces the occurrence of floods (Nosetto & Jobbágy, 2014).

Authors Nisbet and Thomas (2006), as cited by Prado (2019), indicate that short-rotation plantations are more effective than "traditional" forests in mitigating flood problems. When there is adequate forest cover in a watershed and proper management is

implemented, it is possible to desynchronize water flows, which helps reduce flood risks or at least delay the peak of the flood. This provides the opportunity to take protective or evacuation measures more effectively.

Table 19. Qualification of the effect of plantations on flood control.

Criterion	Rating
Character	1
Intensity	3
Extension	5
Persistence	5
Moment	3
Rating	27
Environmental level of importance	Positive: High

Source: (CO2CERO SAS, 2022)

Based on the information provided, it is determined that the effect of plantations on flood control is positive with a medium intensity. As explained earlier, while they help minimize the flood risk, it is not as intense as forests, which have higher biomass in the soil and a greater number of species that contribute to controlling this factor (Nosetto & Jobbágy, 2014). However, due to the large extent of plantations to be established by the project in different areas, there is greater control over this effect, especially considering that the Meta and Vichada departments are characterized by catastrophic river flash floods (Acosta & Casallas, 2019). It is worth noting that for the benefits of plantations in controlling this factor to occur, it is necessary for the plantation to be well-established and have a significant amount of biomass to help control floods (Prado, 2019). Therefore, it is established that this benefit will be realized in the medium term.

Finally, it can be inferred that this effect is rated at 27 points, taking into account the characteristics mentioned above, making it a positive effect with high benefits for the environment (refer to Table 19).

9.7 Generation of noise and atmospheric pollution due to the use of vehicles and machinery.

The effect related to the Generation of noise and atmospheric pollution due to the use of vehicles and machinery within the Proyecto Forestal Alcaraván Orinoquía will primarily be associated with the establishment and harvesting stages of forest plantations. As Clavijo & Morales (2014) mention, the use of machinery for wood extraction, as well as tools such as the machete and chainsaw used in plantation establishment, have a negative impact on the environment due to the frequent noise generated by these tools and the pollution that can result from the waste oils and fuels used in their operation.

Similarly, the generation of particulate matter by vehicles should be taken into account during the establishment and harvesting of the plantations, which is caused by the movement of vehicles on both paved and unpaved roads, generating pollutant residues (Alvis, 2012).

Table 20. Rating of the effect of noise and atmospheric pollution.

Criterion	Rating
Character	-1
Intensity	3
Extension	1
Persistence	1
Moment	5
Reversibility	1
Recoverability	1
Rating	-19
Environmental level of importance	Irrelevant

Source: (CO2CERO SAS, 2022)

However, these tasks will be carried out on a specific sector-by-sector basis for harvesting and establishment, which minimizes the impact of this effect. Furthermore, the noise and atmospheric pollution will not occur constantly, and the intensity will be momentary. However, as mentioned by Clavijo & Morales (2014), it should be noted that noise pollution leads to a decrease in the quantity of wildlife in the area, as noise can deter them, so measures should be taken.

As seen in Table 20, for the generation of noise and atmospheric pollution due to the use of vehicles and machinery, a rating of -19 was obtained, making it a negative impact. However, due to its characteristics mentioned earlier, it is deemed an irrelevant impact that can be corrected with management measures.

9.8 Increased risk of forest fire spread

Maldonado (2023) in his article for País Circular states that specialists from the Laboratory of Biological Invasions (LIB) indicate that forest plantations are not responsible for wildfires, but the lack of proper territorial planning and the homogeneity provided by plantations are considered key factors contributing to the rapid spread of fires. Similarly, Figueroa et al. (2020) establish that fire is a natural feature of forests, but the management and management approach of forest plantations increases the frequency and intensity of fires. It is a significant disruptive factor that alters the ecological dynamics that regulate ecosystem functioning, resulting in the loss or reduction of numerous ecosystem services. Additionally, this same author indicates that plantations burn very quickly and contribute to the distribution of fire as expansion

corridors, due to lower humidity and the presence of fewer species compared to natural forests.

On the other hand, within the Proyecto Forestal Alcaraván Orinoquía, it is important to consider that, according to data provided by IDEAM in 2017, during the period from 2010 to 2015, approximately 467,986 hectares in the Meta department were burned. Furthermore, the deforestation rate in the area ranged from 28,000 to 30,000 hectares per year. Likewise, ADR (2019) states that practically all fires in the department are caused by human activities, either intentionally to expand agricultural frontiers or other activities that seek to transform forests through indiscriminate logging and burning in order to convert them into grazing areas.

Based on the above, it is established in the assessment that the effect of a higher risk of forest fire spread due to the development of forest plantations has a high intensity, as the effects and changes in natural dynamics that fires can cause make it a high risk. Additionally, it is established that it is an effect that spreads rapidly, causing the loss of biodiversity and the ecosystems it affects. Similarly, due to the severe damage it inflicts on the environment, it becomes an irreversible impact, as stated by Fernández et al. (2016), the vegetation that recovers after the fire tends to be homogenous and remains associated with an increase in its flammability, making it vulnerable to fires year after year. However, with the help of anthropogenic processes, some ecological attributes can be restored.

Table 21. Rating of the effect of plantations on the increase in the risk of forest fire spread.

Criterion	Rating
Character	-1
Intensity	5
Extension	5
Persistence	1
Moment	5
Reversibility	5
Recoverability	3
Rating	-39
Environmental level of importance	Critic

Source: (CO2CERO SAS, 2022)

As seen in Table 21, it was determined that the effect of plantations on the increase in the risk of forest fire spread is negative with a critical level of environmental significance, so it is necessary to take several measures to control this effect. The measures are detailed in *Actions* and corrective measures

Below are the corrective actions and measures that will be implemented during the project's lifespan to mitigate the negative effects identified through the socioeconomic assessment conducted in previous chapters, complying with the numerals d) To develop action plans to reduce or mitigate the effects identified and e) To provide a support for monitoring the implementation of action plans and accomplishment of action-plan targets of the Tool “No Net Harm Environmental and Social Safeguards (NNH), version 1.0”.

Table 44. Socioeconomic Actions and corrective measures for the Proyecto Forestal Alcaraván Orinoquía.

Negative effect	Actions	Indicator
1. Solid waste management	1.1 Diagnosis of solid waste management in the Project area 1.2 Training sessions on solid waste management 1.3 Proper handling, use, and disposal of solid waste	1.1 Number of diagnoses per unit of time 1.2 Number of training sessions conducted per unit of time 1.3 Number of participants practicing proper handling, use, and disposal/Total number of participants
2. Occupational safety	2.1 Providing personal protective equipment to protect participants	2.1 Number of Personal Protective Equipment (PPE) provided to each project participant per total project participants
3. Public safety	3.1 Establishing partnerships with reforesters for the control and surveillance of safety in the projects area.	3.1 Number of contracts and agreements signed and issued to legal representatives.
4. Land use and limitations	4.1 Having legal and juridical counseling available to provide guidance on the appropriate measures to take. 4.2 Having solid contracts and agreements that specify the responsibilities and commitments of the parties involved in the project.	4.1.1 Number of properties with land tenure restrictions 4.1.2 Number of consultations provided/Number of properties with restrictions 4.2 Number of clauses present in the agreements signed by legal representatives.
5. Change of ownership	5.1 Have solid contracts and agreements that specify the responsibilities and commitments of the parties involved in the project.	5.1 Number of clauses present in the agreements signed by legal representatives.

Negative effect	Actions	Indicator
6. Carbon market devaluation	6.1 Creating market value with a focus on technical and social management 6.2 Establishing marketing strategies for carbon credits that are more appealing at the local, national and international levels	Number of carbon credits sold per unit of time.
7. Labor dropout	7.1 Quantity of workers with formal employment in the project area	7.1 Number of workers employed formally/Total number of workers

Source:

Risk management.

9.9 Increase in the outbreak of pests and diseases.

Due to their extent and distribution, forest plantations are highly susceptible to the epidemic spread of diseases and pests. This is further exacerbated if proper preventive measures are not implemented during their establishment and growth (Pinzon, 2007). Additionally, the impacts of climate change promote the expansion of increasingly devastating pests, endangering the survival of plants and crops of great economic importance, such as commercial forest plantations, which represent a growing threat to the environment, making this type of forested area more vulnerable (ONU, 2021).

As a result, outbreaks of pests and diseases within plantations have negative effects both economically and environmentally, as they can lead to the loss of forest mass if not properly controlled. It should be noted that pests and diseases of forest plantations are well-studied, and with proper control, they do not cause significant damage (Pinzon, 2007). However, as mentioned earlier, the extent within plantations plays a crucial role in the emergence of new pest outbreaks, so maintaining active surveillance of the presence of new afflictions is essential for the vigor of vegetation within plantations.

Table 22. Rating of the effect of the increase in the outbreak of pests and diseases.

Criterion	Rating
Character	-1
Intensity	3
Extension	3
Persistence	1
Moment	3
Reversibility	3
Recoverability	1

Criterion	Rating
Environmental level of importance	Moderate

Source: (CO2CERO SAS, 2022)

As shown in Table 22 and based on the information mentioned earlier, it is established that the increase in outbreaks of pests and diseases is a negative effect of plantations. However, due to its characteristics in terms of intensity and recoverability, its level of environmental significance has been determined to be moderate.

9.10 Actions and corrective measures

Below are the corrective actions and measures that will be implemented during the project's lifespan to mitigate the negative effects identified through the environmental assessment conducted in previous chapters, complying with the numerals d) To develop action plans to reduce or mitigate the effects identified and e) To provide a support for monitoring the implementation of action plans and accomplishment of action-plan targets of the Tool “No Net Harm Environmental and Social Safeguards (NNH), version 1.0”.

Table 23. Environmental Actions and corrective measures for the Proyecto Forestal Alcaraván Orinoquía.

Negative effect	Actions	Indicator
1. Generation of noise and atmospheric pollution due to the use of vehicles and machinery	1.1 Noise control through the use of personal protective equipment. 1.2 Measurement of emissions from the use of vehicles and machinery in forest plantations.	1.1 Number of participants implementing PPE/Total number of participants 1.2 Amount of emissions from the use of vehicles and machinery in the total project area
2. Increased risk of forest fire spread	2.1 Establishing early warning mechanisms for fires and their suppression. 2.2 Training for the reforesters to eliminate burning as a practice in crop establishment	2.1 Number of controlled fires per unit area (number of records per hectare) 2.2 Number of individuals trained, categorized by gender and age per unit of time
3. Use of agrochemicals	3.1 Diagnosis of agrochemical use for all project participants. 3.2 Training on the adverse effects of agrochemical use. 3.3 Monitoring and control of agrochemical use for all participants.	3.1 Number of diagnoses per unit of time 3.2 Number of individuals trained, categorized by gender and age, per unit of time.

Negative effect	Actions	Indicator
		3.3 Number of participants using agrochemicals/Total number of participants
4. Outbreaks of pests and diseases	<p>4.1 Phytosanitary control for forest plantations according to what is established in the Forest Management and Environmental Protection Plans (PEMF).</p> <p>4.2 Monitoring of forest plantations through the Disturbance Format (See "16_Information management\Formato áreas nuevas y perturbaciones.xlsm")</p>	<p>4.1 Number of phytosanitary controls per time period.</p> <p>4.2 Number of participants reporting pests and/or diseases / Total number of participants.</p>

Source: (CO2CERO SAS, 2022)

10 Socioeconomic Aspects

Complying with the provisions of the tool “No net harm environmental and social safeguards (NNH), version 1.0”, in section b) which describes “Identify environmental and social effects resulting from the implementation of the project and c) Conduct the assessment and the Risk management to identify environmental and social effects of the project activities; below, the predictable effects on the socio-economic aspect within the project boundaries are presented. For this purpose, the environmental assessment is used as a reference, categorizing the effects based on the methodology developed by Conesa (2010) adapted to the social and economic component. This allows for a general overview of the analysis of the identification of effects through a weighted value that indicates the degree of negative or positive impact on the project's development.

Table 24. Description of the classification for the purposes of the Proyecto Forestal Alcaraván Orinoquía.

