PROJECT DESIGN DOCUMENT
PDD V3

VERSION 3

CONTENTS

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1. ABBREVIATIONS AND ACRONYMS.

- AFOLU: Agriculture, Forestry and other Land use.
- CAR: Regional Autonomous Corporations
- UNFCCC: United Nations Framework Convention on Climate Change.
- CORPORINOQUIA: Autonomous Corporation of the Orinoquia region
- ECI: Intermediate Characterization Scenario
- GHG: Greenhouse gases
- IDEAM: Institute of Hydrology, Meteorology and Environmental Studies.
- INCODER: Colombian Institute for Rural Development.
- IPCC: Intergovernmental Panel on Climate Change
- MADS: Ministry of the Environment and Sustainable Development
- MRV: Reporting and Verification Methodology
- NTC: Colombian Technical Standard
- PS: Project Description
- REDD+: Reducing emissions from deforestation and forest degradation
- RNSC: Civil Society Nature Reserves
- RUNAP: Registro Único de Areas Protegidas (Single Registry of Protected Areas).
- UPRA: Agricultural and Livestock Rural Planning Unit
- USAID: U.S. Agency for International Development
- USCUSS: Land Use, Land Use Change, and Forestry

2. SUMMARY

CO_2 Bio is a biodiversity conservation strategy that leverages the implementation of economic incentives for carbon sequestration to mitigate the threat of habitat loss associated with forests with different degrees of intervention in private properties in the departments of Casanare, Arauca and Vichada.

This initiative aims to conserve biodiversity in forest areas within a group of private properties in the Orinoquia region of Colombia, through the implementation of various activities that reduce the factors and threats to the ecosystems found in these areas, seeking to increase forest cover, mitigate land use degradation and reduce pressures from habitat loss, to maintain the capacity of forests to provide goods and services and better adapt to possible effects of climate change.

The work area includes private rural properties located in the departments of Casanare, Arauca and Vichada. The predominant landscape is the floodable and non-floodable plains of the lowlands of the Meta River basin, known nationally as the eastern plains. Its forests are distributed along the rivers and other bodies of water in the region and the inhabitants are distributed depending on water resources and connectivity through primary, secondary and tertiary roads, trails and bridle paths.

Based on a pilot area, the change in biodiversity indicators generated by the reduction of threats will be measured. This is due to the increase in forest cover, originated by the landowner's commitment to carry out activities such as: reduction of deforestation and forest degradation, conservation and sustainable forest management, increase in forest cover, establishment of agroforestry and silvopastoral systems, and the implementation of landscape management tools such as biological and conservation corridors, live fences and assisted ecological restoration processes.

All of the above will be validated and verified through standards and protocols that will allow the commitments to be certified through audits. Carrying out this process, the option will be sought to market certificates for carbon dioxide capture tons (CO_2) as a strategy to generate financial capabilities and empowerment in forest owners, taking as a normative basis Law 164 of 1994 that approves the United Nations Framework Convention on Climate Change, the implementation of the carbon tax by law 1819 of 2016, decree 926 of 2017 for the non-causation of the carbon tax, law 1844 of 2017 ratifying the Paris Agreement, the regulation of payments for environmental services decree 1007 of 2018, law 1931 of 2018 establishing mechanisms for the management of climate change and resolution 1447 of 2018.

The total value of the project's emissions reduction over the 40-year crediting period is 2,197,252 (t CO2) and taking into account the 15% discount is 1,867,664 (t CO2).

Finally, the value of the emissions reduction of the project in the 5-year monitoring period is 258,970 (t CO2) and taking into account the 15% discount is 220,125 (t CO2).

3. PROJECT NAME

Grouped project for the reduction of emissions from deforestation and degradation (REDD+) as a strategy for biodiversity conservation to mitigate the threat to habitat associated with forests on private land in the Orinoquia of Colombia, called CO_2 Bio.

4. PROJECT PROPONENTS

The responsible entity is Fundación Cataruben in alliance with the Natural Wealth program of the United States Agency for International Development (USAID).

4.1. CATARUBEN FOUNDATION

The Cataruben Foundation seeks to promote research, scientific, social, economic, cultural, and technological development of the Orinoquia and the nation. Through the knowledge, monitoring and evaluation of the ecosystems and the socioeconomic system of the region.

In addition, it seeks to manage and articulate projects that promote the preservation of biological, social and cultural diversity. As well as research projects with results that generate guidelines and strategies for the sustainable use, conservation and restoration of social and economic biodiversity.

It is a non-profit, non-governmental organization (NGO), which in this case generates innovation processes as a strategy to achieve sustainable development models. One of them is to achieve that local communities obtain economic benefits through the commercialization of environmental services.

The Cataruben Foundation is legally constituted and in this case is the project proponent (Annex A1 Legal documents of the Cataruben Foundation).

Table 1. Data Cataruben Foundation

ORGANIZATION	CATARUBEN FOUNDATION
TIN	900634522 - 9
LEGAL REPRESENTATIVE	MARIA FERNANDA WILCHES FONSECA
RESPONSIBLE	SANDRA YURIBEL DUARTE
CONTACT	YOPAL - CASANARE CRA 20 #36 04 TEL_3204435972
E-mail	operativa@cataruben.org

Source: Cataruben Foundation

4.2. UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT (USAID) WITH NATURAL WEALTH PROGRAM

The United States Agency for International Development (USAID) was established in 1961 to provide foreign aid and promote social and economic development in developing countries. It fosters public-private partnerships as a key feature of its programs.

As part of its Global Environment and Climate Change strategy, USAID helps communities better manage and benefit from their natural resources, protects biodiversity and functional ecosystems, supports land tenure policies so that people have the right to own and manage natural resources responsibly. It also combats deforestation through increased agricultural productivity and economic growth and improved forest management, and helps mitigate and adapt to the effects of climate change.

In Colombia, USAID has a strong environmental and sustainable development program, which includes biodiversity protection, climate change mitigation and adaptation, and renewable energy. BIOREDD+ is a flagship initiative of the USAID-Colombia Program.

"Riqueza Natural" is a five-year program funded by USAID that seeks to support the Government of Colombia in meeting the goals of conservation and sustainable integrated rural development to achieve a stable and lasting peace. Its efforts are focused on the protection and sustainable management of ecosystems in order to implement activities aimed at addressing the three components of the Program: a) effective protection of priority ecosystems and species, b) development of financial incentives for conservation, and c) land use planning and management to reduce threats to biodiversity.

This will be done through alliances that enroll producer associations, community organizations, non-governmental organizations, private companies, universities with regional presence and applied research institutes. In order to promote biodiversity conservation, income generation and the improvement of the living conditions of the population through conservation, agricultural and livestock activities, the transformation, commercialization and/or provision of services.

In 2019, a cooperation agreement was signed with the Cataruben Foundation (See Annex A2 Legal documents of the agreement signed by USAID).

Table 2. Data from the United States Agency for International Development (USAID).

ORGANIZATION	USAID (Chemonics International)
TIN	900480566-1
LEGAL REPRESENTATIVE	Ricardo Sanchez.
RESPONSIBLE	Harold Arango
CONTACT	Natural Wealth Program
	Address: Calle 76 No. 11 - 17
	Torre los Nogales Building, Bogotá
	Telephone: 3144020058

E-mail	harango@riquezanatural.org

Source: Cataruben Foundation

4.3. OWNERS OF THE PROPERTIES

Group of people formed by the owners of the private properties located in the Colombian Orinoquia that are part of the project and who voluntarily decided to join efforts in order to implement REDD activities in each of their properties to ensure the conservation of carbon stocks and the permanence of biodiversity, These landowners will be called beneficiaries and will be the main executors of the conservation commitments and project activities in the future, in addition, they will receive payment for the sale of carbon certificates by the Cataruben Foundation. (See A3 Landowner's Letters of Intent)

5. ENVIRONMENTAL AUTHORITY WITH JURISDICTION IN THE PROJECT INTERVENTION AREA.

The Autonomous Corporation of the Orinoquia region exercises functions established in Article 31 of Law 99, which can be grouped as follows:

All the Regional Autonomous Corporations shall have the purpose of executing the policies, plans, programs and projects on the environment and renewable natural resources, as well as to comply with and timely apply the legal provisions in force on their disposition, administration, management and use, in accordance with the regulations, guidelines and directives issued by the Ministry of the Environment.

It has the function of Maximum Environmental Authority and is in charge of granting licenses, permits, concessions, authorizations and safeguards required by law, for the use and exploitation or mobilization of renewable natural resources. It enacts norms for the management of watersheds, territorial planning for the use, protection, preservation and recovery of the environment.(Corporinoquia, 2016).

The development of the C02Bio project is articulated with the regional environmental management plan 2013 - 2025, which is the most important planning instrument at departmental and municipal level in environmental matters, seeking to conserve the ecosystems defined as strategic in the Jurisdiction of Corporinoquia regarding gallery forests or Riparian and scrublands.

Likewise, the project is linked to the challenges posed by climate change and that one of the global ambitions in terms of climate change is to limit the average increase in global temperature below 2 °C, between Corporinoquia, Cormacarena, and the International Center for Tropical Agriculture CIAT, the Regional Comprehensive Plan for Climate Change for the Orinoquia "Orinoquia, together against climate change" project is advanced, in strategic alliance with Ecopetrol S.A, whose main objective is to join efforts to formulate the "Climate Change Adaptation and Mitigation Plan for the departments of Meta, Casanare, Vichada, and Arauca." Among other aspects, this project includes gathering information to generate the Greenhouse Gas

Inventory and a vulnerability analysis for each of the departments. A document will serve as a guide to address climate variations from six baselines: Biodiversity and ecosystem services, water resources, the human dimension, hydrocarbons and mining, agriculture and livestock, and agribusiness.

Moreover, through this strategy, corporations and other institutions in charge of environmental issues, such as Municipal and Departmental Territorial Entities, productive sectors, communities and other strategic stakeholders of the territory, will be able to identify and develop actions for mitigation and adaptation, using education as the main tool.

CORPORINOQUIA's jurisdiction is made up of an extensive area comprised of 5 departments and 45 municipalities. (Corporinoquia, 2016)

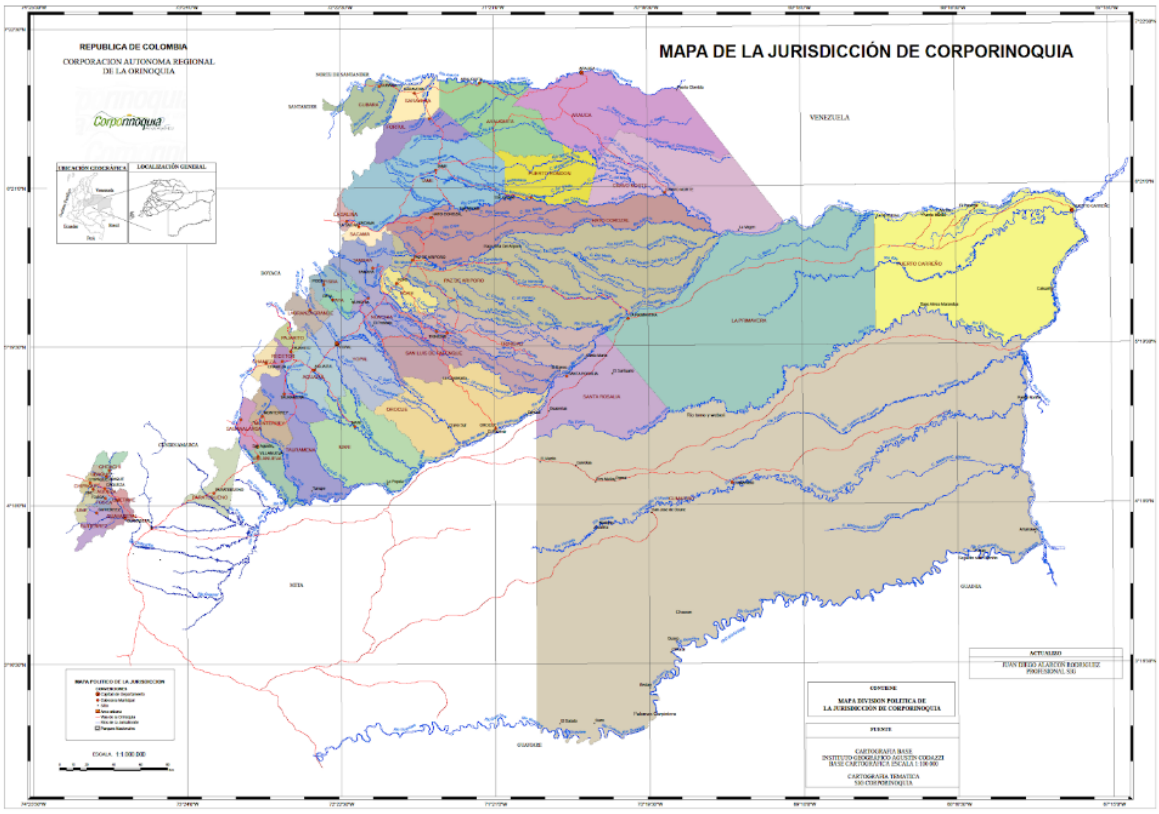


Figure 1. Map of the political division of Corporinoquia's jurisdiction.
Retrieved from Corporación Autónoma Regional de la Orinoquia (2016).

6. PROJECT LOCATION

The work area comprises 42,406 hectares distributed in 44 private rural properties, located in the departments of Casanare, Arauca, and Vichada, more specifically in 14 villages in 10 municipalities of these departments (See Table 3). The predominant landscape in this area is the floodable and non-floodable plains of the lowlands of the Meta River basin and the eastern

mountain range, known nationally as the eastern plains. In the following chapter, specifically in the reference region, the map of the project limits can be seen.

Table 3. Specific location of the properties that are part of the CO_2 Bio project, including department, municipality, locality, name of the property and geographic coordinates.

DEPARTMENT	MUNICIPALITY	VEREDA	PROPERTY	COORDINATES
Casanare	Tamara	Quebrada Honda	Versalles	5°43'44.8" N 72°05'6.19" W
	Nunchía	Paraje Tacare	Tabloncito	5°36'59.07" N 72°11'59.69" W
	Yopal	Tilodiran	Palmarito	5° 8'21.79 "N 72°10'37.69 "W
			Aquí Me Quedo	5° 7'30.66 "N 72°10'58.26 "W
			Coco 2	5°07'53.74" N 72°11'06.12" W
	Orocue	Palmarito	Buena Vista 1	5°50'13.18" N 72°04'45.29" W
			Buena Vista 2	04° 53' 43.1" N 71° 17' 16.4" W
			Charanga 1	4°55'0.02 "N 71°13'20.76 "W
			Charanga 2	4°52'13.17" N 71°15'12.16" W
			Caimán 1	5°50'13.18" N 72°04'45.29" W
			Caimán 2	4°52'7.25" N 71°14'24.37" W
			Sarrapios	4°55'4.75 "N 71°15'25.79 "w
	Hato Corozal	Las Monas	Villa Aurora	06°02'18.3" N 71°46'29.6" W
	Paz De Ariporo	Caño Chiquito	Las Islas RN Aves de Jah	05°43'44.8" N 71°24'24.97 "W
		Elvecia	Macarena	5°49'40.35" N 71°40'15.81" W
	San Luis de Palenque	Pirichigua	Mata de Palma	05° 17' 12.9" N 071° 46' 13.6 W
			Altamira	05° 14' 29.8 "N 071° 47' 55.6 "W
			El Boral	5° 18' 4.68" N 71° 46' 41.699 "W
			Montana	05° 12' 33.8" N 71° 44' 33.7" W
			Buena Vista	5°15'49.15 "N 71°39'55.36" W
	Trinidad	Altagracia Porvenir De Guachiria	El Campin	5°27'2.91 "N 70°37'56.69" W
			San Cristóbal	05° 19' 55.21" N 70° 48' 54.15" W
			San Andrés	05° 18' 1.46" N 70° 50' 26.15" W
			Sonrisa	05° 22' 15.96" N 70° 51' 34.85" W

			El Limonal	05° 22' 28.64" N 70° 52' 5.79" W
			Palmera	05° 20' 6.7" N 70° 48 49.64" W
			El Clavo (Médano los Morrucos)	5°21'28.53" N 71° 0'51.34 "W
			Regadera	5°18'5.33" N 70°51'9.40" W
		San Maria del Loro	Padrote 1	05° 12' 10.49" N 70° 49' 40.16" W
			Padrote 2	5°11'44.45 "N 70°50'3.15 "W
			Padrote 3	5°13'3.50" N 70°50'24.25" W
			Maricelas	05°14' 59.453" N 70° 47' 52.987" W
			Miravalle	05° 16' 10.05" N 70° 44' 1.24" W
			La Mapora	05° 10' 2.693" N 70° 53' 28.36" W
			Progreso	05° 11' 15.2" N 070° 53' 46.9" W
			Flor Amarillo	05° 13' 19.01" N 70° 51' 59.7 "W
			Arizona	05° 13' 29.6" N 70° 50' 13.9" W
Arauca	Cravo Norte	Cinaruco	El Valle	6°27'45.68 "N 69°45'3.17 "W
			La Calzada	6°26'18.57" N 69°50'39.54" W
			La Guajira	6°27'26.07 "N 69°47'47.80 "W
			Los Toros	6°30'36.41 "N 69°48'52.70 "W
Vichada	Santa Rosalia	Nazareth	Trikuti	4°50'36.70 "N 70°15'52.47 "W
		Flor Amarillo	Shambala	4°49'22.86 "N 70°16'10.78" W
		Nazareth	EL Dera	4°51'22.11 "N 70°34'14.51 "W

Source: Cataruben Foundation

6.1. CHARACTERISTICS OF THE DEPARTMENT OF CASANARE

The department of Casanare occupies about 4% of the national territory with 44,640 Km² and is located in the northwest of the Colombian Orinoco region. It contains approximately 3,300 Km² of the eastern mountain range and represents 12.83% of the Orinoco River basin in Colombia, is made up of 19 municipalities, is one of the 32 departments of Colombia. It is bordered on the north by the Department of Arauca, separated by the Casanare River, on the south and east the Meta River separates it from the Department of the same name and the Department of Vichada respectively; on the west by the departments of Boyacá and Cundinamarca (Universidad Nacional de Colombia, 2018).

6.1.1. Geomorphology

The department of Casanare occupies about 4% of the national territory with 44,640 km² and is located in the northwest of the Colombian Orinoco region. It contains approximately 3,300 km² of the eastern mountain range and represents 12.83% of the Orinoco River basin in Colombia. According to the regional geological evolution, the physical configuration and evolution of Colombia's eastern mountain range, three landscape units are defined in the department: mountain, foothills and savannah (Universidad Nacional de Colombia, 2013).

The plains foothills constitute the transition zone between the Eastern Cordillera and the plains, with altitudes ranging between 300 and 1000 m (984 and 3000 ft). It covers about 23% of Casanare and is home to 60% of Casanare's population. Likewise, the plains of Casanare correspond to a wide area of flooded savannas with flat relief; the most important landscapes in the region correspond to recent alluvium, overflow alluvial plain and alluvial plain with eolian influence, the latter resulting from several sedimentation processes during the Tertiary and Quaternary (Matallana, 2016).

On the other hand, the results of a participatory mapping conducted by the Ministry of Agriculture indicate that about 62% of the municipality has forests and semi-natural areas, with a predominant ground cover of herbaceous vegetation corresponding to natural savannas (45.54%). Some 29.44% is covered by clean pastures and only 3.99% of the area is used for agricultural activity with transitory crops (Ministry of Agriculture and Rural Development, 2013).

6.1.2. Soils

Two soil typologies are identified in Casanare: Entisols and Inceptisols. Entisols are characterized by being soils with a very low to low degree of evolution, which is why their morphology reflects little to very little differentiation of horizons (IGAC, 1993). The presence of this type of soil is related to excess water and erosive processes that slow pedogenetic development. Likewise, Inceptisols are characterized by being present in forested areas, and also in steep slopes where soil erosion, continuously eliminates the superficial part of the terrain or also (Fernandez, Castellanos, Cardona, Pinzón, & Vargas, 2011).

In addition to the above, the soils of Casanare, as in most of the eastern plains, have good physical characteristics, but their fertility level is low, they are acidic, with high aluminum and iron content, and low levels of phosphorus, nitrogen and calcium. In general, the soils of the Orinoquia are fragile ecosystems and, with some exceptions, are suitable for traditional economic activities; most of them have a forestry vocation and their true wealth is their biodiversity (Fernandez et al., 2011).

6.1.3. Climatic aspects

The Casanare region has very different temperature peaks in some parts of the territory. While approximately 75% of the department has average annual temperatures of >24ºC with a "warm" designation, municipalities such as Salina, Sácama, Támara, Recetor and Chámeza have a predominance of temperatures between 18-24ºC with a "temperate" designation, and in the

highest parts of these municipalities there are "cold" temperatures with temperatures of 12-18ºC and "very cold" with 6-18ºC (IDEAM, 2011).

Rainfall in the department of Casanare is monomodal, with a rainy period from April to October and a dry or summer period from November to March. The amount and intensity of rainfall increases from northeast to southwest, so that the rainiest area is located in the municipalities of Chámeza, Recetor, and the upper part of Aguazul and Yopal, whose values range between 3,500 and 4,500 mm per year, the least rainy areas are located in the municipalities of Chámeza, Recetor, and the upper part of Aguazul and Yopal, whose values range between 3,500 and 4,500 mm per year.

The less rainy areas are in the upper part of the municipalities of Sácama and La Salina, as well as in the municipalities of Sabana such as San Luis de Palenque, Trinidad, Paz de Ariporo and Hato Corozal, whose rainfall ranges between 2,000 and 2,500 mm per year (IDEAM, 2011). Table 4 shows the climatic characteristics of the municipalities that are part of the project's reference area.

Table 4. Climatic characteristics (temperature, average precipitation and life zones according to the Holdridge classification) of the municipalities of Casanare that are part of the CO_2 Bio project.

MUNICIPALITY	AVERAGE ANNUAL TEMPERATURE (°C)	AVERAGE ANNUAL PRECIPITATION (mm)	LIFE ZONE (HOLDRIDGE)
Tamara	18 - 24	2000 - 4000	Tropical rain forest
Nunchia	>24	2000 - 3000	Tropical rain forest
Yopal	>24	3000 - 4000	Tropical rain forest
Orocue	>24	2000 - 2500	Tropical rain forest
Hato Corozal	>24	3000 - 4000	Tropical rain forest
Paz De Ariporo	>24	2000 - 3000	Tropical rain forest
San Luis de Palenque	>24	2000 - 3000	Tropical rain forest
Trinidad	>24	2000 3000	Tropical rain forest

Source: (IDEAM, 2010)

6.1.4. Vegetation

The Casanare region is characterized by the dominance of tropical savannas, open formations, without a uniform tree canopy, where a herbaceous matrix extends or as an interrupted sea of grasses and herbs. To a lesser extent, there are forests associated with areas where water seasonality is lower, such as river banks and meadows (Fernandez, et al, 2011).

Table 5. Vegetation cover of Casanare, taking into account the percentage of each type of cover.

TYPE OF COVERAGE	CASANARE	%
ANDEAN FOREST	43.636	1,02
BASAL FOREST	129.443	3,04

GALLERY FOREST	399.239	9,36
FOREST-SUB-ANDEAN	100.026	2,35
PARAMO	6.100	0,14
FLOODED SAVANNAS	2.662.724	62,45
STTUBLES	534.652	12,54
WASTELANDS	67.382	1,58
CROPS	320.796	7,52
TOTAL	**4.263.998**	**100**

Source: (CORPORINOQUIA, 2016).

Table 5 shows the distribution of vegetation cover for the Casanare region, where floodable savannas stand out with 62.45% of the territory, followed by stubble and gallery forests.

Sarmiento classifies the tropical savannas of the region in relation to the annual water seasonality, differentiating three types: seasonal savannas (dry savannas), hyper-seasonal (floodable savannas) and semi-seasonal (marshes). On the other hand, gallery or riparian forests give a particular characteristic to the savannas, since they offer conditions for the development of arboreal vegetation, due to the presence of phreatic water throughout the year (Fernandez, Peñuela, & Castro, 2015).

6.1.5. Hydrography

The hydrographic wealth is one of the main potentialities of the Department of Casanare. Abundant rivers, streams, lagoons and wetlands (estuaries) form an intricate water network that provides the "llaneros" (People from the Eastern plains of Colombia) with excellent biodiversity of flora and fauna and serves as a means of communication and transportation during the rainy season to the populations that live there (IGAC, 2002).

Table 6. Hydrography of Casanare

BASIN	BASIN DESCRIPTION	SUBCUENCY	DESCRIPTION SUB-BASIN
Casanare River	It has its source in the department of Boyacá, is navigable in the savannah sector and is used as a means of communication for the population of the Municipality of Hato Corozal. The vegas have been developing rice crops in the piedmont sector. This account occupies a total area of 794,417 hectares; it receives water from the sub-basins of the Casanare River and Ariporo River drainage area (formed by the Ariporo, Chire and Muese Rivers).	Ariporo River	It originates in the limits of Sácama and Támara, and is used as a means of communication during the rainy season by the population of Hato Corozal and Paz de Ariporo located to the east and in the savannah area.
The Meta River	It is the main hydrographic axis and all the waters that drain from the Casanare territory converge on its left bank, through important fluvial arteries such as the Casanare, Ariporo, Guachiría, Guanapalo, Pauto, Tocaría, Cravo Sur, Cusiana, Túa and Upía rivers.	Chire River	It rises in the Zamaricote hill and its flow is drastically reduced during the summer season.
		Muese River	It rises in the Zamaricote hill and its waters flow through the foothills of the municipality of Paz de Ariporo, its flow decreases considerably in summer.