Classification	Description general	Description by classification	Type of Classification	Scale
Direct Effect	The effect of the project activities on the beneficiaries is evaluated	Non-significant socio-economic effects, i.e., when the project activities generate minimal modifications on the beneficiaries and maintain the characteristics of the analyzed environment.	Low	1

Classification	Description general	Description by classification	Type of Classification	Scale
		The effect is significant, generating modifications in the socio-economic components, as there is a partial alteration in the analyzed environment, modifying some of its characteristics.	Medium	3
		The effect significantly alters the socio-economic components of the beneficiaries, mostly or completely modifying the set of characteristics of the environment.	High or total	5
Indirect Effect	The effect of the project activities on the beneficiaries is evaluated	Non-significant socio-economic effects, i.e., when the project activities generate minimal modifications on the beneficiaries and maintain the characteristics of the analyzed environment.	Low	1
		The effect is significant, generating modifications in the socio-economic components, as there is a partial alteration in the analyzed environment, modifying some of its characteristics.	Medium	3
		The effect significantly alters the socio-economic components of the beneficiaries, mostly or completely modifying the set of characteristics of the environment.	High or total	5
Scope of the Effect	The level of incidence of the effect of the activities at both the project and community levels is evaluated	Level of minor impact in the project area	Low	1
		Level of neutral impact in the project area	Medium	3
		Level of major impact in the project area	High or total	5
Magnitude of the effect	The effect of the activity is evaluated according to the increase or decrease in the initial sample	Non-significant effects, i.e., when the project activities generate minimal modifications on the beneficiaries and maintain the characteristics of the analyzed environment.	Low	1
		The effect generates modifications in the socio-economic components of the beneficiaries, as there is a partial alteration in the analyzed environment, modifying some of its characteristics.	Medium	3
		The effect significantly alters the socio-economic components of the beneficiaries, mostly or completely modifying the set of	High or total	5

Classification	Description general	Description by classification	Type of Classification	Scale
		characteristics of the environment.		
Timing of the Effect	The effect of the activity is evaluated according to the increase or decrease over time	If the effect of an action takes more than 15 years to manifest	Long-term	1
		When the time elapsed between the appearance of the action and the beginning of the effect occurs within a period of 1-15 years	Medium-term	3
		When the time elapsed between the appearance of the action and the beginning of the effect is less than 1 year.	Short-term	5
Persistence of the Effect	The effect of the activity is evaluated according to its constancy.	The effect persists for less than 1 year	Momentary	1
		The effect persists for a period between 1 - 15 years	Temporary	3
		The effect persists for more than 15 years	Permanent	5

Source: (CO2CERO SAS, 2022). Adapted from Conesa. (2010).

For the assessment, six (6) analysis categories were chosen, which have been adopted by various theoretical references such as the UN, FAO, SDGs, World Bank, UN Women, among others. This helps to understand on a larger scale what type of impact is being generated at the social and economic levels. However, for a more detailed analysis, within each category, the effects to be rated and evaluated are broken down, totaling seventeen (17) in Table 25. For the rating of effects, six (6) criteria were considered: direct effect, indirect effect, scope, magnitude, timing, and persistence. The explanation of these, as well as the rating given to each effect, can be found in the folder (*13_Monitoring report\04_NNH\02_Socioeconomic aspect and Table 24*).

Table 25. Identification of analysis categories and their social and economic effects

Component	Analysis categories	Effects
Social	Well-being	Project basic services
		Project housing infrastructure
		Health
		Food security
		Education
		Solid waste management
		Family quality of life
	Gender inclusion	Gender equality
	Security	Occupational safety
		Public safety
	Territory	Community relations
		Land use and limitations

Component	Analysis categories	Effects
Economic	Productive chains	Change of ownership
		Carbon market devaluation
		Economic growth
	Employability	Local labor hiring
		Labor dropout

Source: (CO2CERO SAS, 2022).

According to the results obtained in Table 26, it is determined that the Proyecto Forestal Alcaraván Orinoquía, from a socio-economic perspective, has a total of seventeen (17) identified effects, of which there are seven negative, five (5) classified as critical, and two (2) as moderate. On the other hand, there are eleven (11) positive effects (Refer to *13_Monitoring report\04_NNH\02_Socioeconomic aspect\Socioeconomic_evaluation_Alcaravan_V3.xlsx*). Based on the results of this analysis, it is observed that the project during its execution period can generate significant and rewarding changes, not only for the direct beneficiaries but also, to a lesser extent, it influences the territory and its local development, creating new models of employability and value chains, with a significant impact on the environment and social and economic components. Therefore, it is important to promote awareness of the role and commitment of the participants in the implementation of sustainable forest chains and their articulation with neighboring communities, where it has been evident that a good community relationship allows for greater public safety, more efficiency in achieving project objectives, and an improvement in the quality of life of the affected population.

Table 26. Rating and level of socioeconomic importance of the effects determined in the evaluation

N°	Effect	Rating	Socioeconomic level of importance
1	Project basic services	24	Positive: High
2	Project housing infrastructure	20	Positive: Medium
3	Health	26	Positive: High
4	Food security	28	Positive: High
5	Education	20	Positive: Medium
6	Solid waste management	-26	Negative: Critic
7	Family quality of life	20	Positive: Medium
8	Gender equality	28	Positive: High
9	Occupational safety	-26	Negative: Critic
10	Public safety	-22	Negative: Moderated
11	Community relations	20	Positive: Medium
12	Land use and limitations	-26	Negative: Critic
13	Change of ownership	-24	Negative: Critic
14	Carbon market devaluation	-22	Negative: Moderated

N°	Effect	Rating	Socioeconomic level of importance
15	Economic growth	26	Positive: High
16	Local labor hiring	26	Positive: High
17	Labor dropout	-24	Negative: Critic

Source: (CO2CERO SAS, 2022).

Below are the effects that occur in the Proyecto Forestal Alcaraván Orinoquía, according to the socio-economic assessment conducted.

10.1 Projects basic services

This effect is related to the basic services that the project can provide, especially to its employees, such as water, electricity, gas, and waste sanitation. As mentioned by the National Labor Organization (OIT, Organización Nacional del Trabajo, 2020), these services are fundamental and play an essential role in economic and social development. Quality public utility services are a condition that helps effectively eradicate poverty and contributes decisively to human development, acting as multiplier effects on education, food, and health. Therefore, this effect has a positive level of importance: high.

Table 27. Rating of the effect of project's basic services in the socioeconomic aspects in forest plantations.

Criterion	Rating
Character	1
Intensity	5
Extension	1
Persistence	3
Moment	5
Reversibility	5
Recoverability	5
Rating	24
Socioeconomic importance	Positive: High

Source: (CO2CERO SAS, 2022)

10.2 Project housing infrastructure

A suitable housing must be habitable, meaning it can provide adequate spaces for its occupants and protect them from cold, heat, rain, wind, or other threats to health, structural risks, and disease vectors. It must also ensure the physical safety of the occupants. Likewise, the World Health Organization (WHO) considers housing as the environmental factor most frequently associated with conditions that promote diseases in epidemiological analyses; in other words, inadequate and deficient housing conditions

are invariably associated with higher mortality rates (ACNUR, 1991). Therefore, the satisfaction of quality housing allows people to rest well, avoiding occupational, physical, and mental risks. Hence, the importance of this effect is positive: medium.

Table 28. Rating of the effect of basic services on the socio-economic aspects in forest plantations.

Criterion	Rating
Character	1
Intensity	5
Extension	1
Persistence	5
Moment	1
Reversibility	3
Recoverability	5
Rating	20
Socioeconomic importance	Positive: medium

Source: (CO2CERO SAS, 2022)

10.3 Health

It is worth mentioning that this is one of the most important effects at the social level, without diminishing the value and merit of the previous ones, as emphasized by (Serrano, 2021). Occupational health, in the broad sense of the term as defined by the World Health Organization (WHO), is not merely the absence of diseases, but a state of complete physical, mental, and social well-being. This means that when we talk about occupational health, we are not referring exclusively to the illnesses or possible occupational diseases that workers may suffer from, but it is a broader concept directly related to well-being and job satisfaction.

Furthermore, according to (Serrano, 2021), the health of workers is directly connected to a company's productivity, as well as influencing other factors such as a good working environment or the organization's reputation. Companies and organizations, in general, share a common element: they are all composed of people who make up their human and professional team. Creating environments that promote self-care and health affiliation allows the project to avoid occupational, legal, and economic risks while ensuring the integrity and well-being of employees as a fundamental right. Therefore, this effect has a positive level of importance: high.

Table 29. Rating of the health effect on the socio-economic aspects in forest plantations.

Criterion	Rating
Character	1
Intensity	5
Extension	1
Persistence	5
Moment	5
Reversibility	5
Recoverability	5
Rating	26
Socioeconomic importance	Positive: High

Source: (CO2CERO SAS, 2022)

10.4 Food security

Nutritionists have determined the energy expenditure of men and women in various activities. Sedentary office work requires 1.8 kcal per minute; sitting requires 1.39 kcal per minute; practicing agriculture, mining, forestry, or construction may require 5 to 10 kcal per minute of work. Poorer countries more often rely on manual labor, and workers in these nations often consume inadequate calories to cope with such labor-intensive tasks, resulting in weight loss, fatigue, low productivity, and accidents (Wanjek, 2005).

On the other hand, it is important to emphasize that food security is a fundamental right for a good life with quality and well-being. Therefore, this effect has been classified as having a high level of positive importance. Good nutrition ensures better performance in activities, generating greater productive efficiency for the project. However, it is worth noting that forest plantations involve activities with a high demand for physical strength, leading to greater energy expenditure. Therefore, if this need is not adequately and responsibly addressed over time, it can lead to health issues for individuals and disruptions in the operations of activities.

Table 30. Rating of the effect of food security on the socio-economic aspects in forest plantations.

Criterion	Rating
Character	1
Intensity	5
Extension	1
Persistence	5
Moment	5
Reversibility	5
Recoverability	5

Criterion	Rating
Rating	26
Socioeconomic importance	Positive: High

Source: (CO2CERO SAS, 2022)

10.5 Solid waste management

The management of solid waste is a universal problem that concerns every inhabitant of the planet, with over 90% of waste being dumped or burned in open areas, particularly in low-income countries, where the poor and the most vulnerable are the most affected. "Inadequate waste management is causing contamination of the world's oceans, blocking drainage systems and causing floods, transmitting diseases, increasing respiratory diseases due to burning, harming animals that consume waste, and affecting economic development, such as damaging tourism," said Sameh Wahba, Director of Urban and Territorial Development, Disaster Risk Management, and Resilience at the Banco Mundial (Mundial, 2018). It should be noted that in most of the rural areas where the project is located, there is no public waste collection service. Therefore, waste disposal generally involves burning, burying, and, in the worst-case scenarios, dumping waste in various locations in the territory, leaving it freely available to ecosystems and water sources.

Therefore, from the project's social and environmental responsibility, the classification of the importance level of solid waste, both recyclable and hazardous, is critical. Considering that the disposal of waste generated in forest plantations has a significant impact, not only visually or spatially but also on the living conditions of humans, in this case, having a direct impact on employees and reforests, and with an indirect impact on surrounding communities, as well as on wildlife and flora, and water sources. Therefore, without proper final disposal and use of waste, it can alter natural environments and the generation of air pollutants over time. Hence, it is a factor with a critical rating.

Table 31. Rating of the waste management effect on the socio-economic aspects in forest plantations.

Criterion	Rating
Character	-1
Intensity	5
Extension	3
Persistence	5
Moment	5
Reversibility	3
Recoverability	5
Rating	-26

Criterion	Rating
Socioeconomic importance	Critic

Source: (CO2CERO SAS, 2022)

10.6 Family quality of life

This effect highlights the indirect impact that the development of a plantation can have on the families of direct beneficiaries, who are the reforesters and employees. As previously described, providing employment, whether to a woman or a man, indirectly benefits the quality of life of the people they are responsible for, such as spouses, children, elderly parents, etc. According to the referenced information about reforesters, their employees mostly come from very low social strata, with difficulties in meeting their basic needs, and they come from poor regions.

Therefore, as a significant guarantee, the project not only generates employment for a single individual but also impacts a variety of individuals, regardless of their gender, age, ethnicity, culture, religion, etc. Additionally, as the reforesters have rightly pointed out, to have happy, content, and healthy employees, it is necessary to ensure that their families also feel peaceful, happy, and content. Concerns related to family or marital issues can lead to distraction in their work, causing workplace accidents or reduced performance.

This does not mean that it is the responsibility of the reforester to solve situations that may be beyond their control. However, it is their duty to provide fair compensation to their employees in accordance with labor laws and to affiliate them with a compensation fund so that individuals can meet their needs and those of their families with greater peace of mind, offering a wider range of benefits. Therefore, this effect has a medium level of importance.

Table 32. Rating of the family effect on the socio-economic aspects in forest plantations.