Guachiría River	It rises in the Zamaricote hill and bathes the municipalities of Paz de Ariporo, Pore and Trinidad and its flow has a high level of decrease during the summer season. This account occupies a total area of 350,507 hectares.	-	-
Pauto River	It originates in the department of Boyacá and 87% is located in Casanare, in its middle part it has several canals, whose water is mainly used for irrigation of rice crops, generating contamination downstream and loss of flow. It has a formulated POMCA. It is navigable from San Luis de Palenque. This account occupies a total area of 285,730 hectares.	-	-
South Cravo River	It originates in the department of Boyacá, the largest area of the basin is located in the municipalities of Yopal and Orocué. In the middle part of the basin there are canals for irrigation of rice crops and other agricultural and tourist activities, generating loss of flow and pollution downstream. It has formulated POMCA. It is navigable from the town of Algarrobo to the mouth of the Meta River. This account occupies a total area of 285,730 hectares, receives water from the sub-basins Cravo Sur River drainage area and Tocaría River.	Tocaría River	It rises in the department of Boyacá, and its main course is in the municipalities of Nunchía and San Luis de Palenque; in its middle part there are irrigation canals for rice crops and other agricultural activities, generating loss of flow and contamination downstream.
Cusiana River	Its source is in Boyacá; 60% of its course is in the municipalities of Recetor, Chámeza, Tauramena, Maní and Aguazul. It is navigable from Maní and has canals for irrigation of rice crops and other agricultural and livestock activities, with a loss of flow downstream. The Cusiana oil and gas fields are located in the middle part of the river. This account occupies a total area of 471,427 hectares; it receives water from the sub-basins Cusiana River drainage area, Charte River, Unete River and Chitamena River.	Charte River	It rises in the department of Boyacá, in its middle part there are canals and areas dedicated to intensive commercial crops, with a loss of flow downstream and contamination. Also, in its middle part are the Volcaneras oil and gas fields.
		Unete River	It rises in the department of Boyacá, in its middle part there are canals and areas mainly dedicated to commercial rice crops. In its middle part are the Cupiagua deposits.
		Chitamena River	It rises in the municipalities of Chámeza and Recetor and in its middle part there are canals for rice cultivation and in the summer season there are stretches that disappear. It also has oil deposits in exploitation in its middle part.
Túa River	It is born in the municipality of Chámeza and its waters bathe the municipalities of Villanueva and Monterrey, its waters are used for rice crops. This account occupies a total area of 155,186 hectares.	-	-
Upia River	It rises in Boyacá, in its middle part there are irrigation canals for commercial rice and African palm crops. This account occupies a total area of 69,899 hectares.	-	-

Retrieved from: Casanare Positive Hemp (2020)

6.2. CHARACTERISTICS OF THE DEPARTMENT OF ARAUCA

The department of Arauca is located in the eastern region of Colombia, in the northern part of the Colombian Orinoco region, made up of seven municipalities with an area of 23,818 km2, corresponding to 2.1% of the national territory. It is bordered to the north and east by the Bolivarian Republic of Venezuela, to the south by the departments of Casanare and Vichada (separated from these by the Casanare and Meta rivers), and to the east by the department of Boyacá (Gobernación de Arauca, 2011).

6.2.1. Geomorphology

Arauca's relief is made up of three morphological groups: the eastern mountain range, the piedmont and the alluvial plain. The first represents approximately one-fifth of the departmental surface and includes elevations ranging from 500 m above sea level at the limits of the piedmont to 5,380 m above sea level in the Sierra Nevada del Cocuy. The piedmont area, covered by savanna vegetation and equatorial forest, is made up of cones, alluvial fans and terraces with flat and sloping relief. Finally, the alluvial plain, from the piedmont to the limits with Venezuela, is characterized by terraces and overflow alluvial plains, covered by floodable savanna vegetation and gallery forests in the riverbanks and canals (Gobernación de Arauca, 2020).

6.2.2. Soils

In Cravo Norte, flood plains or overflow plains predominate, where the soils are characterized by acidic to very acidic soils with very low fertility. Consequently, land use is limited to pasture for extensive cattle ranching under a latifundia tenure regime. The soils of the river valleys or river banks (V), perhaps because of their greater permeability and better drainage, develop high altitude vegetation and are better suited for agricultural use. The local landscape also includes marshes and wetlands (Ministerio de Minas y Energía, 2010).

6.2.3. Climatic aspects

According to Botero (1997), the Arauca's low floodplains are dominated by a warm, semi-humid climate. The area has a warm thermal floor, which includes average annual temperatures above 24°C (see Table 4); specifically Cravo Norte has an average annual temperature of 27°C, and is influenced by trade winds from subtropical high pressure zones (MinTrabajo, PUND, 2013).

Cravo Norte has a relative humidity of 77%, and the life zone for the municipality of Cravo Norte is Tropical Rainforest (BHT). The lands in this life zone represent for the country one of the most important agricultural regions, both for livestock and for crops and fruit trees, but especially have a high potential for planting high quality timber trees (MinTrabajo, PUND, 2013).

In terms of precipitation, Cravo Norte has a monomodal rainfall regime, with about 2,400 mm per year. The rainy season generally begins in April and lasts until mid-October or November, with the highest rainfall volumes occurring in May and August (Ministry of Agriculture and Rural Development, 2013).

Table 7. Climatic characteristics of Cravo Norte, the municipality of Arauca that is part of the CO_2 Bio project.

MUNICIPALITY	AVERAGE ANNUAL TEMPERATURE (ºC)	ANNUAL PRECIPITATION (mm)	LIFE ZONES (HOLDRIDGE)
Cravo Norte	>24	2500 - 3000	Tropical rain forest

Source: (MinTrabajo, PUND, 2013).

6.2.4. Vegetation

The municipality has three dominant vegetation types: gallery forests, riparian forests and scrub in the savanna region. There are timber species such as conger eel, yellow flower, oil, zaque zaque, carob, and white cane. Natural grasses include guaratara, carretera, lamedora and paja de agua (MinTrabajo, PUND, 2013).

Table 8. Vegetation cover of Arauca, taking into account the percentage of each type of cover.

TYPE OF COVERAGE	ARAUCA	%
ANDEAN FOREST	66.033	2,87
BASAL FOREST	251.593	10,94
GALLERY FOREST	99.744	4,34
SUB-ANDEAN FOREST	78.398	3,41
PARAMO	46.289	2,01
FLOODED SAVANNAS	1.257.396	54,65
STUBBLES	294.092	12,78
WASTELANDS	24.985	1,09
CROPS	182.163	7,92
TOTAL	**2.300.693**	**100**

Source: (CORPORINOQUIA, 2016).

Table 8 shows the type of vegetation in the department of Arauca. The most abundant vegetation in the municipality is found within the dikes along the rivers as gallery forests, while in the lowlands, the natural vegetation has been cut down to develop pastures for extensive cattle ranching. The lands in this area represent one of the most important agricultural regions for the country, both for cattle ranching and for crops and fruit trees, but especially have a high potential for planting high quality timber trees (Ministerio de Minas y Energía, 2010).

6.2.5. Hydrography

Arauca with great water resources. The entire fluvial system drains west to east towards the Orinoco through the Arauca, Casanare, Tocoragua, Tame, Cravo Norte, Ele, Lipa, San Miguel and the Negro - Cinaruco rivers, as well as numerous streams, canals and lagoons (IGAC, 2002).

Table 9. *Watersheds and Sub-watersheds in the Department of Arauca*

BASIN AND/OR SUB-BASIN	DESCRIPTION

Arauca River	With a length of 238 km, it originates in Colombian territory, in the limits of the departments of Santander and Norte de Santander (Eastern Cordillera), and runs for 338 km. It then enters Venezuelan territory to flow into the left bank of the Orinoco, reaching an approximate length of 800 km, of which 400 km are navigable.
Casanare River	With a length of 240 km, it is tributary to the Lipa River, which is reached by the Cumalí, Ele, Cravo Norte, Tame, Lope and Negro, the Colorada and El Playón streams, and the San Rafael stream; also before the Casanare flows into the Meta, it receives the waters of the Ariporo River, which in turn receives the waters of the Chire, Aricaporo, and Meuse rivers. Further south, the Casanare receives the waters of the Caño aguas claras, which constitute the natural boundary between the Departments of Arauca and Casanare. It has a length of 600 km.
Cinaruco River	With a length of 68 km, they originate from the overflow waters of the Arauca River that form the Lipa estuary; the Agua Limon and Rosario streams deposit their waters in the Porvenir and Guahita savannas, and then become the Cinaruco and Capanaparo rivers, respectively. The Capanaparo river has the Cabuyare stream (the same as the Negro stream) as a tributary; the Cinaruco river has the Maporillal Lagoon, the Juriepe river, and the Cinaruquito and Araguato streams.

Retrieved from: IGAC, 2002

6.3. CHARACTERISTICS OF THE DEPARTMENT OF VICHADA

The Department of Vichada is located in the extreme east of the country and of the Colombian Orinoco region. It has an area of 100,242 km2 and is bordered on the north by the Meta River, which separates it from the departments of Casanare, Arauca and the Republic of Venezuela.

To the east, the Orinoco River separates it from the Republic of Venezuela, to the south, the Guaviare River separates it from the departments of Guainía and Guaviare and to the west, the departments of Meta and Casanare. The extensive plains of the Eastern Plains occupy a large part of the department's territory, with some terraces such as the Vichada, Mono and Motavení hills (Gobernación de Vichada, 2020).

6.3.1. Geomorphology

The department of Vichada is located in the Orinoquia region of Colombia, occupying about 45% of the region's surface area. A large part of this department is located within the high plains of the Orinoquia sub-region. There are four types of physiography: alluvial plain (poorly drained), high plain (well-drained), alluvial strip and Guiana shield (Gestión del Riesgo de Desastres, 2012).

The alluvial plain is formed by low shallows located to the north between the municipalities of Puerto Carreño and La Primavera. The highlands occupy the largest area of the department and are located between the Meta and Vichada rivers. The alluvial strip extends parallel to the Meta, Tomo, Bita, Tuparro and Orinoco rivers. Finally, the Guiana Shield is located in isolated sectors in the eastern part of the department (Gestión del Riesgo de Desastres, 2012).

6.3.2. Soils

They correspond to a set of high plains , glacis and terraces with different degrees of dissection in Tertiary and Quaternary sediments. In addition, near the Craton there are outcrops of Precambrian igneous rocks in island mountains and associated pediplanos. Open savannas with scrublands, morichales and gallery forests also predominate (Colombian Geological Service, 2014).

6.3.3. Climatic aspects

In Vichada, its wedging between the Guiana shield and the eastern cordillera, and the mixing with SE air masses at the intertropical confluence near 2°N and 1°S, is the reason why the advective regime of rainfall formation, directed by NE winds, predominates (Colombian Geological Service, 2014).

Table 10. Climatic characteristics (temperature, average precipitation and life zones according to the Holdridge classification) of the Santa Rosalía that is part of the reference area of the CO_2 Bio project.

MUNICIPALITY	TEMPERATURE (°C)	ANNUAL PRECIPITATION (mm)	LIFE ZONES (HOLDRIDGE)
Santa Rosalia	>24	2000 - 3000	Tropical rain forest

Source: (Colombian Geological Service, 2014).

It is important to mention other parameters such as relative humidity with an annual average of 79.4%, with a minimum average of 63% during February and a maximum of 88% in June. In the case of solar brightness and cloudiness, they are highest during the dry period and lowest in winter (Colombian Geological Service, 2014). Table 7 shows the climatic characteristics of the municipality of Cravo Norte, which belongs to the project's reference area,

6.3.4. Vegetation

The vegetation of the region is fundamentally the result of the interactions of relief, soil, climate, hydrology and human presence. In the department of Vichada it is possible to identify different types of vegetation associated with the coverages of savanna, gallery forest, transition forest, planted forests in addition to the flora associated with wetlands and bodies of water, and the distribution can be seen in Table 8 (CORPORINOQUIA, 2016).

Table 11. Vegetation cover of Vichada, taking into account the percentage of each type of cover.

TYPE OF COVERAGE	VICHADA	%
GALLERY FOREST	814.648	8,48
AMAZON FOREST	3.434.935	35,76
FLOODED SAVANNAS	3.935.092	40,97
STUBBLES	283.819	2,95
WASTELANDS	140.495	1,46
CROPS	995.830	10,37
TOTAL	**9.604.819**	**100**

Source: (CORPORINOQUIA, 2016).

6.3.5. Hydrography

The hydrographic network of the department of Vichada is made up of large rivers, streams, canals and some lagoons that drain into the Orinoco through the Meta, Vichada, Guaviare and Tomo rivers. In addition to the aforementioned streams, there are the Bita, Tuparro, Uvá, Elbita, Muco, Iteviare and Siare rivers, and the Tuparrito, Bravo and Mono canals. The most important lagoons are Sesama and Caimán (IGAC, 2002).

Table 12. Watersheds and Sub-watersheds in the Department of Vichada.

BASIN AND/OR SUB-BASIN	DESCRIPTION
Orinoco River	It has a length of 2,900 km, of which approximately 420 km serve as the border between Colombia and Venezuela, and 250 km correspond to the department of Vichada between the mouth of the Guaviare River and the Meta River. Its navigability is interrupted by the presence of the Atures and Maipures streams.
Meta River	The Meta River originates in the Páramo of Sumapaz, has an approximate length of 1,142 km and serves as the border between Colombia and Venezuela. It is also the most active river route in Vichada and carries a large amount of cargo and passengers.
Guaviare River	It divides the eastern part of Colombia in two: the Orinoco region and the Amazon region. Its basin covers 125,000 km2 and its average water contribution is estimated at 4,200 m3 /sec. It has a length of 1,700 km, the flow of the river offers navigation facilities, but this is difficult in the Vichada by the Mapiripán streams, fishing in this river is abundant and bathes regions with timber resources, cocoa and rubber.
Bita River	Important fluvial network that has its origin in several streams that originate in the highlands to the west of the municipality of Puerto Carreño. In its journey from west to east, more than 200 km are navigable in winter, mostly by small boats. As tributaries, it has numerous streams among them: El Bravo, Pendare, Cabrillas, Avión and Tres Matas.
Vichada River	The Vichada is, par excellence, the Guahibo River of the country. It is formed with the drains and springs that spring up in the morichales of San Martin. It receives the contributions of the Guarrojo and the Muco, and descends to the Orinoco River, near the large streams of Atures and Maipures.
Tomo River	It is navigable by boats of up to 10 tons from La Palmita to Caño Guaripa and from this point to its mouth in the Orinoco River, by boats of up to 150 tons, over a distance of 280 km. Among other rivers are the Urimica, Guaira pali, El Boral and El Negro: Caño Urimica, Guaira pali, El Boral and El Negro.
Dagua River	Navigable only by small boats, this river is of great beauty and a reserve of ornamental fish.
Uva River	An important navigable artery in good extension, linking localities nestled in the jungle with production centers, such as the population of Guérima with the entire region of the Amazon arm and Puerto Inírida, flows into the Guaviare River, an important route of trade and development in the Guaviare River.
Mesetas River	Important fluvial source, navigable by boats such as "voladoras" and "bongos". The beauty of the landscape, the crystalline waters and the indigenous communities that surround it make the Mesetas River a tourist attraction.

Caño Segua	It flows 150 m above the town of Guérima in the upper part of the department of Vichada and connects the Guérima inspection with the Puerto Príncipe inspection. This town is the center of trade movements between Guérima, Barranco Minas and San José.

Retrieved from: IGAC (2002)

7. SPATIAL AND TEMPORAL LIMITS

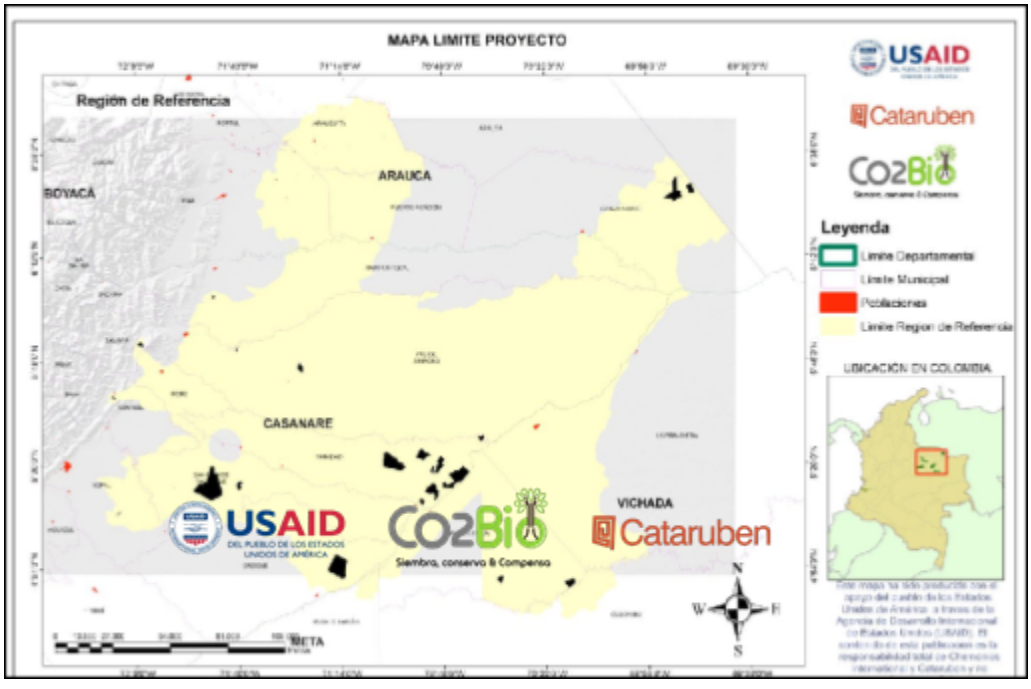
7.1 REFERENCE REGION

The reference region for REDD+ actions corresponds to the area in which the analysis of land use change, deforestation, degradation and study of agents and drivers of deforestation and degradation is performed (Annex B1 GIS Geodatabase). For the reference area, the methodology used, and its development was based on NTC 6208 and to complement and add more criteria, guidelines were used to define the geographic limits of the Proclima standard.

The criteria for defining the geographic limits of the reference region of the CO_2 Bio project were as follows:

a) The identified deforestation drivers and agents can access and have an interest in the project area.
b) Land tenure and land use rights are represented in the reference region, after excluding the project area.
c) The exclusion of areas of restricted access to agents and drivers of deforestation and degradation was carried out.
d) The proposed reference region is similar and includes the entire project area. Access, agents, deforestation determinants, forest types, post-deforestation uses, land tenure, political context and enforceable norms were verified.

Figure 2. Map of the limits of the intervention area and reference region of the CO_2 Bio project.



Source: Cataruben Foundation

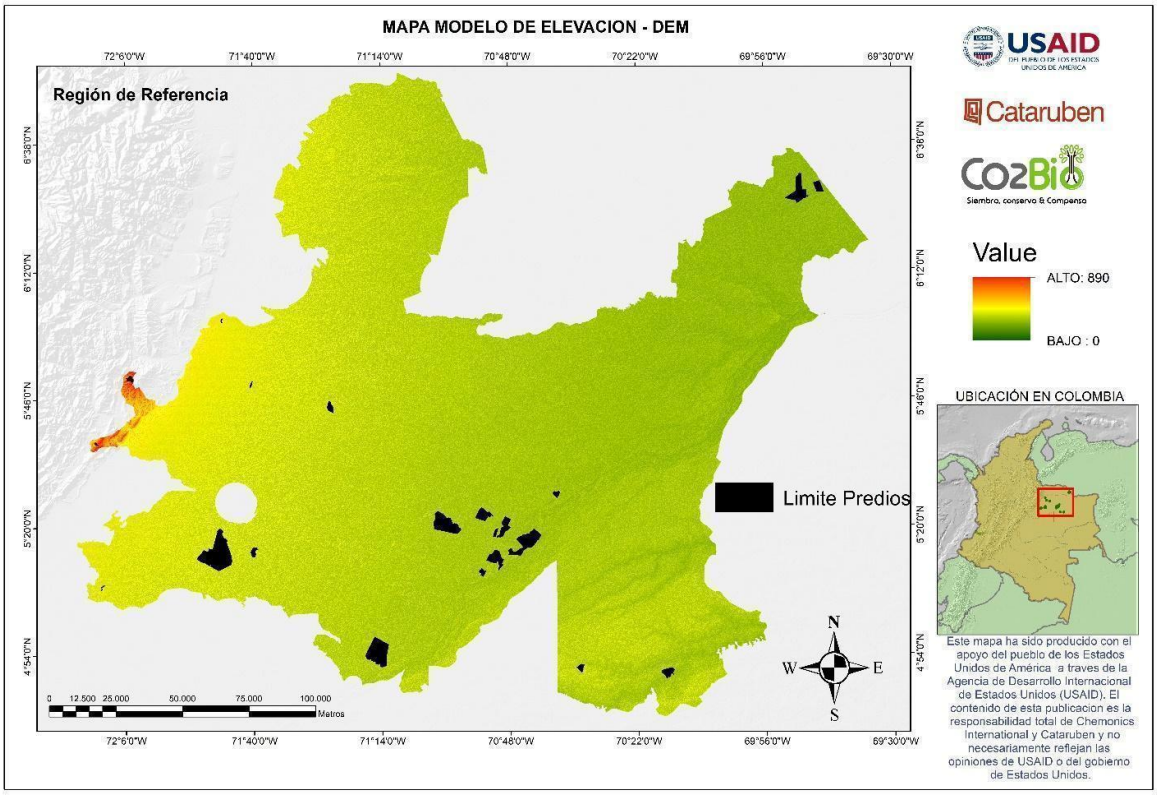
The reference region is similar in that it duly represents the project area and meets the following landscape criteria: slope ranges, altitude ranges, forest cover type or climate (mean annual precipitation/temperature). Overlapping areas corresponding to other REDD+ forestry projects, national park areas, black communities and indigenous reserves were also excluded from the reference area and not taken into account (Figure 2). The exact dates for the comparison of the change in land use of the baseline are for the whole year (January 1 to December 31) for each year in comparison 2005 and 2015, as indicated by the IDEAM methodology for the detection of change due to deforestation for the 10-year period.

For the comparison of land use change in the reference area for the calculation of the baseline, the entire project area has been included. For this purpose, the guidelines of the Proclima methodology were followed, where the entire project area can be included within the reference region.

7.2. GEOGRAPHIC INFORMATION

For the generation of spatial slope and elevation information of the reference region area, a Digital Elevation Model (DEM) with a spatial resolution of 30 meters and freely available in NASA's Shuttle Radar Topography Mission (SRTM) information catalog was used (Figure 3).

Figure 3. DEM digital elevation model generated for the reference region of the CO_2 Bio project.



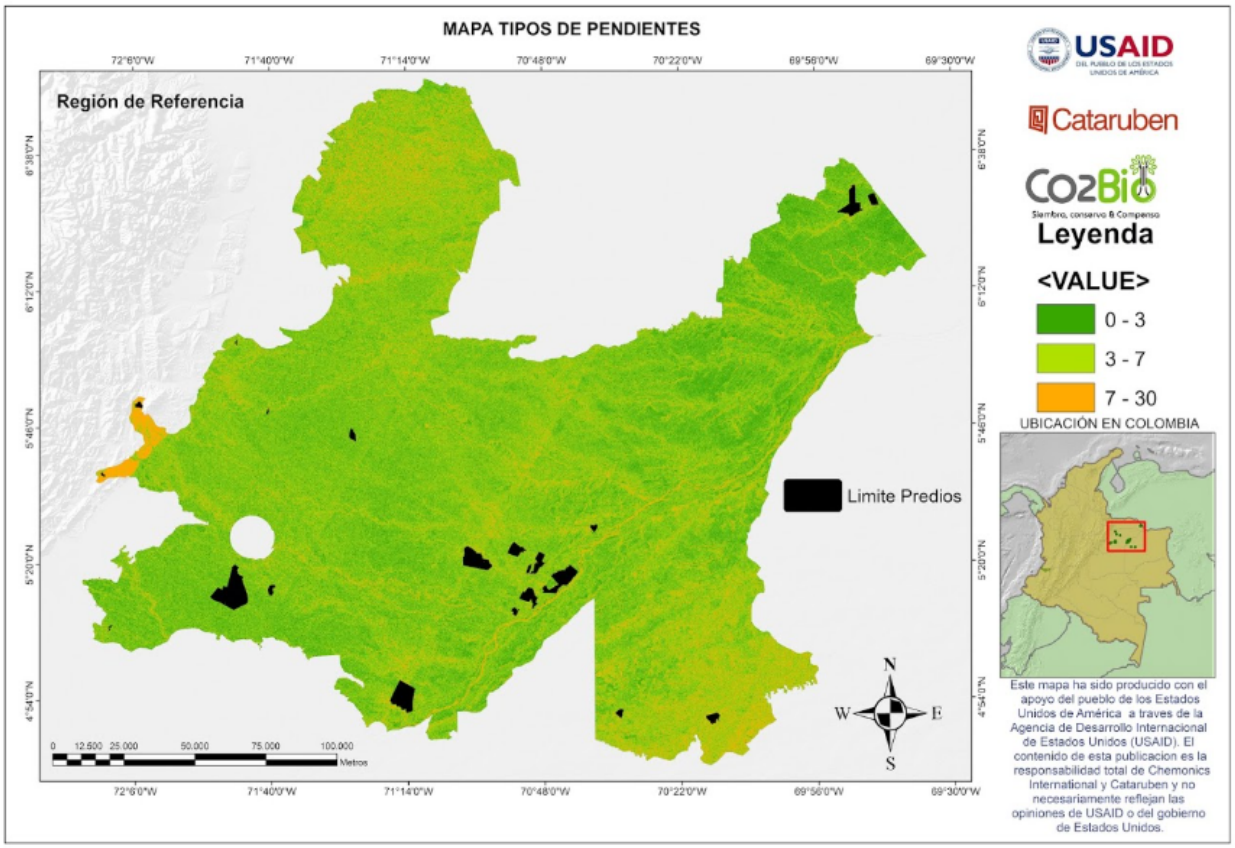
Source: Cataruben Foundation

The elevation model was used as a basis of elevation and slope layers were generated for the entire reference region and project area. Spatial data analysis was performed in ARGIS 10.4 software with the Slope and Contour lines tools (Annex B1 GIS Geodatabase).

7.3. TERRAIN SLOPES

It was modeled using the contour data generated from the DEM and then classified according to the United States Department of Agriculture methodology (Annex B1 GIS Geodatabase). Both the project area and the reference area are classified as relatively flat, with slopes in the range of 0% - 3% (See Figure 4).