Criterion	Rating
Character	1
Intensity	3
Extension	1
Persistence	3
Moment	5
Reversibility	3
Recoverability	5
Rating	20
Socioeconomic importance	Medium

Source: (CO2CERO SAS, 2022)

10.7 Education

It has been observed that hiring labor for field activities does not require a standardized and qualified profile. However, as a positive aspect of the Proyecto Forestal Alcaraván Orinoquía, strategies are being developed in collaboration with nearby educational institutions in the project's influence area to create opportunities for employees to continue their education voluntarily, whether it's primary school, high school, or undergraduate studies. It is worth noting that Ecologic S.A.S has been promoting these initiatives, and to date, five employees have graduated by completing their high school education.

As mentioned on several occasions, the Proyecto Forestal Alcaraván Orinoquía not only aims to generate economic income and preserve forests but also recognizes the importance of the impact that such projects can have on the social component of individuals. Therefore, education is one of the fundamental pillars of the project. As mentioned by (Larrañaga, 1997), the primary link between education and poverty alleviation is the impact that the level and quality of education have on the future labor productivity and income of individuals. Income from work is the main means for escaping poverty. Conversely, the lack of employment or precarious employment is the main cause of insufficient livelihoods.

Hence, the classification of the level of importance of this effect is positive: medium. Firstly, it aims to create better living conditions for employees, and secondly, it has been proven that having individuals with a broader education level promotes the strengthening of new ideas and innovations in the workplace. Innovation and creativity have been shown to lead to cost reductions in specific activities, as they evaluate new methodologies or different ways of doing things, thereby reducing physical or economic resources. It is important to emphasize that the goal is not to segregate individuals based on their level of education. As described initially, employment opportunities are provided for individuals in general, especially those who lack opportunities due to their age or lack of experience. The goal is to bring about changes that improve living conditions for everyone.

Table 33. Rating of the education effect on the socio-economic aspects in forest plantations.

Criterion	Rating
Character	1
Intensity	3
Extension	1
Persistence	3
Moment	3
Reversibility	3

Criterion	Rating
Recoverability	5
Rating	20
Socioeconomic importance	Positive: Medium

Source: (CO2CERO SAS, 2022)

10.8 Gender equity

According to the report by (DANE, 2023), the unemployment rate for women was 13.4%, which remains a significant number for the country. It is worth mentioning that historically, women have always been affected by the gender wage gap, which reduces their quality of life as women. This gap particularly impacts female heads of households, especially those in rural areas, indigenous or Afro-Colombian women. They face challenges in finding employment that matches their skills and abilities, and they rely on natural resources for their food or local craftsmanship, making them more vulnerable to the deprivation of their basic needs.

Therefore, the Proyecto Forestal Alcaraván Orinoquía aims to provide employment opportunities for female labor in activities based on their physical and intellectual abilities, particularly in the nursery area. One of the reforesters mentioned that women's hands and sensitivity have a better effect on the growth and care of seeds and trees. On the other hand, it aims to create new opportunities for a better quality of life and reduce gender inequality gaps. As a result, the level of importance of this effect is classified as positive: high.

Table 34. Rating of the gender equality effect on the socio-economic aspects in forest plantations.

Criterion	Rating
Character	1
Intensity	5
Extension	5
Persistence	5
Moment	3
Reversibility	5
Recoverability	5
Rating	28
Socioeconomic importance	Positive: High

Source: (CO2CERO SAS, 2022)

10.9 Safety at work

Forest work continues to be one of the most dangerous sectors in most countries. Worldwide, there are often discouraging trends regarding the increasing and increasingly high rates of accidents and occupational diseases, as well as the early retirement age among forestry workers. However, there are clear indications that it is possible to ensure that forestry work is performed in safe and healthy conditions. Most members of the ILO recognize that workplace safety is not only an ethical imperative but also a profitable and sensible one (OIT, 1998).

As such, this effect has a critical level of social and economic importance, due to the significant impact it can have on both the worker's health, including injuries or the loss of a body part, the legal procedures for the forestry company, and the project's increased costs in dealing with the situation or potential temporary or permanent closure. This could result in a reduction of labor force, changes in the landscape and environment, and the complete loss of materials and production.

Table 35. Rating of the management occupational safety in the socioeconomic aspects of forests plantations.

Criterion	Rating
Character	-1
Intensity	5
Extension	1
Persistence	5
Moment	3
Reversibility	3
Recoverability	5
Rating	-26
Socioeconomic importance	Critic

Source: (CO2CERO SAS, 2022)

10.10 Public security

For this effect, it is necessary to mention the overall public security situation in various rural territories, where, according to (Sergio Guarín & Patricia Bulla , 2015), the public security service provided by the State in Colombia is unequal. It is mainly concentrated in large cities and municipal centers but is absent in vast expanses of the national geography. In these regions, it is painful to see the state's inability to enforce the law, address citizen conflicts, and protect and promote a social order based on peaceful coexistence.

In rural settings, in terms of security, the State has placed special emphasis on combating illegal armed groups (national security). For this reason, in these contexts, security is associated with military control, while the security and coexistence issues faced by citizens in their daily lives do not receive the same attention from the authorities. Additionally, the institutions responsible for guaranteeing conditions of coexistence and security have low operational capacity and insufficient coverage (Sergio Guarín & Patricia Bulla , 2015).

Therefore, the level of importance of this effect is classified as moderate, considering the vulnerability in which the project is immersed. Due to its territorial location, it does not have constant security, whether police or military, and the population could be at risk of experiencing a public security incident with people from the surrounding communities or with illegal armed groups that may emerge in the area. Depending on the situation, this could lead to violations of an individual's human rights, affecting their mental, cognitive, and physical state, and, on the other hand, jeopardizing the progress of activities due to the disruptions that may occur, in some cases leading to the permanent closure of a plantation.

Table 36. Rating of the effect of public safety management on the socioeconomic aspects in forest plantations.

Criterion	Rating
Character	-1
Intensity	5
Extension	1
Persistence	5
Moment	3
Reversibility	3
Recoverability	5
Rating	-22
Socioeconomic importance	Moderate

Source: (CO2CERO SAS, 2022)

10.11 Community relationships

Community engagement is seen as a wide variety of interactions with others, where, based on collective interests, efforts are made to create connections for the development of actions with common goods. Thus, over time, any type of company or project that involves the social impact on a neighboring community must establish a dialogue and consultation framework that does not hinder the future development or execution of a project's activities, avoiding conflicts or internal disagreements.

It is worth noting that, although the project is privately owned and not obligated to conduct prior informed consultations with communities or engage in forced investments, reforesters have expressed the importance and interest in building networks with the community. They emphasize collective care, the benefits that can be jointly generated, and the potential for significant impact on the territories and people who enable the project's activities. Therefore, the level of importance of this effect is positive: medium, with the value potentially changing over time, depending on the degree of intention to work collaboratively with the community and the level of impact on local territorial development.

Table 37. Rating of the community engagement effect on the socio-economic aspects of forest plantations.

Criterion	Rating
Character	1
Intensity	1
Extension	5
Persistence	3
Moment	3
Reversibility	3
Recoverability	5
Rating	20
Socioeconomic importance	Medium

Source: (CO2CERO SAS, 2022)

10.12 Limitation of land use

This effect refers to a land exchange or mortgage of the property, which can lead to the total loss of the land and the right to use it. It has a close similarity to the first effect mentioned, as it is classified with a critical level of importance. This is because the future of forestry activity would be uncertain, causing negative effects on both direct and indirect beneficiaries at the social and economic levels. Additionally, the interest in the use of the land by the new owner is highlighted, and this land may be used for purposes that could harm the care and preservation of the environment.

Table 38. Rating of the effect of land use limitation on the socioeconomic aspects of forest plantations.

Criterion	Rating
Character	-1
Intensity	5
Extension	1
Persistence	5
Moment	5

Criterion	Rating
Reversibility	5
Recoverability	5
Rating	-26
Socioeconomic importance	Critic

Source: (CO2CERO SAS, 2022)

10.13 Change of ownership

This effect refers to the fact that if the legal representative of the property decides to sell, appoint someone else as a family heir, or in case of their passing. Therefore, it is categorized as having a critical socio-economic importance level because it is uncertain how the project's continuity would be handled if they choose to do so, or conversely, if they decide to terminate it permanently, causing negative effects on both direct and indirect beneficiaries and changes in the landscape of the influence area.

Table 39. Rating of the effect of change of ownership in the socio-economic aspects of forest plantations.

Criterion	Rating
Character	-1
Intensity	5
Extension	1
Persistence	5
Moment	3
Reversibility	5
Recoverability	5
Rating	-24
Socioeconomic importance	Critic

Source: (CO2CERO SAS, 2022)

10.14 Depreciation of the carbon market

According to (Group, 2022), commercial reforestation plays a crucial role in greenhouse gas emissions removal in the country. This, in turn, makes the sector an indispensable player in the national strategy to mitigate climate change by 2050. Additionally, they state that carbon credits, technically known as carbon certificates, have allowed certified projects to benefit economically. While these economic benefits are marginal compared to the timber business, they contribute to the cash flow of reforestation projects, providing relief for these long-term endeavors.

However, as mentioned in (Portafolio, 2014), due to the lack of policy decisions regarding the future of the voluntary and regulated carbon market, the price of Emission Reduction Certificates is on a downward trend. Likewise, (Tagle, 2019) points out that due to the shortage of Validation and Verification Bodies that meet the requirements set by Decree 926 of 2017, many projects, especially forest-related ones, have been unable to register and trade their carbon credits. As a result, many local communities and forestry companies have missed out on the economic benefits that this market represents.

For these reasons, the depreciation of the carbon credit market can have negative effects on social, economic, and environmental levels, as it may reduce investment in forestry activities, leading to a decrease in labor hiring and voluntary social investment.

Table 40. Rating of the effect of the depreciation of the carbon credit market on the socio-economic aspects of forest plantations.

Criterion	Rating
Character	-1
Intensity	5
Extension	1
Persistence	3
Moment	5
Reversibility	5
Recoverability	3
Rating	-22
Socioeconomic importance	Moderate

Source: (CO2CERO SAS, 2022)

10.15 Economic growth

According to (Tomaselli, 2009), forest plantations are long-term investments. In the short term, a well-structured planting program can create (directly and indirectly) permanent jobs in rural areas, contributing to mitigating the effects of the financial crisis. It will also foster long-term socio-economic development, attracting investments in wood processing activities that facilitate the creation of a cluster that generates jobs in the industry and services.

It is important to highlight an article by (Semana, 2020) that mentions, 'We have been saying for years that Colombia has suitable land for generating wealth with these plantations, an alternative that relieves pressure on natural forests, creates an export industry, and strengthens value chains for regions, making them more sustainable and profitable.'

Considering that in the rural areas where the project is currently located, and according to the reforestation workers, the level of local rural development is minimal, as they have been dependent on oil wells without seeing investment at the social and economic levels. Therefore, as mentioned in some sections, effective execution of a forest project in the short, medium, and long term, with more active participation from the surrounding communities, can promote more stable and long-lasting territorial economic growth.

Table 41. Rating of the effect of economic growth on the socioeconomic aspects in forest plantations.

Criterion	Rating
Character	1
Intensity	5
Extension	5
Persistence	1
Moment	5
Reversibility	5
Recoverability	5
Rating	26
Socioeconomic importance	Positive: High

Source: (CO2CERO SAS, 2022)

10.16 Local labor hiring

According to DANE figures, in May 2023, Colombia has a 10.5% unemployment rate, which corresponds to 14,267 thousand inhabitants (DANE, 2023), especially young people, single mothers, and the elderly. On the other hand, an article from (Semana, 2020) states that the forest chain has generated "323,760 jobs, producing vital raw materials and finished products for the education, development, and well-being of communities.

With the above information, we can analyze the positive impacts that forest plantations can have on labor hiring, helping to reduce these unemployment gaps that directly affect people's living conditions, particularly for those living in rural areas where unemployment is more pronounced. It's worth noting that when hiring a person, it not only improves their standard of living by allowing them to meet their needs with quality but also has an indirect impact on the people they are responsible for. Therefore, this effect is classified with a positive level of social and economic importance: high.

Table 42. Rating of the effect of labor hiring on the socio-economic aspects of forest plantations.

Criterion	Rating
Character	1

Criterion	Rating
Intensity	5
Extension	3
Persistence	3
Moment	5
Reversibility	5
Recoverability	5
Rating	26
Socioeconomic importance	Positive: High

Source: (CO2CERO SAS, 2022)

10.17 Employee attrition

On the other hand, according to the experiences of the reforesters, the goal is to create jobs for local labor in order to truly ensure development in the rural area. However, the reality is that most people living in these areas are waiting for employment in the oil company, which leads to a frequent turnover of personnel in the plantation, directly affecting the reforester and project activities.