Figure 4. Slope map of the CO_2 Bio project reference area**.**



Source: Cataruben Foundation

7.4. GROUND ELEVATION

A comparison of contour data produced at a scale of 1:100,000 was made for the reference region and the project area (Annex B1 GIS Geodatabase). This elevation information indicates that the reference area and the project area are between the same elevation ranges (See Figure 5).

Figure 5. Elevation map of the project reference area CO2Bio.

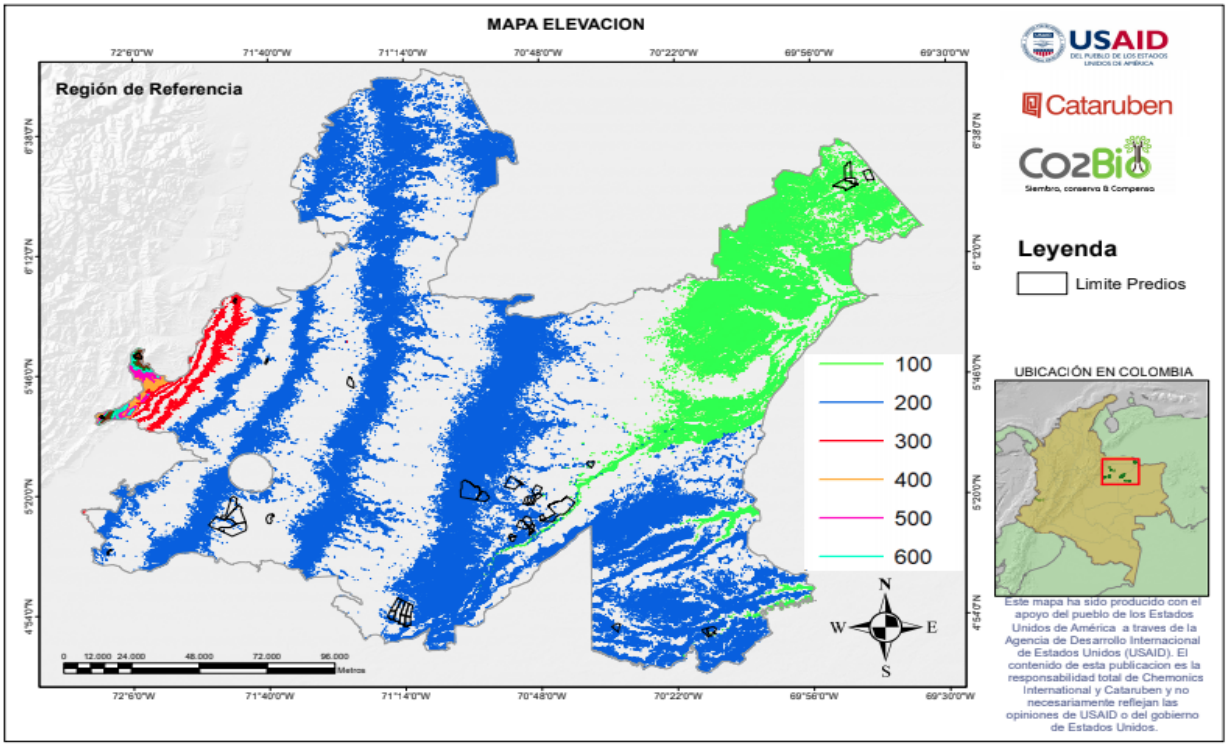
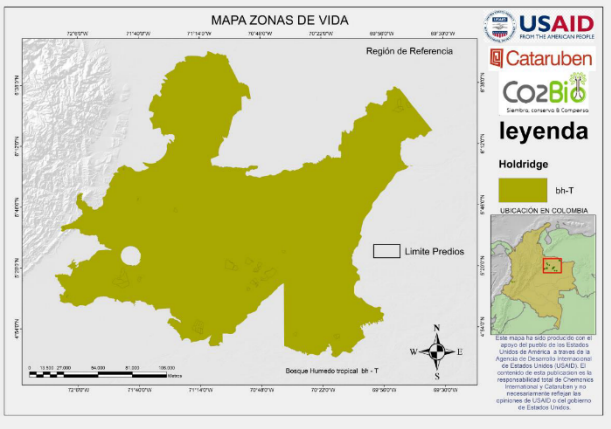
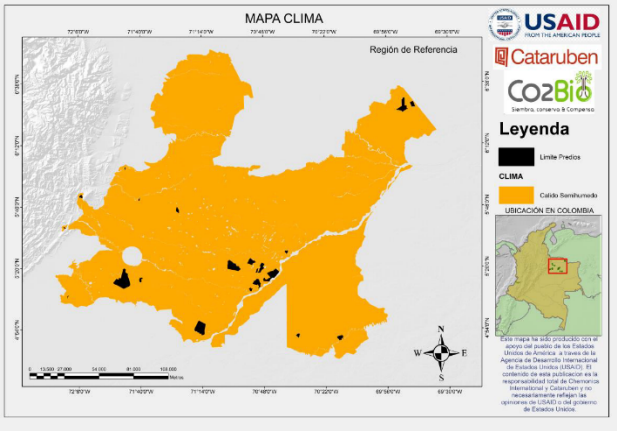


Figure 6. Maps of life zones (left) and climate (right) of the CO_2Bio





The life zone map of the project area was also generated and corresponds in its entirety with the Tropical Humid Forest classification (Figure 6 left) and according to the IDEAM classification, the type of climate for the entire reference region and area of the properties corresponds to the Warm Semi-Humid classification (Figure 7 right).

7.5. LEAKAGE BELT AREA FOR CO_2Bio PROJECT

Leakage is defined as the net change in anthropogenic emissions by sources of greenhouse gases (GHG) that occurs outside the project boundary, and that is measurable and attributable to the project activity. The deforestation projection in the reference region and leakage area contemplates five years from the start date (Annex B1 GIS Geodatabase). The area of the leakage belt corresponds to the area of forest cover around the project and has similar characteristics such as slope, altitude and climate, etc.

Leakage corresponds to the areas where any deforestation above the reference area projection will be considered a leakage event. It is necessary to calculate and determine the leakage belt because in the area of the CO_2Bio project properties, a displacement and increase of deforestation/degradation processes could be generated outside the limits of the project area.

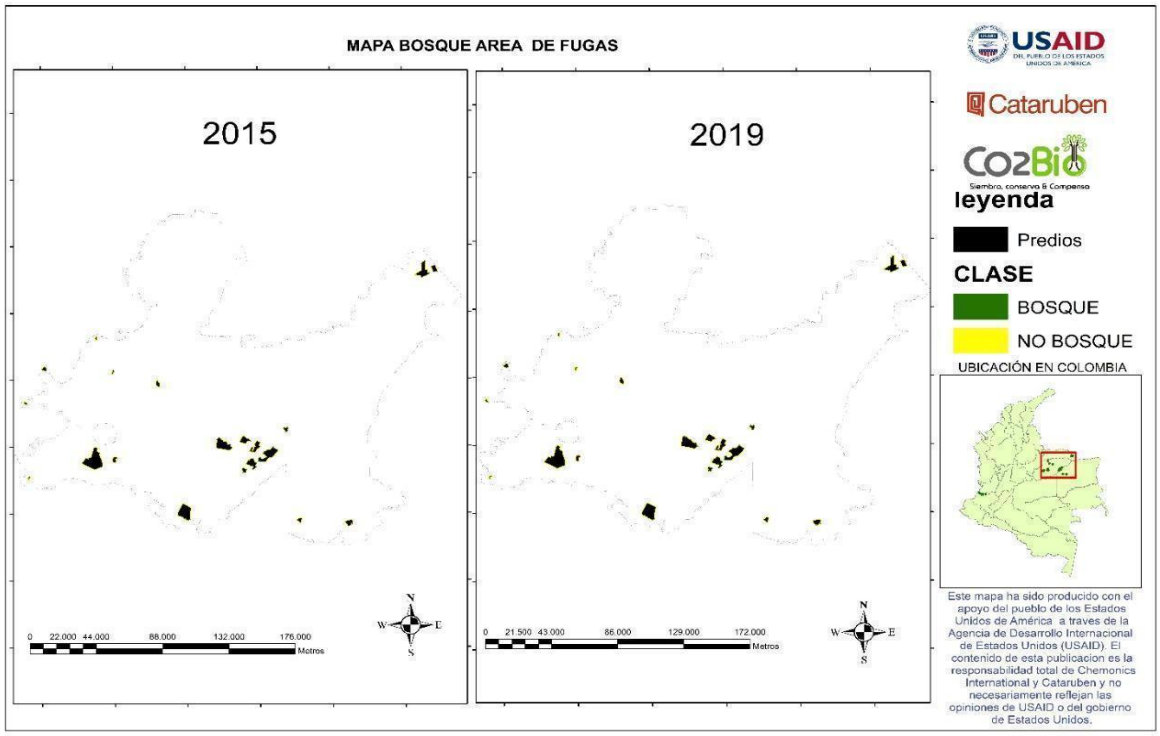
The methodology used and its development for the leakage belt, as well as the reference area, followed criteria to define the geographic limits and buffer area of the leakage belt of the CO_2Bio project, such as the following:

-The exclusion of areas of restricted access to deforestation agents was carried out.

-The leakage belt area is similar to the project area. For which access, agents, deforestation determinants, forest types, land tenure and political context were verified. Also landscape criteria such as slope ranges, altitude ranges, forest cover type or climate (mean annual rainfall/temperature).

Based on the different criteria, a buffer area was delimited around each property with a distance of 500 m (Figure 7). The areas of change due to deforestation in the period 2015 to 2019 were also calculated (Figure 8). The exact dates for leakage monitoring are from January 1, 2015 to December 31, 2019. According to the IDEAM methodology, for the detection of change due to deforestation for the 5-year verification period of the project.

Figure 7. Map of the leakage belt area in CO2BIO project for the year 2015 to 2019.



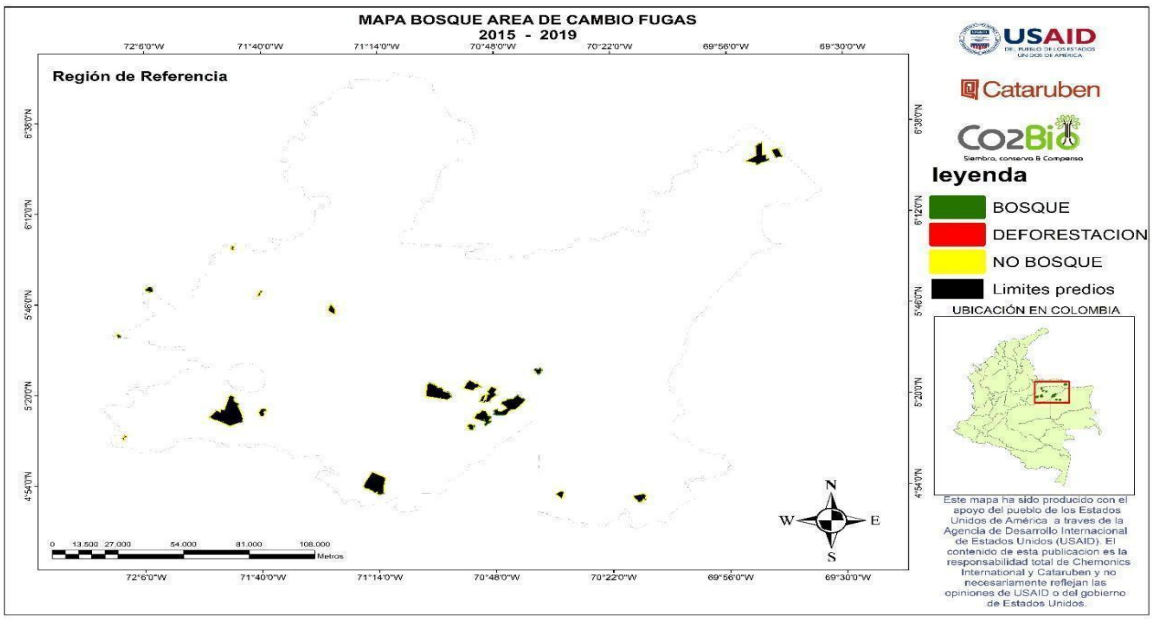


Figure 8. Map of the area of coverage change in the leakage belt in the project for 2015 to 2019.

8. START DATE OF MITIGATION ACTIONS AND DURATION OF THE PROJECT

Co2Bio started on January 1, 2015. At this time, conservation activities were initiated on land in the Orinoquia region, which generated positive reactions from landowners in the region. They signed a letter of intent, where they affirmed that they wanted to belong to the project, assume conservation practices and strengthen the governance of their properties.

It should be noted that Cataruben Foundation was connected with 44 landowners since 2014, which allowed strengthening commitments between the parties, clarifying doubts regarding the scope of the project and its obligations. (See Annex C.1.3) In addition, reconnaissance activities were carried out to identify environmental and productive factors that had been developed on these properties. Based on this, the eligibility of the area was defined, since it was intended that the area with natural forest would not have any intervention for at least 10 years.