Thus, this effect is classified as having a critical level of importance because the high turnover of personnel leads to increased costs for the project. This includes the need to constantly search for new employees, conduct entrance exams, provide social security enrollment, supply work uniforms, and sometimes cover travel expenses for their transportation. These costs can ultimately jeopardize the project's long-term sustainability.

Therefore, to address this need, the project seeks labor from the regional level to continue promoting development in the local area where the project is located. However, this approach can sometimes lead to tensions with the neighboring communities due to the lack of local personnel involvement. Hence, the importance of community engagement where mutually beneficial solutions can be reached.

Table 43. Rating of the effect of employee attrition on the socio-economic aspects of forest plantations.

Criterion	Rating
Character	-1
Intensity	5
Extension	1
Persistence	5
Moment	3
Reversibility	5

Criterion	Rating
Recoverability	5
Rating	-24
Socioeconomic importance	Critic

Source: (CO2CERO SAS, 2022)

10.18 Actions and corrective measures

Below are the corrective actions and measures that will be implemented during the project's lifespan to mitigate the negative effects identified through the socioeconomic assessment conducted in previous chapters, complying with the numerals d) To develop action plans to reduce or mitigate the effects identified and e) To provide a support for monitoring the implementation of action plans and accomplishment of action-plan targets of the Tool "No Net Harm Environmental and Social Safeguards (NNH), version 1.0".

Table 44. Socioeconomic Actions and corrective measures for the Proyecto Forestal Alcaraván Orinoquía.

Negative effect	Actions	Indicator
1. Solid waste management	1.1 Diagnosis of solid waste management in the Project area 1.2 Training sessions on solid waste management 1.3 Proper handling, use, and disposal of solid waste	1.1 Number of diagnoses per unit of time 1.2 Number of training sessions conducted per unit of time 1.3 Number of participants practicing proper handling, use, and disposal/Total number of participants
2. Occupational safety	2.1 Providing personal protective equipment to protect participants	2.1 Number of Personal Protective Equipment (PPE) provided to each project participant per total project participants
3. Public safety	3.1 Establishing partnerships with reforesters for the control and surveillance of safety in the projects area.	3.1 Number of contracts and agreements signed and issued to legal representatives.
4. Land use and limitations	4.1 Having legal and juridical counseling available to provide guidance on the appropriate measures to take. 4.2 Having solid contracts and agreements that specify the responsibilities and	4.1.1 Number of properties with land tenure restrictions 4.1.2 Number of consultations provided/Number of properties with restrictions

Negative effect	Actions	Indicator
	commitments of the parties involved in the project.	4.2 Number of clauses present in the agreements signed by legal representatives.
5. Change of ownership	5.1 Have solid contracts and agreements that specify the responsibilities and commitments of the parties involved in the project.	5.1 Number of clauses present in the agreements signed by legal representatives.
6. Carbon market devaluation	6.1 Creating market value with a focus on technical and social management 6.2 Establishing marketing strategies for carbon credits that are more appealing at the local, national and international levels	Number of carbon credits sold per unit of time.
7. Labor dropout	7.1 Quantity of workers with formal employment in the project area	7.1 Number of workers employed formally/Total number of workers

Source: (CO2CERO SAS, 2022)

11 Risk management

For Proyecto Forestal Alcaraván Orinoquía, in accordance to the provisions outlined in the BioCarbon Registry Tool. Permanence and Risk Management. BCR Project holder take actions to ensure the Project benefits are maintained over time. Version 1.0. March 7, 2023, and identification of potential natural, anthropogenic, financial, and social risks associated with the planned project actions is conducted.

Once these potential risks are identified, they are assessed based on their level of control and secondary information used by the project's environmental evaluation.). The risk level is defined based in the results of the environmental assessment and the control level rating using the three levels established by the BioCarbon Registry's Permanence and Risk Management tool.

These risks are considered and evaluated in order to identify potential threats that may arise during the project's execution. Below is a brief description of the analyzed dimensions:

- Environmental Risk: According to (ISO, 2018) these are hazards and threats that have the potential to negatively affect the environment, ecosystems, and/or

natural resources. These risks include events such as natural disasters, water pollution, loss of biodiversity, among others.

- **Social Risk:** Refers to conditions or trends that have the potential to adversely affect the quality of life, social cohesion, or stability of a society (World Economic Forum, 2020).
- **Financial Risk:** The possibility of suffering economic losses due to adverse fluctuations in prices, changes in exchange rates, or the occurrence of adverse events in financial markets (Basel Committee on Banking Supervisión, 2018) (see "*AUDITORIA_VERIFICACION_2022\13_Monitoring_report\05_Risk management\Costs_projection_Alcaravan_V1.xlsx*")

In order to assess the impact of the risks, they were categorized based on the level of control by competent authorities and the eight project participants, as can be seen in Table 45. The level of control will be defined according to the area in which the impact may occur.

Control Area: Corresponds to the physical space where the plantations are established to carry out the Proyecto Forestal Alcaraván Orinoquía.

Influence Area: Refers to the area in which significant environmental impacts that may be caused by the execution of the Project will manifest themselves, affecting the biotic, abiotic, and socioeconomic factors factors (ANLA, 2018).

Table 45. Level of Risk Control for the Proyecto Forestal Alcaraván Orinoquía

Rating	Level of control	
	Description	
A	It is within its control area	Being within the control area allows the creation of mitigation, prevention, or correction mechanisms.
B	It is within its influence area	There is no direct control over the risk, but influence can be exerted on those who do.
C	It is outside its influence area	There is no direct or indirect control or influence over the causes of the risks.

Source: (CO2CERO SAS, 2023).

Subsequently, strategies are proposed for mitigating each of the risks, along with verification indicator for each measure, as seen in Table 46.

Table 46. Risk management Proyecto Forestal Alcaraván Orinoquia.

Type	Risk	Control level	Risk level	Mitigation measure	Indicator
Environmental	Forest fires	a	3	Establish early warning mechanisms for fires and their suppression.	Number of controlled fires per unit area (Number of records/hectare)
				Training for reforestation workers to eliminate burning as a practice in crop establishment.	Number of people trained, disaggregated by sex and age per unit of time.
	Floods	c	1	Establish communication mechanisms and early warnings during periods of heavy rainfall and tropical storms.	Number of flood-related reports per project properties (hectares)
				Coordinate with competent local, national, and international organizations for early and necessary aid for damage repair.	Aid received from competent organizations per project duration (time)
	Strong winds	c	1	Conduct periodic inspections of infrastructure and support elements in the project areas to ensure they are in good condition and resistant to potential strong winds..	Number of inspections conducted on each project property per unit of time
				Train project participants to understand the nationally established measures for dealing with strong winds in the area.	Number of people trained, disaggregated by sex and age per unit of time.
	Pests and Diseases	a	3	Periodic monitoring of the condition of the trees in the project area to promptly identify any pathogens affecting the plantation	Number of trees evaluated / total number of trees planted per plot
				Implementation of an integrated Pest and disease management plan	Number of plans/total number of participants

Type	Risk	Control level	Risk level	Mitigation measure	Indicator
	Noise and Air Pollution from Vehicle and Machinery Use	a	1	Preventive maintenance to avoid uncontrolled noise emissions.	Number of vehicles and machinery inspected / total machinery used
				Training project participants on noise control and hearing care.	Number of people trained, disaggregated by sex and age per unit of time
Financial	Potential Losses in the Value of Carbon Credits Generated by the Project Due to Market Fluctuations	c	3	Generate market value by emphasizing technical and social management.	Number of carbon credits sold per unit of time.
				Establish more attractive marketing strategies for carbon credits at local, national, and international levels.	
	Operational Risk due to Human Errors, Inadequate or Defective Processes, System Failures, and External Events.	a	1	Monitor organizational operations of participating companies to prevent risks.	Number of meetings held among project participants per unit of time over the project's duration.
				Carry out the accountability process within established timelines to verify progress in project activities.	
Financial Capacity of the Project Holder	a	3	Conducting accountability processes at predetermined times to verify progress in project activities.	Number of meetings held among project participants per unit of time over the project's duration.	
Budget for Project Establishment and Maintenance (Secured Resources)	a	3	Regularly monitor project progress and periodically review its budget and costs.	Number of financial reviews conducted per unit of time over the project's duration	
			Implement a detailed financial plan including detailed and conservative costs and budgets for the project.	Number of financial plans per project duration (time)	

Type	Risk	Control level	Risk level	Mitigation measure	Indicator
Social	Change of Ownership due to Illness or Death of the Holder	a;c	2	Establish direct and efficient communication channels among project participants to promptly address any eventualities that may arise.	Number of meetings held among project participants per unit of time over the project's duration.
				Possess solid contracts and agreements specifying the responsibilities and commitments of the parties involved in the project.	Number of clauses present in the agreements signed by legal representatives.
	Land Use Limitation (Mortgage, Sales, Land Exchange for Project Execution)	a	3	Have legal and juridical advisory available to provide guidance on appropriate measures to take.	Number of contracts and agreements signed and issued to legal representatives.
				Possess solid contracts and agreements specifying the responsibilities and commitments of the parties involved in the project.	Number of clauses present in the agreements signed by legal representatives.
	Land Disputes (Invasion Management)	a;c	3	Conduct an analysis regarding the project's applicability conditions.	Number of documents registered per owner/total required documentation for each owner
				Verify and ensure that property titles are legitimate and duly registered.	
	Occupational Safety	a	2	Training on the proper use of tools and personal protective equipment (PPE).	Number of people trained, disaggregated by sex and age per unit of time.
				Provide personal protective equipment to project participants.	Number of PPE provided to each project participant / total number of project participants.
Political Risk: Illegal Activities	a;b	3	Establish alliances with reforestation companies for control and surveillance of security in the project's area of influence	Number of contracts and agreements signed and issued to legal representatives.	
Political Risk: Armed Conflict	c	3	Training on prevention of kidnapping and extortion	Number of people trained,	

Type	Risk	Control level	Risk level	Mitigation measure	Indicator
					disaggregated by sex and age per unit of time.
	Political Risk: Corruption/Governance	a	1	<p>Monitoring the organizational operations of the companies involved in the project to prevent risks.</p> <p>Carrying out the accountability process within established timelines to verify progress in project activities.</p>	Number of meetings held among project participants per unit of time over the project's duration.
	Opportunity Cost: Economic Alternatives with Better Results	a	3	Possess solid contracts and agreements specifying the responsibilities and commitments of the parties involved in the project.	Number of clauses present in the agreements signed by legal representatives.

Source: (CO2CERO SAS, 2022)

11.1 Reversion risk

The company CO₂CERO S.A.S., as the owner of the Proyecto Forestal Alcaraván Orinoquía, has taken a series of actions to ensure the projects continuity and its proper execution within the established 30-year timeframe. To achieve this, contracts were entered into with the legal representatives involved in the project, specifying their respective responsibilities through clauses. The purpose of these contracts is to ensure transparency and proper management throughout the process (refer to *1_Agreements*).

Additionally, in accordance with the BioCarbon Methodology BCR0001 and Permanence and Risk Management. BCR Tool. BCR Project holder take actions to ensure the Project benefits are maintained over time. Version 1.0, the project will allocate a 20% reserve of the total GHG emission removals quantified for each verified period. This is done to secure a portion of the credits that may be lost due to the occurrence of any type of event. Various management measures are in place to address reversal of achievements and progress.

Regarding the environmental component, mechanisms for communication and early warning have been established to promptly detect potential threats that may generate negative impacts in the environment. These measures are accompanied by coordination with competent organizations and are foundational principles for the development of a forest management system. This system is based on continuous monitoring and early

and effective intervention to mitigate, correct or prevent, as the case maybe, the root cause of each barrier, risk or threat.

Concerning the social and financial aspects, measures have been directed to toward risk prevention through constant, transparent, an effective communication between the forest project owner and its clients. Technical tools that are highly useful and relevant are employed when carrying out various processes.

12 Stakeholders' Consultation

Below, the processes used to achieve the implementation of the Proyecto Forestal Alcaraván Orinoquía by the stakeholders are described.

12.1 Project idea

Consolidation of the idea of the Proyecto Forestal Alcaraván Orinoquía arises from the technical developer and reforesters, as a result of an analysis of the normative, legal, and technical framework, which ensures that the project will provide benefits to the participants, environmental protection, greenhouse gas mitigation, and will be permanent for a period of 20 years. In order to ensure a responsible and committed workflow, both parties establish a temporary contract, where they commit, through their skills, to contribute to the fulfillment and achievements of the project.

Steps for the development of the project idea

Initiative: Typically, the promotion or dissemination of forest plantation projects arises from events or gatherings where discussions about the importance of sustainable initiatives with commercial purposes, which can also generate carbon certificates for climate change mitigation, take place.

As such, the initial contact between the interested parties is made through phone calls, WhatsApp messages, or emails, followed by a more detailed conversation about the initiative, its location, and the participants. If the participant is interested, a further briefing is conducted about what the AR project entails, the types of actions involved, the benefits, addressing questions and concerns, and explaining the commitments associated with joining the initiative (Refer to *1_Agreements\01_Manifest of interest*).

Prefeasibility: Once the project design is approved, the technical team proceeds with the prefeasibility study, allowing for a preliminary analysis of the proposal to determine if it is viable for development.

Checklist: Each participant is provided with a checklist of documents and requirements needed for the project's development. This is done to validate the information, including the legal aspects such as land ownership analysis, to prevent any potential reversals in activities during the execution phase.

Temporary Contract: During this phase of communication among partners, the percentages of participation related to management and technical implementation, payment mechanisms, benefit transfer, project's general objectives, and certification program based on alternative analysis, commitments, and responsibilities are defined (Refer to *1_Agreements\02_Temporal agreement*).

12.2 Project socialization

It is important to note that for AR projects, it is not a requirement to conduct prior socialization with the communities adjacent to the project. This is because it is a private property where the initiative can be implemented, ensuring that no harm will be done to the well-being of the population or the natural environment. However, it is emphasized that having an effective relationship with the community is crucial to strengthen social ties, which can be beneficial for the project over time.

As forest projects continue to develop, there is an increasing emphasis on the importance of the social component, which is a cross-cutting axis for sustainability efficiency and effectiveness. Therefore, the Proyecto Forestal Alcaraván Orinoquia, through its voluntary actions, seeks to promote activities that generate well-being for both direct and indirect beneficiaries while responsibly impacting the environment. In the context of the socializations that have been carried out with the participants, it has been found that they have undertaken social actions with and without the project, as evidenced by the results shared by Ecologic SAS.

With the above, it is evident that the project has a vision beyond the economic aspect, focusing on new sustainable development models, considering the importance of preserving and protecting native forests and generating actions that benefit populations that often have unmet basic needs, especially in rural areas.



Illustration 1. Community work carried out by the company Ecologic SAS in collaboration with the community of the Santa Helena village. Source: ECOLOGIC SAS. (2022)

12.3 Handling of requests, complains, claims and suggestions

In order to strengthen the formal communication channels between the technical developer and the participants, a (Requests, Complaints, Claims, and Suggestions) email address for forest projects (PQRS.Forestal@co2cero.co) has been created. Its purpose is to address questions, complaints, claims, and/or suggestions from the participants directly involved in the development of Forest Projects (A/R), ensuring that they receive the appropriate response. This allows for the ongoing recording of requests, commitments, and actions. Currently, it is in the process of being socialized, and it is emphasized that as of the present date, there have been no requests received.

13 Grouped Projects

The Proyecto Forestal Alcaraván Orinoquía is not a grouped project.

14 Implementation of the project

Below, the processes that the initiative undergoes during its evaluation, certification, and accreditation are described.

14.1 Phase

In process

14.2 Verification events

Without verifications

14.3 Net GHG removals or net GHG emission reductions obtained during the monitoring period

According to the selected reservoirs in the project (aboveground biomass, belowground biomass, soil organic carbon, litter and deadwood), which are explained in the section 4 Quantification of Emissions and Removals in the project document (see *7_Project Document\BCR_PDD_Alcaravan_V9.pdf*), the project obtains a total of 26,424 net tCO₂e for the initial verification period within the project area. It should be noted that the actual total reductions of the project amount to 33,033 tCO₂e (see Table 57) (see *5_Carbon calculation\Ex-Post\ Expost_AlcaravanOrinoquia_V4.xlsx*).

14.4 Revision of monitoring plan

The monitoring plan has not been reviewed, because it is the first certification of the project.

14.5 Request for deviation applied to this monitoring period

14.5.1 *Deviations in the implementation of the Climate Change Mitigation Project compared to the PDD.*

For the Proyecto Forestal Alcaraván Orinoquia, there are no deviations in the implementation compared to what is established in the PDD.

14.5.2 *Methodological deviations*

The project doesn't generate methodological deviations from what is established in the BCR0001 Quantification of GHG Removals Afforestation, Reforestation, and Revegetation methodology developed by Biocarbon Registry version 4.0.

15 Monitoring system

Next, the compliance with the recommendations described in the “No net harm Environmental and social Safeguards (NNH), versión 1.0” tool is presented:

- a) The data and information necessary to estimate GHG emission removals or reductions during the project quantification period: In the chapter 15.6.1 Data and parameters monitored, all the data used for quantifying the removals of the Project are presented.
- b) Data and complementary information to determine the baseline or reference scenario: The procedures and data used to determine the baseline scenario are found in Chapter 18.1 Quantification of GHG removals in the baseline scenario.
- c) Specification of all potential emissions that would occur outside the project boundary attributable to GHG project activities (leakage): The results and procedures for determining leaks through carrying capacity are shown in 18.2 Leaks.
- d) Information related to the environmental effects assessment of the GHG project activities and no net harm: The Environmental Assessment is conducted in chapters 9 Environmental Aspects and 15.7 Monitoring of the evaluation of socioeconomic and environmental aspects.
- e) The procedures established for the management of GHG emission reductions or removals and related quality control for monitoring activities: The Quality Control of the Proyecto Forestal Alcaraván Orinoquía is developed in chapter 19 Information management.
- f) Description of defined procedures for periodic calculation of GHG emission reductions or removals and leakage: The equations and procedures for obtaining the data on greenhouse gas removals are described in 7_Project Document/BCR_PDD_Alcaravan_V9.pdf/3.5. Mitigation results.
- g) The assignment of roles and responsibilities for monitoring and reporting of variables relevant to the calculation of GHG emission reductions or removals: The responsibilities of the parties involved in the Project are described in 8 Carbon ownership and rights and the folder 1_Agreements.
- h) Procedures related to the assessment of the project’s contribution to the Sustainable Development Goals (SDGs): In the chapter 5 Contribution to Sustainable Development Goals (SDG) and the report *13_Monitoring report\03_SDG\BCR TOOL SDG_Alcaravan_V4.xlsm*, the indicators for measuring the fulfillment of the Sustainable Development Goals (SDGs) are defined.
- i) Criteria and indicators related to the assessment of the project’s contribution to the Sustainable Development Goals (SDGs): In the chapter 5 Contribution to Sustainable Development Goals (SDG) and the report *13_Monitoring report\03_SDG\BCR TOOL SDG_Alcaravan_V4.xlsm*, the indicators for

measuring the fulfillment of the Sustainable Development Goals (SDGs) are defined.

- j) Procedures related to co-benefits and special category follow-up, when applicable: This section does not apply, because the project does not have any special category.
- k) The criteria and indicators defined to demonstrate the additional benefits and the measurement of co-benefits and the special category, when applicable: This section does not apply, because the project does not have any special category.

The monitoring plan must describe the procedure used by the project manager to track project activities of GHG removals/emissions attributable to the project's forestry activities.

To fulfill this requirement, we adhered to the guidelines outlined in the methodology employed for removals calculation (BCR0001 V 4.0) BCR Tool “monitoring, reporting and verification (MRV), version 1.0”. Our approach encompassed the inclusion of monitored data and parameters, the methodologies employed for data generation (including appropriate collection and archiving procedures), as well as the processes associated with sampling models and quality control.

According to the methodology, the Monitoring Plan must provide all the necessary information to:

- a) Verify the conditions of applicability of the methodology
- b) Verify changes in carbon stocks in selected sinks
- c) Verify project emissions and leakage

The data needed for carbon estimates adheres to widely accepted principles and practices for commercial plantation management and forest inventories. The monitoring plan features the following aspects:

- a) Monitoring project boundaries
- b) Monitoring the implementation of forestry activities
- c) Monitoring forestry biomass management and growth
- d) Monitoring the quantification of net project removals

15.1 Monitoring project boundaries

The project's geographical boundaries constituted by the eligible areas on which the forestry activities are developed, have been incorporated in the Geographic Information System (GIS). This involves georeferencing each of the lots with their respective ID, recording the initial vegetation cover for each parcel, and documenting the areas within different forest systems, among other things. This approach enables the monitoring of

forestry activities for each of the lots or geographical areas included in the project. The activities undertaken for effective management and monitoring of these areas include:

- a) Reviewing all areas and boundaries of the project by evaluating reforestation activities by site (lot).
- b) Georeferencing (latitude and longitude) each polygon by species and stratum, using a GPS.
- c) Recording the position of each site, through GPS, in the Geographic Information System and calculating the planted area in each stratum.
- d) Verifying periodically the correspondence of the boundaries defined for the project and the eligibility analysis of the areas in the project.

The information concerning the boundaries of the mitigation project, specifically the areas where planting has occurred or is planned, undergo periodic evaluation and verification using GPS field demarcation. These boundaries are represented in the Geographic Information System to ensure that the project area is up-to-date. By identifying updated areas and defining project boundaries, the initially detailed strata will be improved. Modified limits, if applicable, will be available during each project follow-up audit. In cases where carbon credits need to be deducted due to limit changes, these will be properly deducted from the calculations.

Similarly, changes in the areas will be documented through field analysis with the information obtained through GIS. The analysis entails listing the areas by system, species, and year of planting, affected by disturbance events. The data and parameters used to monitor project boundaries are presented in Table 47.

Table 47. Variables used to monitor project boundaries.

Variable	Unit of Measure	How it is obtained	Registration frequency	Cover/Other measures or number of data collected	Remarks
Stratum	Stratification map	C	Periodically	100% of the area	Identifier of each stratum by means of species planted and sowing year.
Polygons of the areas included in the project. GPS coordinates	Latitude and Longitude	m	Annually (every 3 years maximum)	100% of the area	Verified annually. Constituted by the coordinates (latitude and longitude) of each polygon included in the project, identifying the areas affected by natural or anthropic disturbances.
A_{ikt}	Hectares	c	Annually (every 3 years maximum)	100% of the area	Polygons of the areas included in the project, during time t , in stratum i , in the forest system k .

Variable	Unit of Measure	How it is obtained	Registration frequency	Cover/Other measures or number of data collected	Remarks
A_T		c	Annually (every 3 years maximum)	100% of the area	Total area at time T . The area of the project boundaries will be measured and documented. Project boundary maps will be available at each follow-up audit. It corresponds to the sum of the areas at the boundaries in period T .
$Adist_{ikt}$		c	Every 3 years maximum	100% of the affected area	Areas affected by natural phenomena (pests, fire, etc.) or anthropic activities (interventions or deforestation), by stratum i , by forest system k , at time t .

Source: (CO2CERO SAS, 2022). *Where M: measured, C: calculated; E: Estimated and D: Default

15.2 Monitoring the implementation of project activities

In accordance with forestry practices, the activities for monitoring their implementation are as follows:

- Ensuring that soil preparation and site selection adhere to the guidelines outlined in the establishment and management plans, as well as the project document.
- Reviewing and updating annually the planted areas, by species and stratum.
- Evaluating the survival of plantations and identifying any decreases in areas or events that lead to the decline of biomass.

Table 48. Variables used to monitor the execution of plantation activities.

Variable	Unit of Measure	How it is obtained	Registration frequency	Coverage/Other measures or number of data collected	Remarks
ID - Ref. SIG	Alphanumeric	Defined	Continuously	100% of the area	For each established forest stratum and system, associated with an alphanumeric identifier.
Localization	Geographical coordinates	M	Continuously	100% of the area	Using GPS to identify the geographical coordinates of each lot included in the project.
A_ikt	Hectare	C	Continuously	100% of the area	Polygons of the areas planted during time t , by stratum i , in forest model k .

Variable	Unit of Measure	How it is obtained	Registration frequency	Coverage/Other measures or number of data collected	Remarks
Site Preparation	Hectare	M	At the beginning of each establishment	100% of the area	Area intervened for the establishment of plantations.
Species planted by each stratum	N/A	Defined	Annually	100% of the area	Species planted by each stratum, within the boundaries of the project.
Survival	Trees/ha	m,c	Three months after planting and annual	100% of the area	The survival rate per established hectare is calculated for each stratum, species and forest system.
Date of planting	Alphanumeric	M	At the beginning of each establishment	100% of the area	Date of planting of each lot (site).