In the first year of operation (2015) the Shambala, Trikuti and El Dera properties were declared as Civil Society Nature Reserves. This set a precedent for other properties to join this initiative over the years. The Cataruben Foundation has provided technical and scientific support, especially constant monitoring through the use of a multisensor drone and satellite images, among others. This makes it possible to delimit the environmental conditions and regeneration processes of the forest and its surroundings.

On the other hand, with the firm objective of joining efforts to reduce GHG emissions and bearing in mind the different co-benefits resulting from the implementation of the CO_2Bio project, a 40-year accreditation period is defined for the project, where compliance with REDD+ activities will be periodically evaluated.

Thus, it is concluded that:

- Verification Period: January 1, 2015 - December 31, 2019
- Period of accreditation: January 1, 2015 - December 31, 2054

Within the process of generating the preconditions for the CO2Bio project, one of the important phases was the social validation in the sense of determining the short, medium and long term duration for the fulfillment of the project activities.

According to the consensus with the owners the short term was determined to be 12 years, therefore, it was agreed by the owners that a contract would be made for that first block of time; however, one of the clauses of the contract (Clause Nine - V5 - Extension) specifies the continuity of the process as required by the project and the commitment of the owners to continue developing the planned conservation activities.

9. IDENTIFICATION OF THE BASELINE SCENARIO

9.1. ENVIRONMENTAL CONDITIONS IN THE PROJECT AREA

In the "project location" chapter, the soil, vegetation, geomorphological and climatic characteristics of the project's reference area were described. This indicator analyzes the activities previously defined as relevant and influencing the project; activities that are part of the environmental risk matrix determined by technical visits to the properties. This environmental matrix assigns a risk score between 1 and 5, with 5 being the highest score for natural and anthropogenic hazards on the properties.

Of the 21 activities analyzed in the 44 properties, 9 were defined as activities that are more frequent and that allow us to have a baseline to determine the causes of deforestation and degradation, as well as to reinforce the mitigation activities that ensure the development of the project. These actions are specified taking into account the socio-cultural and economic context previously identified in the field visits, and in relation to detailed secondary information in the project's reference region, which is included in the annexes.

Anthropogenic activities include cattle grazing in the forest or restoration areas, scattered logging, inappropriate use of agricultural inputs, indiscriminate burning, and conflict with the local population. Natural threats include fires, long periods of drought, floods, and deterioration of water sources.

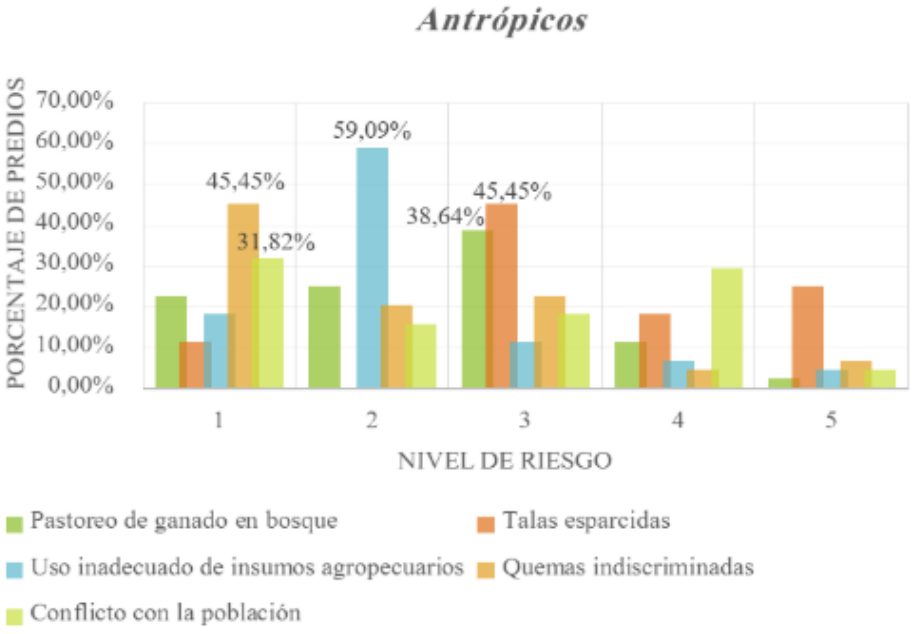


Figure 9. Anthropic hazards defined according to the level of risk registered in each of the 44 properties.

Thus, Figure 9 shows the anthropic threats and their respective percentage of risk in the properties. Initially, cattle grazing in forests, whose practice is one of the major causes of deforestation and degradation, had a single-mode behavior, where it was determined that 38.64% of the properties have a level 3 risk of having this activity in their forests. Although there were lower percentages in the higher risk levels, it is a threat that must be managed accordingly, since cattle ranching is the most common economic activity in the project area, which is a constant risk for forest conservation and contributes to further forest degradation.

In 45.45% of the properties, this threat was defined as risk level 3, 18% as risk level 4, and 25% of the properties have a risk level of 5 for this activity. This implies a challenge of training and implementation of activities for sustainable forest management, where limits and good practices are defined to avoid deforestation and forest degradation in the first place, as well as the loss of biodiversity resulting from poor management of this ecosystem.

Regarding the improper use of agricultural inputs, this had its highest peak in risk level 2, where 59.09% of the farms were determined that although it is not an action that generates considerable danger for the execution of the project in the project area, it is important to receive training on the consequences of improper handling of these products (or tools), either because their farms carry out commercial agricultural work or, on the contrary, for grazing.

Finally, both indiscriminate burning and conflict with the population had their highest percentages in risk level 1, with 45.45% and 31.82% respectively. On the one hand, indiscriminate burning and inadequate fire management are not constant tasks, since there is already awareness that, in dry seasons, these actions can get out of control and cause fires that devastate the forests and biodiversity of the affected area. Likewise, conflict with the population is not a main cause of deforestation and degradation, but it can interrupt the proper management of forests by landowners on their properties, which is why it is important to manage and deal with these situations favorably.

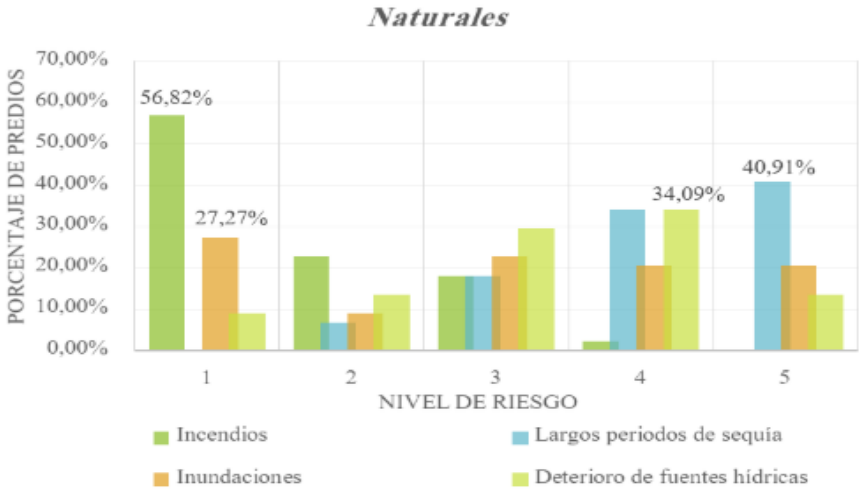


Figure 10. Natural hazards defined according to the level of risk recorded in each of the 44 properties.

Regarding natural hazards in the project area, Figure 10 shows the distribution of percentages according to the perception evaluated with the landowners during the field visits. In the first place, fires, which for 56.82% of the properties represent a risk level 1, is a positive aspect for the development of the project; however, taking into account the significance of an event of such magnitude in natural forests, this threat and everything that could cause it must be taken into account for the implementation of the project.

For 27.27% of the properties, flooding represents a level 1 risk; however, it was close to having a uniform behavior in each risk score, which implies that it is a natural hazard that is important for most properties, but it is not significant for the correct development of the project.

However, long periods of drought and the deterioration of water sources are natural hazards that represent a contingency for most of the properties. However, they are events that do not prevent the development of the project, but do considerably affect the well-being of the occupants of the properties.

9.2. SOCIAL CONDITIONS IN THE PROJECT AREA

This section presents certain social characteristics that are the result of the psychosocial surveys conducted with landowners, to contextualize the issue in the project area where REDD activities will be developed (see Annex C1. to see the complete psychosocial surveys). However, it is possible to observe the social conditions in the reference area, specifically in the municipalities where properties were registered in the CO_2 Bio project.

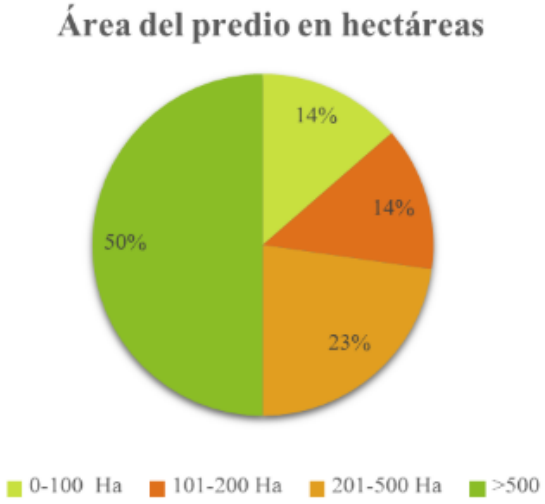


Figure 11. Hectares defined in percentage of the 44 properties that belong to the project area.

Referring to the project area, specifically the properties where mitigation activities are being carried out, Figure 11 shows that 50% of the properties have more than 500 hectares, 23% have between 201-500 hectares, 14% have between 101 and 200 hectares and the remaining 14% have 0-100 hectares. It is important to mention that most of the properties have more than 100 hectares, since the plains are characterized by herds and ranches made up of thousands of

hectares, which have been sold over time for plots of extensive sizes (Observatorio de Frontera, Territorio y Paz, 2017).

Figure 12 shows that the most common economic activity in the farms is the livestock sector (89%), which means that of the 44 farms, 39 of them practice livestock farming as the main source of income for their livelihoods. This makes sense according to the reference area where the project is being executed, which belongs to the eastern plains of Colombia, where since the seventeenth century cattle ranching has been the main economic activity in the region. Although in the last 30 years, the oil industry has gained strength, the agricultural sector is essential to the economy of the Orinoquia region (Observatorio de Frontera, Territorio y Paz, 2017).

Figure 12. Economic activities carried out in the 44 properties of the project, values referenced in percentages.

It can also be observed that 4% of the properties develop agricultural activities, with crops such as turmeric, cassava and plantain. Likewise, 7% of the properties do not carry out economic activities, so they see the CO_2 Bio project as a conservation alternative that can generate income and not use their land for other activities that contaminate what they have protected for years. Finally, none of the properties have forestry or tourism as their main economic source.

Regarding the value of family income, Figure 3 shows that 57% of the plots receive family incomes between $500,000 - 1'000,000 million pesos, 16% between $1'000,000-$1'500,000, 16% less than $500,000 pesos and 11% more than $1'500,000. Evidently, the values vary in the total area of the project, however, these incomes are the result of the intensity with which each family that owns the land carries out their economic activities.

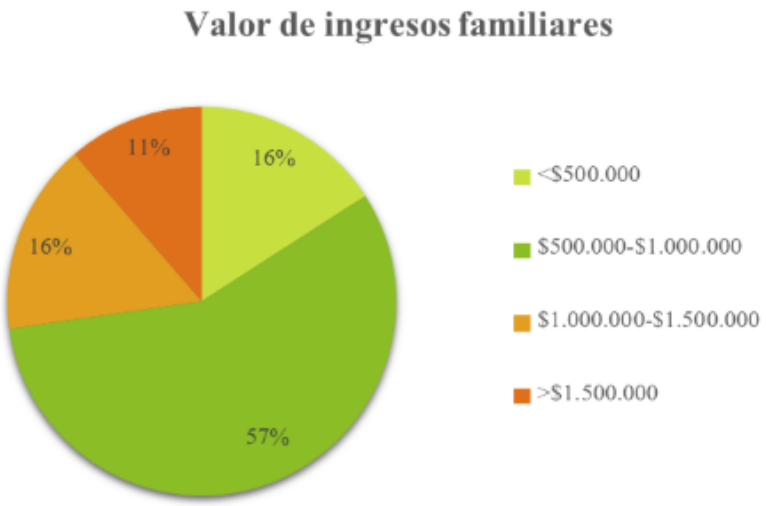


Figure 13. Family income values given as a percentage of the 44 properties that are part of the project area.

Finally, the number of household inhabitants is also taken into account, where 55% of the plots are made up of families with 1 to 3 inhabitants, 20% with more than 5 people and 25% with between 4 and 5 inhabitants, as shown in Figure 4. This is in agreement with national studies that have determined that in rural sectors below 400 meters above sea level, the population density is 1.5 inhabitants/km2 , which is a low value in comparison with urban areas and higher territories (CORPORINOQUIA, 2005).