Source: (CO2CERO SAS, 2022). *Where M: measured, C: calculated; E: Estimated and D: Default

After completing the monitoring activities for forestry practices, information related to soil preparation and site selection is obtained. This information is based on the principle of restriction of planting in plantation protection areas or natural forest. This is achieved through eligibility analysis, which ensures compliance (See *3_Eligibility*) and shows the environmental restrictions for the corresponding areas.

For the participants, compliance with environmental restrictions for the installation of plantations is determined through multi-temporal analysis. Additionally, field visits display the activities carried out in plantations, such as fire barriers and cleaning, which corresponds to what was proposed in the management plan.

To ensure accurate updates on planted areas, the monitoring of boundaries is taken into consideration. Additionally, the year of sowing is used as a base factor to determine the age of each of the strata. As part of the carbon calculations, a unique identifier is generated, incorporating species and year of planting, which ensure clarity of the data, and characterized as the stratum. In the event of a disturbance or change in the effective areas, a report is filled out with the details of new planted areas and disturbances, provided directly by the reforestation team. This guarantees the authenticity and transparency of the information presented.

15.3 Monitoring crop management and growth

CO2CERO S.A.S established a Protocol for the measurement for the permanent growth of plots. This was done hand in hand with ECOLOGIC SAS, and it was based on the Guide for the quantification of biomass and forest carbon, the generation of models, and the use of tools developed by Corporación Autónoma de Cundinamarca for its estimation, which is summarized below. Table 49 lists the materials needed for a crew and their respective uses. The following sections of the document present the general guidelines used.

Table 49. Materials for forest management and growth measurements.

Item	Quantity	Use
Tape measure	1	<ul style="list-style-type: none"> To measure the 1.3 height to mark the DHB of the tree. <ul style="list-style-type: none"> To confirm plot radii.
Diameter tape	1	<ul style="list-style-type: none"> To directly measure the DHB of the tree.
PVC pipe or a 1.3-meter stake	1	To establish the permanent parcel center.
Rope or pita fiber	<ul style="list-style-type: none"> Graduated Ungraduated 	<ul style="list-style-type: none"> Graduated: to verify radii of the circle to determine whether a tree enters the plot. Ungraduated: for different uses that arise in the field.
Data forms	Variable	To collect date of field plots
GPS	1	Geopositioning of the plot in Degrees-Minutes-Seconds format (WGS-84)
Velcro	Variable	Place the velcro at chest height (1.3 meters), to be able to paint the tree on a straight circumference, before measuring it, so that it does not alter the value of the diameter at chest height (DHB)
Yellow asphalt paint	Variable	<ul style="list-style-type: none"> The circumference should be painted on the Velcro. It should facilitate the location and ensure the mark is straight. On this mark the DHB should always be measured. Identify numerically and alphabetically all the trees in the plot. Ex: # Individual + plot name* = 1M Identify the name of the plot. In Annex 1 of the forest monitoring lists is the nomenclature to be used for each property.

Item	Quantity	Use
Height measuring equipment (Clinometer)	1	To measure the height of the tree at a known horizontal distance.

Source: (CO2CERO SAS, 2022).

15.4 Stratification

Because there are differences in the biomass, present within the project area, which are attributed to the different species and periods of plantation establishment, the stratification process is implemented with the purpose of improving the accuracy of the project's biomass estimates.

The strata present in the baseline scenario are shown in "*7_Project Document\BCR_PDD_Alcaravan_V9.pdf/3.3.3 Step 1: Identifying land use*" based on the analysis developed in the Eligibility component. On the other hand, for the project scenario, stratification is based on planting and forest establishment plans, consisting of the forest species planted and the year of planting.

15.5 Sampling plots

The definition of the number and location of the plots was carried out under the eligible project area, based on a systematic sampling design. To find the number of plots needed for the project, a preliminary sampling is executed according to the number and area of each stratum by adapting what is suggested in the CDM Tool AR-TOOL 0003. After obtaining the number of plots, they are distributed in the study area on the base cartography of the project.

The plot size measures 400 square meters, except for the participant Punta de Garzas Inversiones Forestales, whose plots measure 420 square meters. The GPS is used to get to the plot 15 meters before reaching the destination. From there, the remaining 15 meters are traversed using a decameter and compass, while maintaining the same course, to ensure accurate arrival at the center of the plot. The center of the plot is marked with a PVC pipe, stake, or central tree, as determined by the professional in charge, and the plot number is indicated there. The plot center is situated to the north, and the first tree lies within an 11.28-meter radius to the north (see Figure 4). For Punta de Garzas Inversiones Forestales, circular plots with an 11.56-meter radius were chosen. It should be noted that the project may result in the standardization of plot type and size.

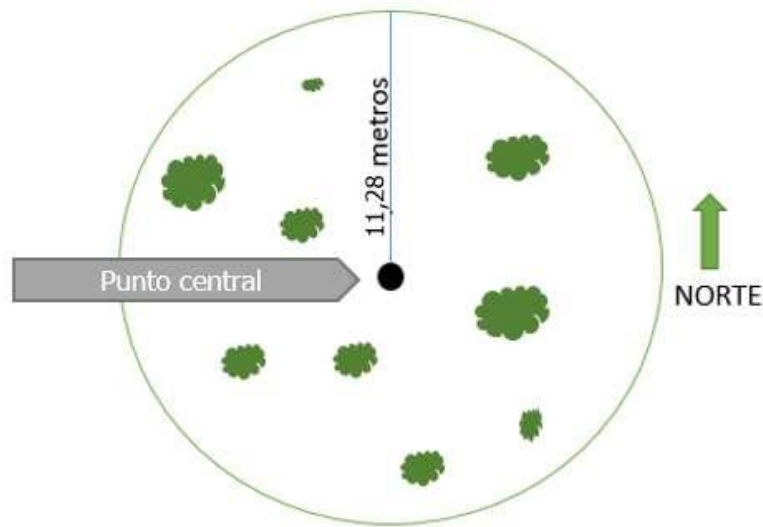


Figure 4. 400 m² plot diagram.
Source: (CO2CERO SAS, 2022)

To mark the trees, we begin by placing the Velcro at chest height (1.3 meters). Then, we paint a straight circumference around the individual, before measuring it. Next, with the same paint, we mark on a straight line the exact spot where the measurement was taken. This serves as a reference for all subsequent measurements of the tree's DHB.

15.6 Measurements and estimation of changes in carbon content

The following attributes will be recorded for each tree without exception:

- Number of the tree with paint: a paint mark indicating where the DHB was measured on the tree should also remain on the shaft.
- Attributes (crooked, sick, forked, with ants, etc.). In case the tree does not present anything noticeable it will be registered as "normal".
- Observations or annotations on the plot, if relevant (presence of obvious diseases or pests, significant presence of regrowth or regeneration of forest species other than that consigned for the property, etc.).

The trees are measured and marked in a sequential order, starting from an arbitrary north point. To accomplish this, they were all chosen and marked by following a zigzag pattern, returning to the starting point once the line was completed (Figure 5).

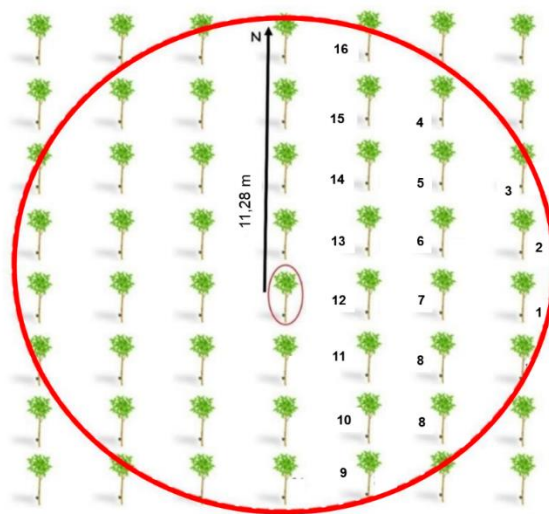


Figure 5. Parcel tree numbering. Source: (CO2CERO SAS, 2022).

The height of the individuals must be measured in the first instance with specialized equipment. If you do not have the equipment, the height must be estimated visually by rounding the value to the nearest meter. The height measurement methodology must be explicit in the document and field forms.

In the plots of ENLACE ROJO S.A.S., ECOSISTEMA PRODUCTIVO MATAMONTE S.A.S., ECOLOGIC S.A.S., LUIS FERNANDO RODRÍGUEZ, SULTANA S.A.S. Y CLAUDIA HUERFANO, the height of 25% of the total individuals is systematically measured, taking into account the series identified every four trees within the plot (1, 4, 8, 12...), which represents a value that provides an acceptable estimation of R² in height regression. For trees without field measurements, their estimation is done through regression analysis. The selected model for the height diameter relationship depends on estimation analysis, where the statistical value R² is most representative. This analysis begins with regressions by species, followed by stratum, and if required representativeness is not achieved, groupings are made by nearby or individual plots. The parameters by species are presented in Table 50. In the case of INVERSIONES GUARDABOSQUES DE COLOMBIA and PUNTA DE GARZA INVERSIONES FORESTALES, the height of all individuals was measured.

Table 50. Regressions used for height estimation.

Specie	regression type	Estructure
<i>Acacia mangium</i>	$Ht = \alpha \text{ dap}^2 + \beta \text{ dap} + \gamma$	Polinómico grado 2
<i>Eucalyptus pellita</i>	$Ht = \alpha \text{ dap}^2 + \beta \text{ dap} + \gamma$	Polinómico grado 2

Specie	regression type	Estructure
<i>Pinus caribaea</i>	$H_t = \alpha \text{dap}^3 + \beta \text{dap}^2 + \gamma \text{dap} + \mu$	Polinómico grado 3

Source: (CO2CERO SAS, 2022).

With the results generated by field measurements, carbon stocks (quantity of CO₂e in tons as of the date) are calculated in the carbon reservoirs included in the project, according to the applied methodology; these indirectly calculated reservoirs will be estimating using expansion factors as shown in section 4.2 of this document.

15.6.1 Data and parameters monitored

Below, we can find the data and parameters subject to monitoring within the project.

Data/Parameter	Diameter at Chest Height (DHB).
Unit of measurement	Centimeters.
Description	Reflects tree growth and carbon storage.
Source of information	Field monitoring in the plantations stands linked to the project.
Applied values	Result of the monitoring plots measured in each of the plantations stands linked to the project.
Choosing data or measurement methods and procedures	The person in charge of monitoring this variable is the technical operator hired by the project owner. The frequency of measurement depends on the verification processes executed in the project. Finally, the accuracy of the measurements, methods, and measurement procedures are carried out following section 16.3 Site management and biomass growth monitoring, of BCR0001 V4.0.
Information purpose	Controlled, CO ₂ -related calculation of the removals generated by the project activity.
Monitoring equipment	Diametric tape made of fabric or steel; the precision is centimeters. Technical specifications: Material: Synthetic fabric reinforced with thin wires of phosphor bronze. Claw hook
Quality control and assurance procedures	The procedures described in section 16 of the BCR0001 V4.0 methodology regarding the data verification process are carried out.
Monitoring frequency	Permanent. Measured every time the project is verified (triennial).
Comments	-

Data/Parameter	Total height (Ht).
Unit of measurement	Meter
Description	Reflects tree growth and carbon storage.
Source of information	Field monitoring in the plantations stands linked to the project.

Applied values	Result of the monitoring plots measured in each of the plantations stands linked to the project.
Choosing data or measurement methods and procedures	The person in charge of monitoring this variable is the technical operator hired by the project owner. The frequency of measurement depends on the verification processes executed in the project. Finally, the accuracy of the measurements, methods, and measurement procedures are carried out following section 16.3 Site management and biomass growth monitoring, of BCR0001 V4.0.
Information purpose	Controlled, CO ₂ -related calculation of the removals generated by the project activity.
Monitoring equipment	Hypsometer, Vertex brand, with 0.1 m resolution and 1% distance accuracy. 70 mm diameter transponder. The calibration was carried out before starting the field work, in the time period of 01/04/2022 to 02/12/2022.
Quality control and assurance	The procedures described in section 16 of the BCR0001 V4.0 methodology regarding the data verification process are carried out.
Monitoring frequency	Permanent. Measured every time the project is verified (triennial).
Comments	-

15.6.2 Monitoring crop management and growth

After completing the forest yield monitoring activities, the result is an estimation that provides information for quantifying the carbon stored in the plantations. It also offers an approximation of the behavior carbon stored over time. This activity seeks to guarantee the transparency of the information processed and allows a more accurate verification of the data taken in previous inventory phases.

In *7_Project Document\BCR_PDD_Alcavan_V9.pdf*, section 4, emphasis is placed on the measurement process and the importance of ensuring the authenticity of information to minimize the potential for overestimation or underestimation. The information obtained in this phase is recorded in predefined field formats that capture various variables related to the structure of evaluated individuals (such as height and diameter), along with species information, sowing year, and owner details.

The verified growth period is between the most recent verification and the previous one. Within each verification period, the removals of this certification are distributed linearly. Within each verification period, the carbon removals are evenly distributed over time. The results of each monitoring phase and the subsequent verification are presented in folder *13_Monitoring report*.

15.7 Monitoring of the evaluation of socioeconomic and environmental aspects

We conduct an assessment of environmental and socio-economic aspects for the project, with the aim of understanding the impacts generated by the project activities to be carried out (refer to *13_Monitoring report\04_NNH\01_Enviromental aspect & 02_Socioeconomic aspect*). Likewise, in the *Actions* and corrective measures

Below are the corrective actions and measures that will be implemented during the project's lifespan to mitigate the negative effects identified through the socioeconomic assessment conducted in previous chapters, complying with the numerals d) To develop action plans to reduce or mitigate the effects identified and e) To provide a support for monitoring the implementation of action plans and accomplishment of action-plan targets of the Tool “No Net Harm Environmental and Social Safeguards (NNH), version 1.0”.

Table 44. Socioeconomic Actions and corrective measures for the Proyecto Forestal Alcaraván Orinoquía.

Negative effect	Actions	Indicator
1. Solid waste management	1.1 Diagnosis of solid waste management in the Project area 1.2 Training sessions on solid waste management 1.3 Proper handling, use, and disposal of solid waste	1.1 Number of diagnoses per unit of time 1.2 Number of training sessions conducted per unit of time 1.3 Number of participants practicing proper handling, use, and disposal/Total number of participants
2. Occupational safety	2.1 Providing personal protective equipment to protect participants	2.1 Number of Personal Protective Equipment (PPE) provided to each project participant per total project participants
3. Public safety	3.1 Establishing partnerships with reforesters for the control and surveillance of safety in the projects area.	3.1 Number of contracts and agreements signed and issued to legal representatives.
4. Land use and limitations	4.1 Having legal and juridical counseling available to provide guidance on the appropriate measures to take. 4.2 Having solid contracts and agreements that specify the responsibilities and commitments of the parties involved in the project.	4.1.1 Number of properties with land tenure restrictions 4.1.2 Number of consultations provided/Number of properties with restrictions 4.2 Number of clauses present in the agreements

Negative effect	Actions	Indicator
		signed by legal representatives.
5. Change of ownership	5.1 Have solid contracts and agreements that specify the responsibilities and commitments of the parties involved in the project.	5.1 Number of clauses present in the agreements signed by legal representatives.
6. Carbon market devaluation	6.1 Creating market value with a focus on technical and social management 6.2 Establishing marketing strategies for carbon credits that are more appealing at the local, national and international levels	Number of carbon credits sold per unit of time.
7. Labor dropout	7.1 Quantity of workers with formal employment in the project area	7.1 Number of workers employed formally/Total number of workers

Source:

Risk management *section*, we present the management of potential environmental, social and financial risks along with their respective monitoring indicators and variables that arise during its execution.

15.8 Assignment of roles and responsibilities for monitoring and reporting relevant variables for GHG removal calculations

The technical operator contracted by CO₂CERO S.A.S. (project holder) will be responsible for monitoring the established variables. In this report the measurements, will be conducted periodically in order to collect information promptly and make the corresponding estimations.

The technical operator responsibilities include:

- Collecting accurate and relevant data measurable parameters.
- Monitoring tree growth through periodic measurements of individual trees, using sampling techniques described in this chapter to obtain the data.
- Maintaining detailed records of activities and operations carried out in the project plantations.
- Preparing technical reports summarizing the collected information and the monitoring results. Additionally, providing the databases containing all field measured data.

- Reviewing the values recorded for each variable in different plots to ensure data quality on-site; adapted from (Ecologic S.A.S., 2022).
- Complying with applicable regulations and standards for the project, including safety regulations and sustainable forest management guidelines.

CO₂CERO S.A.S. as the project holder shall ensure that the information provided in the monitoring is delivered within the established timelines and in an appropriate manner. Therefore, a review and control out on the submissions made by the technical operator responsible for conducting the monitoring.

15.9 Monitoring of the assessment of the project’s contribution to the Sustainable Development Goals (SDG’s)

For each sustainable development goal, its respective evaluation is carried out by implementing the contribution to the sustainable development goals tool prepared by BioCarbon Registry (refer to *13_ Monitoring report\03_SDG\BCR TOOL SDG_Alcaravan_V4.xlsm*). In this tool the controllable indicators by the Project are selected, along their annual results and the final outcome, confirming compliance with the worker indicator. Similarly, in chapter 5 Contribution to Sustainable Development Goals (SDG), a brief description of the actions and activities undertaken by the project is provided, working collaboratively with participants, and prioritizing collective well-being and local development.

16 Carbon reservoirs and GHG sources

The reservoir considered for Proyecto Forestal Alcaraván Orinoquía are described in Table 51, which are consistent with those established by the IPCC.

Table 51. Reservoir considered for the Proyecto Forestal Alcaraván Orinoquía.

Sink	Baseline Scenario	Project Scenario	Justification
Aboveground biomass (AGB)	Yes	Yes	It is the main carbon sink showing the increase of the carbon stock in the forest cover of the project area. It covers tree and non-tree biomass. For the Baseline scenario, the AR-TOOL14 tool specifies that according to carbon contents, it can be counted as zero if the conditions described in numeral 5 are met.
Belowground biomass (BGB)	Yes	Yes	The carbon sink is included as it is the second most important pool and is expected to increase thanks to the project.

Sink	Baseline Scenario	Project Scenario	Justification
			For the Baseline scenario, the AR-TOOL14 tool specifies that according to carbon contents, it can be counted as zero if the conditions described in numeral 5 are met.
Dead wood (DW)	Yes	Yes	This carbon sink is expected to increase, due to the implementation of project activities. In the baseline scenario, the carbon in these pools is equivalent in proportion to aboveground biomass. Therefore, for the project, it is counted as zero.
Leaf litter (LI)	Yes	Yes	This carbon sink is expected to increase, due to the implementation of project activities. In the baseline scenario, the carbon in these pools is equivalent in proportion to the aboveground biomass. Therefore, for the project, it is counted as zero.
Soil Organic Carbon (SOC)	Yes	Yes	It is expected that throughout the life of the project, its content will increase due to the permanent presence of tree cover.

Source: (CO2CERO SAS, 2022)

The reservoir included are measured, directly or indirectly, for application in the project scenario considered as significant that contain the planted area. Therefore, they are likely to generate GHG removals in the project scenario.

16.1 GHG emission sources

Table 52, identifies the emission sources that align with the ones specified in the BCR0001 V 4.0 methodology.

Table 52. Emission sources considered for Proyecto Forestal Alcaraván Orinoquía

Source	Baseline scenario			Project scenario		
	CO ₂	CH ₄	N ₂ O	CO ₂	CH ₄	N ₂ O
Woody biomass combustion	No	No	No	Yes	No	No

Source: (CO2CERO SAS, 2022)

In both the baseline scenario and project scenario, the emissions of methane and nitrous oxide resulting from the burning of woody biomass will not be taken into account unless they are deemed significant. Specifically, they must contribute more than 5% of the total emissions, as stated in the protocol. Emissions by CH₄ and N₂O will not occur since there is no evidence of activities such as the use of fertilizers, burning for soil preparation or

nitrogenous bacteria, or large-scale anaerobic decomposition of organic matter in the project area.

17 Eligible areas in the GHG project boundary

The eligibility determines the areas suitable for inclusion in Proyecto Forestal Alcaraván Orinoquía. It complies with the premise that “the project area does not correspond to the category of forest, nor to natural vegetation covers other than forest, at the beginning of the project, or five years before the start date.”, as stipulated by the methodology. The following is the eligibility analysis carried out.

The results of the cover analysis at the beginning of the project and 5 years before the start reveal clean pasture covers, mosaics of pastures and natural spaces, and, to a lesser extent, gallery and/or riparian forests, which are ineligible covers for the project.

17.1 Project Eligibility

A total of 1,094.43 eligible hectares were identified for the entire project. Table 53 shows the eligible and ineligible areas according to the analysis carried out. It indicates that the project presents 100% of the total area as eligible.

Table 53. Eligible Area - Not Eligible for the Project.

Eligibility	Area (ha)	Area (%)
Eligible	1,094.43	99.42 %
Not Eligible	6.38	0.57 %
Total planting	1,100.81	100%

Source: (CO2CERO SAS, 2022).

Figure 6 shows the eligibility map, with the eligible areas being differentiated from the ineligible areas of a specific participant. To corroborate the eligibility of the other participants, see the shapefile (go to *14_GIS\02_SHP\Elegibilidad_2022_V2_5.shp*).

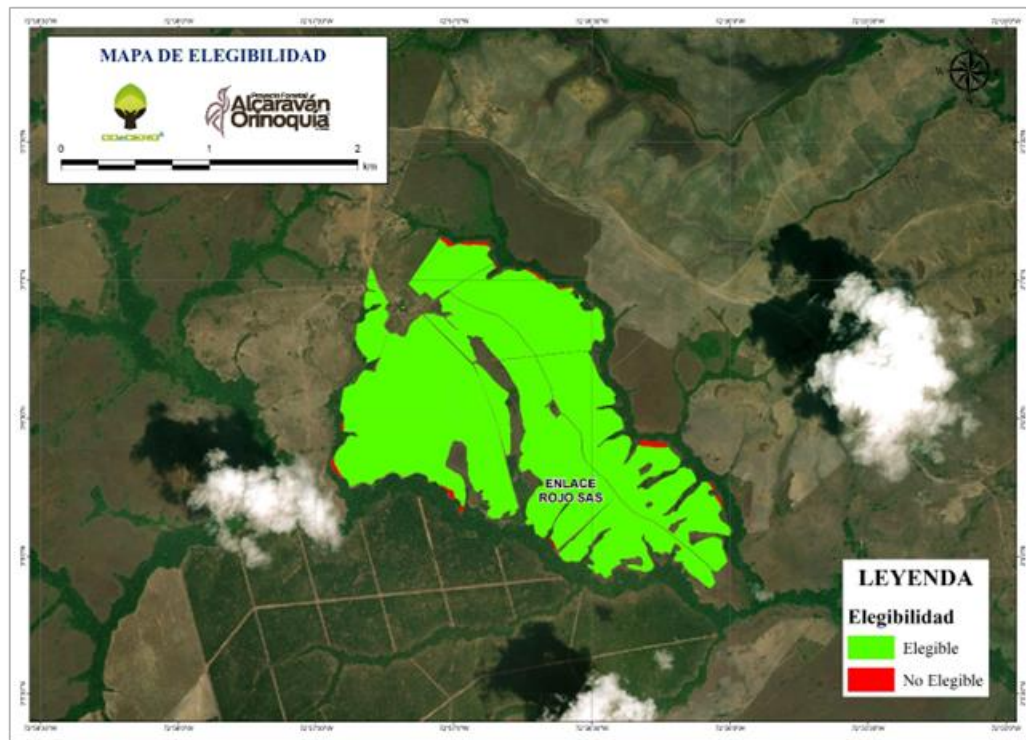


Figure 6. Project Eligibility Map.
Source: (CO2CERO SAS, 2022)

18 Quantification of GHG emission removals

The calculation of GHG emissions and removals was developed under the guidelines of the BCR0001 V 4.0 Methodology, and the suggested tools.

18.1 Quantification of GHG removals in the baseline scenario

Section 5 of the AR-TOOL14 *"Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"*, states that the carbon content of tree biomass in the baseline scenario can be considered negligible or zero. Similarly, in section 15.1 of the BCR0001 V 4.0 methodology, this condition applies under the following circumstances:

1. Trees present before the project are not harvested, cleared, or removed throughout the duration of the project.
2. Trees present before the project implementation do not suffer mortality because of competition from trees planted by the project, nor are damaged because of implementation of the project activity, at any time during the duration of the project.

3. The trees present before the project are not inventoried along with the project trees that are monitored to estimate carbon stocks, but their existence continues, according to the baseline, which is monitored throughout the duration of the project.

Moreover, changes in carbon stocks in the baseline scenario can be considered null if the following conditions are met:

1. Evident decrease in the depth of the surface soil, evidenced, for example, by the exposure of the roots, presence of pedestals and exposure of the horizons of the subsoil.
2. The presence of ravines, laminar or furrow erosion, landslides, or other forms of mass movement.
3. The presence of locally known plant species as indicators of low soil fertility.
4. The soil is composed of bare sand dunes or other bare lands.
5. The terrain is made up of contaminated soil, areas degraded by mining, or highly alkaline or saline soils.
6. The land undergoes periodic cycles (e.g. slash-and-burn or thinning and regeneration cycles), whereby the biomass ranges from a minimum to maximum value at the baseline.
7. Compliance with conditions I, II and II, is necessary to count the stock of tree biomass as zero.