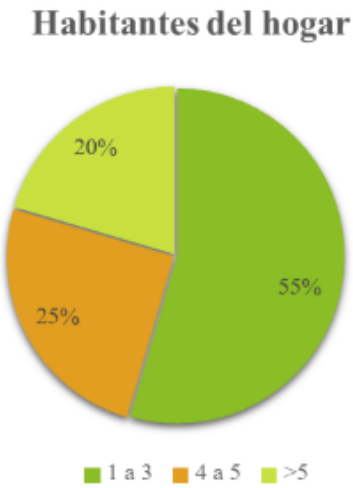


Figure 14. Inhabitants that make up each of the households in the 44 properties that are part of the project area.

9.3. BIODIVERSITY CONDITIONS IN THE PROJECT AREA

The Colombian Orinoquia is a vast and heterogeneous region, with a diversity of ecosystems and outstanding life forms, the product of historical natural processes to which species have adapted over time. This region encompasses numerous ecosystems found in paramo, foothills, savannas

of the Guiana Shield, floodplains and highlands, whose evolutionary histories and current conditions and specific resources determine the distribution of fauna and flora species (Lasso, et al., 2011).

The departments of Arauca, Casanare and Vichada include representative areas of the region with ecosystems of flooded savannas, foothills, gallery forests and wetlands such as estuaries and lagoons. In the project area, the dominant ecosystem is the flooded savannah with the presence of stubble or forest relicts, gallery forests, morichal forests and estuaries, among others. As is well known, the characteristics of the savannas are the result of the unique interaction of multiple factors associated with soil, rainfall, temperature, invasive exotic species, and climate change.

Thanks to this diversity of ecosystems that show dynamics with very strong periods of flooding and drought, the presence of many species of different taxonomic groups is a surprising and very interesting aspect. Despite this, the potential and value of the region in terms of biodiversity is unknown to many, when in fact, it has been demonstrated that the Orinoco has an important relationship between the Andean and Amazonian ecosystems that allows maintaining ecosystem functions not only at the national level but of the American continent.

For this reason, there is an increasingly evident need to carry out studies that allow a quantitative and qualitative approximation of the region's biodiversity, identifying the state of threat to species, demographic aspects, management and conservation, among others. To this end, in recent years local and national environmental entities have joined with scientific research groups from universities, international NGOs and local communities through associations, whose work has allowed a more accurate approximation and estimation of the biodiversity and richness of the Orinoquia region.

Many of the results of these efforts are shared with the community and are freely available for consultation, which makes it possible to generate lists of wild species in different departments of the country. Accordingly, the biodiversity baseline could be carried out by consulting this secondary information, specific to the 11 municipalities that make up the reference area of the project, in the departments of Arauca, Casanare and Vichada.

For this purpose, different databases were searched and downloaded from SIB Colombia, the biological information cataloger of the Alexander von Humboldt Institute (CEIBA), the Sinchi Institute and in some cases monitoring studies carried out on the same properties in the project area, as evidenced in the Runap resolutions.

All this information was integrated into a database with more than 15,000 records of plant species, non-flying terrestrial mammals, birds, amphibians and diurnal butterflies as shown below. From the construction of this database, it was possible to identify the richness and abundance of wild species in the project area, determining the species with the highest occurrence in the data. Similarly, the species found on the IUCN website were consulted to determine the conservation status of the species and their habitat (see Annex C2 biodiversity database).

9.3.1. Results

The following is a summary of the information that makes up the fauna and flora database for the project area.

Table 13. Number of records, families and species found by taxonomic group (The column Number of Records refers to the number of times individuals of the species listed in the table have been observed).

TAXONOMIC GROUP	NUMBER OF RECORDS	NUMBER OF FAMILIES	NUMBER OF SPECIES
Plants	3238	140	1345
Mammals	135	25	59
Birds	10073	74	602
Amphibians	2114	13	76
Butterflies	1308	23	202

Source: Cataruben Foundation

Table 14. Most abundant species by taxonomic group in the project area. (Most abundant species by taxonomic group in the project area. LC (Least Concern), NE (Not Evaluated), VU (Vulnerable).

SPECIES	FAMILY	STATE OF CONSERVATION (IUCN)	HABITAT
PLANTS			
Siparuna guianensis	Siparunaceae	LC	Forest
Jacaranda obtusifolia	Bignoniaceae	NE	Forest
Tapirira guianensis	Anacardiaceae	LC	Forest
Ficus americana	Moraceae	LC	Forest
Ludwigia rigida	Onagraceae	NE	Forest
MAMMALS			
Dasyprocta fuliginosa	Dasyproctidae	LC	Forest
Tapirus terrestris	Tapiridae	VU	Forest, savanna
Myrmecophaga tridactyla	Myrmecophagidae	VU	Forest, savanna
Puma concolor	Felidae	LC	Forest, savanna
Cuniculus paca	Cuniculidae	LC	Forest
Odocoileus virginianus	Cervidae	LC	Forest, savanna
BIRDS			
Ramphocelus carbo	Thraupidae	LC	Shrublands, forests
Tyrannus melancholicus	Tyrannidae	LC	Forests, scrubland
Vanellus chilensis	Charadriidae	LC	Grasslands, wetlands
Bubulcus ibis	Ardeidae	LC	Forests, pastures
Milvago chimachima	Falconidae	LC	Savanna, scrubland
ANFIBIOS			

Leptodactylus fuscus	Leptodactylidae	LC	Forest, savanna
Leptodactylus colombiensis	Leptodactylidae	LC	Forest, savanna
Physalaemus fischeri	Leptodactylidae	LC	Forest, savanna
Boana xerophylla	Hylidae	LC	Forest, scrubland
Pristimantis medemi	Craugastoridae	LC	Forest, wetlands
DAY BUTTERFLIES			
Hermeuptychia hermes	Nymphalidae	NE	Forests
Heliconius numata	Nymphalidae	NE	Forests
Stalachtis calliope	Lycaenidae	NE	Forests
Nymphidium onaeum	Lycaenidae	NE	Forests
Prepona laertes	Nymphalidae	NE	Forests

It is important to clarify that the species shown do not necessarily correspond to the most representative species of the area, but rather that these are the most abundant species in the records of the sources consulted. Being stricter or more precise, it could be said that in the case of plants (for example), the predominant species in the project area correspond to herbaceous and/or grasses of families such as Poaceae and Cyperaceae that form typical plant associations in the extensive savanna cover.

With respect to mammals, the records show diversity in this group due to the presence of species with different types of habit and diet that indicate the ecosystemic complexity present in the natural areas of the project. This is evidenced by the distribution of forest relicts in the savannah and the presence of moriche palms on the edges of gallery forests associated with estuaries and other bodies of water. However, species richness is low, which suggests that the distribution or presence of mammals in patches of the region is explained by the radiation of Amazonian populations.

Similarly, the group of birds also shows a very high diversity that can be explained by the heterogeneity of the ecosystems found both in the plains and in the foothills. For this group, species can be categorized into forest, understory, savannah and wetland birds, depending on their habitat and the conditions and resources necessary for them.

In the amphibian group, records were found mainly from the order Anura and Gymnopghiona, where the family Leptodactylidae (mostly terrestrial species), showed a great representativeness in terms of richness and abundance of species associated with places with the presence of bodies of water.

Finally, the butterfly group also showed numerous records and high species richness within the Nymphalidae family, which is consistent with other studies carried out in the department of

Casanare. In addition, within this group of insects there are generalist and specialist species, which allows a better capacity for ecological adaptability (Usma & Trujillo, 2011).

10. ADDITIONAL

Although NTC-6208 does not mention the methodological steps with which additionality must be demonstrated, according to Proclima's SECTOR AFOLU METHODOLOGICAL DOCUMENT, additionality is a characteristic that allows demonstrating that the GHG emission reductions or removals, derived from the implementation of a GHG mitigation initiative, generate a net benefit to the atmosphere in terms of reduced or removed GHG emissions. Emission reductions or GHG removals that the holder of the GHG mitigation initiative demonstrates would not have occurred in the absence of the GHG mitigation initiative are considered additional, taking into consideration the provisions of section 0 of this document.

On the other hand, according to Icontec (2018), additionality is the effect of the forestry activity, implemented through a project, to increase the actual net GHG removals by sinks above the sum of the changes in carbon stocks in carbon reservoirs, within the project boundaries, that would have occurred in the absence of the implemented forestry activity (Adapted from the United Nations Framework Convention on Climate Change - UNFCCC). It further proposes that a project is additional if it meets at least one of the following conditions:

- Projects developed by indigenous, black or peasant communities, which are constituted as associations or community organizations.
- Projects that generate socio-economic development with the communities living in the project areas; or projects that involve these communities.
- Projects for the establishment of forestry systems that include areas destined for ecological restoration (passive or active) in 20% or more of the total area of the project.
- Projects for the establishment of forestry systems, grouping landowners; each of them with proven ownership or tenure of the land, over areas of less than 200 hectares.
- Forestry system establishment projects that include planting native species in 20% or more of the total project area.
- Projects that estimate an emissions reduction of less than 10,000 tons of CO2e, on average per year.
- Projects in which 50% or more of the total project area is located outside the high aptitude zones for commercial forestry plantations, according to the classification of the UPRA (Rural Agricultural Planning Unit).
- Projects that demonstrate a positive impact on profitability indicators (IRR, NPV, TEV), considering the sale of carbon credits in the financial evaluation.

Taking into account these definitions and the methodological section number 9 of Proclima's AFOLU SECTOR METHODOLOGICAL DOCUMENT, the CO2Bio project team identified the baseline scenario to demonstrate that the project is additional.

As suggested by this entity, the work team had to select the most appropriate among the criteria, justifying the convenience of its choice and taking into account the suggestion made by Proclima itself, we took into account paragraph (c), which mentions the changes in carbon stocks in the project boundaries, identifying the most probable land use at the beginning of the project.

The steps followed were those suggested by the methodology:

10.1. STEP 0. REDD+ PROJECT START DATE

The date on which the activities that translate into effective GHG emission reductions and/or removals began was January 1, 2015.

Although the supports provided by the project regarding the conservation activities listed in section 19.1.1 show that in some points of the project area they began prior to 2015, the project start date was established on January 1, 2015, taking into account that by that date the Cataruben Foundation formalized contracts with professionals who would carry out the initial phases of implementation of conservation actions, marking the beginning of compliance with the established goals. This demonstrates that the start date of the project is within the 5 years prior to the start of validation (October 1, 2020). The supports that demonstrate the investment of resources in the 2015 payroll are highlighted in the document "payroll year 2015" in Annex C.1.11 CONTRACTUAL / C1. ACTIVITY SUPPORTS.

10.2. STEP 1. IDENTIFICATION OF LAND USE ALTERNATIVES

10.2.1. Sub-step 1a. Identification of likely land use alternatives in the CO2BIO project areas

Based on historical trends regarding land use and occupation in the region where the CO2BIO project is located, three credible and realistic scenarios have been identified that are considered likely to occur in the absence of the associated activities.

Continuation of land use as it was before the project: This scenario is the continuation of the expansion and/or opening of the agricultural frontier, especially for the establishment of rice fields, palm trees, introduced pastures, and burning for the "reactivation" of native pastures for livestock. These activities have been widely introduced in the past in the region of reference and in the project area, despite the fact that many of the properties are currently cataloged as Natural Reserves of the Civil Society by the National Parks and have conservation figures determined by the local and regional environmental authorities.

Conservation initiatives that go hand in hand with improved governance of state entities. Given that the Ministry of Environment and Sustainable Development (MADS) is promoting the National REDD+ Strategy and could eventually increase the annual budget allocated to the Regional Autonomous Corporations (CARs). In addition, through the Royalties Fund, departments are accessing resources for research on sustainable production systems, smart agriculture, etc., which could have an impact on forest conservation.

Conservation as a result of a change in existing land use practices towards the implementation of sustainable production systems. The region has some of these initiatives, which have been encouraged through access to credit, private organizations or associations such as local cattle

ranchers' committees, or through international cooperation in association with USAID Natural Wealth Program and other partners, such as National Natural Parks that encouraged the development of the RNSC registration process. Therefore, some of these initiatives could expand their activities to involve people who carry out unsustainable productive activities within the project area, reducing the rate of deforestation.

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

Scenario 1 represents the current situation, in other words, the scenario without the project, while the following two scenarios represent activities proposed by the project, but taking place in the same area without being registered as a REDD+ project. That is, in the absence of financing through the sale of carbon credits for REDD+.

Scenario 2 would require a significant increase in financial resources by state entities to ensure forest conservation. However, given the history of the state budget and prioritization of resources there is no basis to argue that without the project, the budget could increase significantly.

Under scenario 3, a significant shift in traditional practices towards sustainable practices would be required, which implies massive training for farmers in good agricultural practices (GAP), organic input management, etc., requiring additional time and resources. Under these circumstances, the current practice of conversion of agriculture and forests to other uses is likely to continue.

The consistency of credible land-use scenarios with effectively enforced land-use regulations and laws can be determined by considering that a one-time forest harvesting operation that involves a change in land use (or deforestation), in accordance with Decree 1791 of 1996, requires permission or authorization from the regional environmental authority, in this case Corporinoquia. To obtain an authorization, several requirements must be met, including a technical study demonstrating that the new activity is a rational use of the land compared to the previous one. Failure to comply with this procedure implies sanctions that Corporinoquia will impose on the offender.

In terms of environmental determinants, this regulation also applies, including those related to water courses and environmental zoning determined in the municipalities' Land Management Plans.