Considering the above, the carbon contents in the biomass present in the baseline scenario are considered null since it meets these conditions, as evidenced in the forest inventory data and satellite observations. The baseline scenario pertains to variations in carbon stocks found in each cover that would be present in the absence of the carbon project. In this particular case, it refers to the carbon stocks of grasslands that existed prior to the project's implementation and in its absence.

18.2 Leaks

As stated in Section 6 of the AR-TOOL15 V 02.0 tool, leakage of GHG emissions occurs when agricultural or livestock activities that were previously conducted within the project area are displaced due to the project implementation.

According to the section 15.3 of the BCR0001 methodology, the leaks attributable to the displacement of agricultural activities are considered insignificant and can be quantified as zero, under the condition of item (b) where animals do not exceed the carrying capacity of the grazing land they are moved to. To verify the guidelines and establish that leaks are zero in the Proyecto Forestal Alcaraván Orinoquía, a comparative analysis was conducted between the number of farms with bovine cattle according to the ICA

National Agricultural Census in the years 2016 and 2023, in order to determine the increase pastures that changed their use to grazing. In Table 54, it can be confirmed that there was an increase in a total of 6,675 farms compared to 2016 with bovine presence.

Table 54. Comparative analysis between the total number of farms with cattle.

Departament	Number of cattle farms 2016	Number of cattle farms 2023
Meta	13,740.00	20,200.00
Vichada	1,539.00	1,754.00
Total general	15,279.00	21,954.00

Source: (ICA, 2023).

To determine that the carrying capacity of the land has not been exceeded, the calculation was performed with respect to the total municipal area and the number of cattle counted by the ICA, for the years 2016 and 2023. Concluding the average value for the municipalities of Puerto Gaitán and Puerto Lleras (0.31 cattle/ha) does not exceed the calculated value for the entire Meta department (0.48 cattle/ha). Similarly, in Cumaribo, the value is 0.01 cattle/ha, which is lower than the departmental average for Vichada. (Refer to *5_Carbon calculation\Leakages\Municipal Carrying Capacity_V1.xlsx*).

18.3 Quantification of removals generated in the Ex-Ante project scenario

The Ex-ante estimation was conducted by gathering secondary information on the average annual growth in height and diameter of the selected species. The growth increments used were taken from the project's inventory by averaging the growth in heights and diameters of the species. Data specifically taken from the department of Meta and Vichada, which are the more relevant to the project, was reported. To prevent overestimation of removals, conservative parameters were employed in the estimation process (See Table 55).

Table 55. Average Annual growth in DHB and H.

Species	AAI DAP (cm)	AAI H (m)	Source
<i>Acacia mangium</i>	1.69	1.72	Project's inventory
<i>Eucalyptus pellita</i>	1.68	1.71	Project's inventory
<i>Pinus caribaea</i>	1.68	1.69	Project's inventory

Source: (CO2CERO SAS, 2022).

The volume estimation was developed using the equations reported in *7_Project Document\BCR_PDD_Alcaravan_V9.pdf*. This was done understanding that the forest

species were planted specifically to provide raw material to the timber harvesting market. The plantations were subjected to silvicultural management practices such as thinning and harvests, which result in reductions in GHG removals. Below, a summary of the management given to each of the plantations that are part of this project is presented.

Table 56. Thinning and harvesting of forest species

Species	Thinning (%)	Year	Harvest shift (years)
<i>Acacia mangium</i>	50	7	15
	30	12	
<i>Eucalyptus pellita</i>	60	6	14
	20	10	
<i>Pinus caribaea</i>	50	7	21
	30	12	

Source: (CO2CERO SAS, 2022).

The carbon estimate is generated according to the quantification method described in section 4.2 of the AR-ACM0003 methodology version 2.0, accounting for the expected removals in the twenty years of the duration of the project. The results are summarized in Table 57. These estimates were made for the area identified as eligible and for the carbon sinks that have been contemplated during the establishment of the project.

Table 57. Ex-Ante GHG removals of the project.

Year	Baseline removals (tCO ₂ e)	Project removals by sinks (tCO ₂ e)			Leaks (tCO ₂ e)	Total net removals (tCO ₂ e)	
		Incremental removals	Accumulated removals	Reserve		Incremental removals	Incremental removals
2018	-	636	636	127	-	509	509
2019	-	2,490	3,126	498	-	1,992	2,501
2020	-	5,161	8,287	1,032	-	4,129	6,630
2021	-	10,044	18,331	2,009	-	8,035	14,665
2022	-	15,611	33,942	3,122	-	12,489	27,154
2023	-	1,180	35,122	236	-	944	28,098
2024	-	18,975	54,097	3,795	-	15,180	43,278
2025	-	27,312	81,409	5,462	-	21,850	65,128
2026	-	32,513	113,922	6,503	-	26,010	91,138
2027	-	0	113,922	0	-	0	91,138
2028	-	33,577	147,499	6,715	-	26,862	118,000
2029	-	44,744	192,243	8,949	-	35,795	153,795
2030	-	54,257	246,500	10,851	-	43,406	197,201
2031	-	42,308	288,808	8,462	-	33,846	231,047

Year	Baseline removals (tCO ₂ e)	Project removals by sinks (tCO ₂ e)			Leaks (tCO ₂ e)	Total net removals (tCO ₂ e)	
		Incremental removals	Accumulated removals	Reserve		Incremental removals	Incremental removals
2032	-	11,926	300,734	2,385	-	9,541	240,588
2033	-	51,905	352,639	10,381	-	41,524	282,112
2034	-	29,748	382,387	5,950	-	23,798	305,910
2035	-	35,089	417,476	7,018	-	28,071	333,981
2036	-	41,431	458,907	8,286	-	33,145	367,126
2037	-	58,098	517,005	11,620	-	46,478	413,604
Total	-	517,005		103,401	-	413,604	

Source: (CO2CERO SAS, 2022).

The net removal of the project in its credit life based on Ex-Ante calculations is 517,005 tCO₂e, with the 20% of reserve (See *5_Carbon calculation\Ex-Ante\ExAnte_AlcaravanOrinoquia_V3.xlsm*).

18.4 Quantification of removals generated in the Ex-Post project scenario.

Based on the monitoring information collected from the inventories in the different identified strata of the project, the project area's GHG emission removals are calculated applying the specified parameters. The number of removals for each area and their respective sink is determined.

The estimation of carbon stocks in the project's trees was calculated based on the established of 139 field plots. The plots were established according to the sampling design section of BCR0001 methodology. The average sampling error calculated for the plots was 9.86% with a 95% confidence level. The plot size was 400 m², except for the participant Punta de Garzas Inversiones Forestales with 420 m² (Refer to *5_Carbon calculation*).

In the document *5_Carbon calculation\Ex-Post\Expost_AlcaravanOrinoquia_V4.xlsx*, is carrying the ex-post calculation of the current net removals for the Proyecto Forestal Alcaraván Orinoquía. It summarizes the verified current net removals in 2022, which involve an eligible area of 1,094.43 hectares. The determination of the carbon credits was based on the inventory's information conducted in the identified strata.

Table 58. Net GHG emission removals to 2022.

Participant	Stratum	Temporality	Baseline removals (tCO ₂ e)	Leaks (tCO ₂ e)	Total Removals (tCO ₂ e)	Total net removals (tCO ₂ e)
CLAUDIA HUERFANO	<i>Pinus caribaea</i> de 2018	Validation - Verification	-	-	518	415
ECOLOGIC S.A.S	<i>Acacia mangium</i> de 2020	Validation - Verification	-	-	6,827	5,462
ECOLOGIC S.A.S	<i>Acacia mangium</i> de 2021	Validation - Verification	-	-	319	255
ECOSISTEMA PRODUCTIVO MATAEMONTE SAS	<i>Acacia mangium</i> de 2021	Validation - Verification	-	-	1,558	1,246
ENLACE ROJO SAS	<i>Eucalyptus pellita</i> de 2018	Validation - Verification	-	-	10,363	8,290
ENLACE ROJO SAS	<i>Eucalyptus pellita</i> de 2019	Validation - Verification	-	-	730	584
ENLACE ROJO SAS	<i>Eucalyptus pellita</i> de 2020	Validation - Verification	-	-	285	228
INVERSIONES GUARDABOSQUES DE COLOMBIA	<i>Pinus caribaea</i> de 2018	Validation - Verification	-	-	2,674	2,140
LUIS FERNANDO RODRÍGUEZ	<i>Eucalyptus pellita</i> de 2018	Validation - Verification	-	-	2,820	2,256
PUNTA DE GARZA INVERSIONES FORESTALES	<i>Eucalyptus pellita</i> de 2018	Validation - Verification	-	-	2,591	2,073
PUNTA DE GARZA INVERSIONES FORESTALES	<i>Pinus caribaea</i> de 2018	Validation - Verification	-	-	2,270	1,816
SULTANA SAS	<i>Acacia mangium</i> de 2021	Validation - Verification	-	-	2,075	1,660
Total			-	-	33,030	26,424

Source: (CO2CERO SAS, 2022)

In order to calculate annual removals for the Proyecto Forestal Alcaraván Orinoquía, the annual contribution generated by the forest plantations calculated for the period 2018-

2022. The Table 59 presents the annual breakdown of removals for the verification period.

Table 59. Annual removals of the project

Remotion year	Total Removals tCO ₂ e	Net Removals tCO ₂ e
2018	4,247	3,398
2019	4,430	3,544
2020	6,800	5,440
2021	8,776	7,021
2022	8,776	7,021
Total	33,030	26,424

Source: (CO2CERO SAS, 2022)

The total removals are temporally in the period from April 11, 2018, to December 2, 2022. In order to this verification period, the annual breakdown of removals was done proportionally to the growth time of the strata in a lineal manner. In other words, the total removals were multiplied by the scalar 12/60 (months) to determine the removals for the years, respective.

18.5 Comparison of actual emission removals with estimates in the project document

The estimates of the Ex Ante scenario established in the project document are similar to the Ex post scenario of the present monitoring period, this difference of less than 3% occurs because the Ex Ante scenario is a projection in accordance with the growth parameters by species for each of the participants, as seen in the following table:

Table 60. Comparison of actual emissions removals with estimates in the project document.

Remotion Project	Ex Ante	Ex post	Difference
Total Removals tCO ₂ e	33.942,00	33.030	2,76%
Net Removals tCO ₂ e	27.154,00	26.424	2,76%

Source: (CO2CERO SAS, 2022)

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

En este caso no se reportan aumentos en las remociones generadas por la implementación de la iniciativa debido a que es el primer período de monitoreo del proyecto Forestal Alcaraván Orinoquía, sometido a un proceso de validación y verificación, lo cual significa que no se presentan cambios en las estimaciones

presentadas en la sección 3.5 *Mitigation results of 7_Project Document\BCR_PDD_Alcaravan_V9.pdf.*

19 Information management

The Proyecto Forestal Alcaraván Orinoquía manages its information according to the guidelines established by the project developer and its corresponding information management and data handling processes. In folder *16_Information management*, the procedures for information management in Forest Carbon Projects are presented.

For each of the products and deliverables generated for this initiative, a quality review process has been carried out, which depends on the sources providing the information. In any case, the information generator filters their records to provide suitable information for the project's requirements. Regarding project participants who acquire municipal administrative information, this information undergoes a quality review by the project developer, who verifies the truthfulness, transparency, and quality of the generated information, which will be integrated into the project document, monitoring report, and supporting documents for its structure.

Finally, the products to be provided to the validation and verification body will be supervised by the project developer and other project associates if required. Their contents are compared against the certification program and methodological rubrics, reducing the level of uncertainty and improving consistency with it.

The processed and generated information for the projection and quantification of GHG emissions removals in both the ExAnte and ExPost scenarios has been managed within a level of uncertainty in accordance with ISO 14064-2, 14064-3, and 14065:2020 standards, equivalent to 95% or higher. Similarly, the materiality threshold involved in the various calculations is set at 5% in accordance with the certification program's determination. This is related to the fact that currently, the Proyecto Forestal Alcaraván Orinoquía has an error rate of less than 10% once evaluated based on the information gathered in the forest inventory.

20 References

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21 References and document history

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9	03/05/2024	Angie Castillo	Version nine (V9): Adjustments to the document due to BCR non-conformities