Taking into account the conditions of the protected areas system, the project area should be governed by the following considerations:

a) Protect water resources producing and buffer zones to ensure water supply to inhabitants and contribute to environmental management.

b) Maintain and/or restore biological connectivity between the main natural forest patches

c) Perpetuate in their natural state the main ecosystems and habitats of wild fauna and flora species, contributing to the viability of these populations, with special attention to those in danger of extinction, vulnerable, endemic and/or rare species

d) Facilitate the restoration of strategic ecosystems that provide vital ecosystem services for sustainable development and provide habitat for the conservation of wildlife species

e) Harmonize the productive activities of the areas belonging to Protected Areas with the conservation objectives described in their management plans and/or action plans and improve the quality of life of the communities they inhabit

f) Promote civil society participation and inter-institutional coordination in the management and administration of natural resources, especially protected areas

g) Promote natural areas for the collective enjoyment of our natural and landscape heritage and the development of environmental educational activities

h) Recognize private conservation initiatives as a contribution of civil society to the maintenance of the natural heritage

The land use system operates in agricultural mode, more specifically slash and burn rotation. Crops are spread through the forest. First, the trees are felled, and the timber is extracted (slashing). Then, fire clears all plots of woody vegetation (burning) before planting crops. After soil exhaustion during one or more crop cycles, the land is left in stubble (initial succession of plants) and secondary vegetation is established on the plots.

Several stages can be distinguished: low stubble, where grass and shrub layers dominate; and high stubble, where trees constitute the canopy. However, agricultural activities do not require local environmental permits or permissions, except in wooded or tall stubble.

Under scenario 1, it is clear that current mandatory laws and regulations are not being enforced and could be demonstrated through reports related to administrative acts. However, the Colombian government lacks the resources to effectively maintain or enforce these laws. This situation occurs in the project area, and generally in other regions of the country. According to several press reports, deforestation and degradation in protected areas has progressed in recent years despite significant efforts by the State to improve the management of these areas and address the main factors that threaten their protection. It is concluded that at this stage, scenario a) is quite feasible to continue.

Scenario 2 is consistent with national laws, provided that existing restrictions on protection zones and land use guidelines, such as municipal zoning and protected areas, are met. However, the short-term viability of the government to expand the budget of the Corporaciones Autónomas Regionales is unlikely.

On the other hand, scenario 3 would be partially consistent with applicable laws, to the extent that activities are carried out within areas permitted as zoning for this land use.

10.3. STEP 2. BARRIER ANALYSIS

In accordance with paragraph 9 sub-step 2 of Proclima's AFOLU SECTOR METHODOLOGY DOCUMENT, a barrier analysis was conducted to demonstrate that the proposed activities under the project scenario face barriers to implementation, and that these can be overcome with the intervention of finance through the sale of GHG emission reductions or carbon credits.

Sub-step 3a. Identification of barriers to project implementation

Existing land uses do not face barriers, therefore, they are the reference scenario. Crops for subsistence and medium-scale production, livestock, etc. predominate in the region. Some of these activities have a relatively low cost and, in general, are short-term activities, except for livestock, which are a long-term investment. Therefore, the associated financial and technological barriers are low, given that the implementation of this form of land use is based on traditional practices that do not use good agricultural practices and improved technology.

With the CO2Bio project, alternative land uses were implemented to avoid impacting the traditional practices and customs of the inhabitants of the agricultural area. This initiative proposes activities to improve agricultural and livestock practices, including technical assistance.

These activities, compared to traditional practices, imply higher implementation costs, but are expected to be sustainable over time (ecologically and financially). And in such a way to achieve an improvement in productivity and economy to positively impact the reduction of deforestation, improving the livelihoods of farmers.

However, for their implementation, the following barriers must be overcome:

- **Investment barriers, among others:**

One of the main barriers is access to credit and financing for conservation activities. The cost of implementing and maintaining these activities requires financing or access to credit facilities by the landowners or beneficiaries. This means, in most cases, providing guarantees or co-financing, as banks will not lend the money required if the landowner does not have a credit history or backing from a financially strong third party.

Debt financing is not available for these types of activities, which is reflected in the lack of access to credit by landowners. Finally, the lack of resources from the environmental authority to ensure compliance with the law could also be a financial barrier to forest conservation.

- **Institutional barriers, among others:**

Incentives for agricultural production are not geared towards sustainable production. For example, the National Federation of Cattle Ranchers does not monitor new areas converted to cattle ranching to confirm that they were not previously deforested areas. The same applies to loans from the Banks; non-deforestation in both cases should be a criterion for monitoring and access to institutional support to encourage forest protection and sustainable production. Another barrier is the weakness of environmental institutions to enforce environmental regulation.

Another barrier that would prevent project implementation, if the project does not contemplate participation in the carbon market, is social conditions. As mentioned in some sections of the PD, traditional practices in the project area are related to the expansion of the agricultural and livestock frontier. In this process, the traditional practice is the clearing and burning of forest areas for the establishment of crops and pastures. These practices are rooted in the community and, to some extent, may be a barrier at the time of project implementation, as it is still part of the customs and traditions of some farmers, and the adoption of new practices on their part may be seen as a change in their culture.

However, activities implemented under a REDD project scenario could overcome the identified barriers, as revenues from the sale of carbon certificates will be used to raise capital through conservation incentives, technical assistance, marketing support, etc.

In the case of the CO2BIO project, financing was planned and executed for the implementation of activities during the first years with initial private investment, and later, selling carbon credits generated by the project through the reduction of emissions from deforestation. In addition, the Cataruben Foundation will manage the reimbursable and non-reimbursable resources for the project.

The barriers identified constitute sufficient evidence to demonstrate the additionality of the project only if they prevent potential initiative holders from carrying out the project if they are not expected to participate in the carbon market.

10.4. STEP 4. IMPACT OF PROJECT REGISTRATION

The CO2BIO project is not an economic investment activity. In the absence of economic resources from the sale of carbon credits, proponents may not be able to financially support the scope of specific activities that are necessary to reduce deforestation in the project area. This is the reason for the co-financing of the investment plan by entities such as USAID's Natural Wealth program. Therefore, all revenues generated by the REDD project will be invested in the proposals and activities planned to reduce deforestation, as well as financial incentives for this purpose (See Annex D1 Financial Model).

It is concluded that, for the situation of the selected scenario, the simple cost analysis method should be performed, because the actors of the Carbon - CO2BIO project do not generate additional economic benefits, therefore, a simple cost analysis that focuses specifically on the income generated by the project is justified.

- **Sub-step 2b - Option I.** Apply a simple cost analysis.

The activities carried out through the Carbon - CO2BIO project do not yet generate income for their owners, but there is still a commitment to the objective that the areas managed for the project have conservation and forest restoration purposes, which will not be used for livestock or crop production, manifested in the biological and environmental importance with flooded savannas and gallery forests that optimize the ecosystem and improve the economic conditions of the inhabitants of the region and globally with the capture of carbon dioxide.

The Carbon Project - CO2BIO will incur ongoing costs which are activities performed by the beneficiaries related to the maintenance of enclosures of protection areas, farm managers and biodiversity protection, which will not generate future financial benefits other than revenues related to CARBON CERTIFICATES, therefore, this project will be viable when offset by revenues from the sale of carbon certificates. (See Annex D1 Financial Model).

10.5. PROJECTED CASH FLOW OF THE CARBON PROJECT - CO2BIO

A cumulative cash flow is presented with the income from the activities carried out during the years 2015 - 2016 - 2017 - 2018 - 2019 and 2020, the break-even point is achieved in the sixth year due to the income from the sales of CARBON CERTIFICATES, which would make the cash flow remain positive from 2020 onwards.

The accumulated projected sale will be 258,970 CARBON CERTIFICATES of the Carbon Project - CO2BIO established for the years 2015 to 2019, the break-even point is in the first year, taking into account that with this income the economic resources invested accumulated since the beginning of the project are recovered in this year. (See Annex D1 Financial Model).

10.6. STEPS TO FIND THE BREAK-EVEN POINT

It is the result of the analysis of the cumulative costs incurred during the development of the different activities since the beginning of the Carbon - CO2BIO project, established from the year 2015 to the current year 2020 which is estimated the first cumulative sale of CARBON CERTIFICATES. Thus, the income from the sale of CARBON CERTIFICATES fully covers the costs of the project activities since 2015, including the capital contribution of the work performed by the project proponents (See Annex D1 Financial Model).

10.7. PROJECTED SALES OF BOND CERTIFICATES PER YEAR

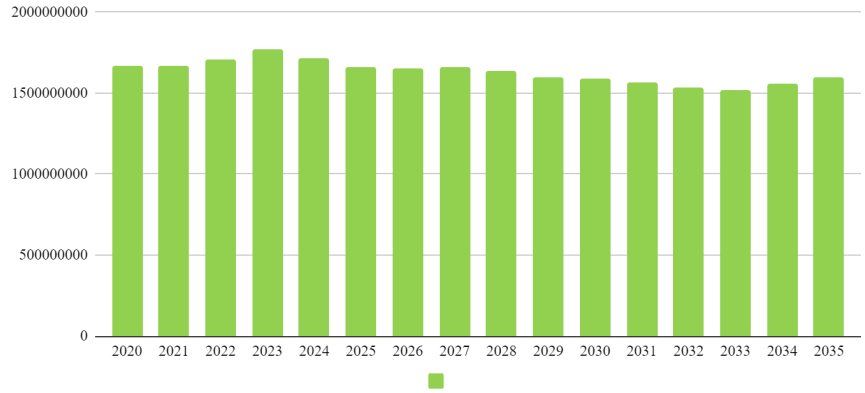


Figure 15. Projected sales of carbon certificates in the CO2Bio Project
Source: Cataruben Foundation

According to Figure 15 of projected sales, an analysis was considered that projects the first sales of CARBON CERTIFICATES to be made in the year 2021.

The sales projection for the cash flow represents the project cycle that corresponds to the certification in the year 2021 of the carbon certificates corresponding to the years

2015-2016-2017-2018-2019, subsequently certification of the CARBON CERTIFICATES will be requested for the following years framed by the Carbon Project - CO2BIO. (See Annex D1 Financial Model).

10.8. QUANTIFICATION OF COSTS INCURRED FROM 2015 THROUGH 2020

Corresponds to all the activities necessary for the project design, development and implementation of the Carbon - CO2BIO project (See Annex D1 Financial Model).

a) Baseline survey. This is done with the objective of obtaining primary information to obtain a technical annex document for each property where field activities are broken down, which consists of forest classification, correction of property areas, flight with unmanned aircraft (Drone) for forest quantification and finally the identification of forest areas and restoration to be implemented.

b) Monitoring of biodiversity indicators. Plant sampling is carried out in each of the properties by means of permanent plots for flora identification, identification of large mammals, understory birds, amphibians and diurnal butterflies by means of transects for the installation of camera traps and subsequent identification.

c) Quantification of CO2 removal. By means of a direct analysis taking into account the forest inventory and an indirect analysis through the application of allometric equations and satellite images, it is possible to quantify the carbon stock and therefore the number of CO2 removals from year to year.

d) Training to beneficiaries. It is estimated to train a minimum of 290 people who are directly and indirectly part of the Carbon - CO2BIO project on issues related to climate change, environmental education, cultural work, management and conservation of water resources, biodiversity conservation and implementation of good environmental practices, with this, it seeks to ensure and prolong the long-term sustainability of the project.

10.9. COST VALUATION OF CARBON PROJECT ACTIVITIES - CO2BIO

Until the sales of CARBON CERTIFICATES are made, the implementation costs of the Carbon - CO2BIO project will be financed by the proponents where the following strategies are applied:

a) Cash investment for the initial development of the Carbon - CO2BIO project activities

b) According to the previous point, the main investment contribution is made by USAID, with which the design, preparation and development of initial activities of the Carbon - CO2BIO project is achieved, allowing the obtaining of the CARBON CERTIFICATES, the contribution of CATARUBEN carrying out the field work and the owners of the properties

10.10. ORIGIN OF THE RESOURCES.

The following table shows the financing contributions of the proponents USAID, CATARUBEN Foundation and the beneficiaries of the land for the execution of the Carbon - CO2BIO project.

Table 15. Origin of project resources

	Natural Wealth	Cataruben Foundation	Quantix	Compensate	Property owner	**Total**
Investment	$460.273.644	$478.816.148	$20.000.000	$65.603.800	$823.930.000	**$1.848.623.592**
% share	25%	26%	1%	4%	45%	**100%**

Source: Cataruben Foundation

10.11. CASH FLOW

Cash flow is composed of the following components:

1. Projected revenue from sales of Carbon Certificates / year

2. Projected project implementation costs

Project sustainability

4. Net balance

The initial selling price of the CARBON CERTIFICATES unit is COP$18,372.

(a) It is the result of the sale of CARBON CERTIFICATES per year

(b) These are the costs of sustaining the project for each year

(c) is the verification and certification of CARBON CERTIFICATES every two years

(d) is the sum of (b) and (c), which shows the projected costs

(f) Payment to project beneficiary 70%.

(g) ORP Benefit of the Carbon Project - CO2Bio.

(h) Is the net benefit, which is the subtraction of (g) and (d), under consideration of the Carbon Project - CO2Bio.

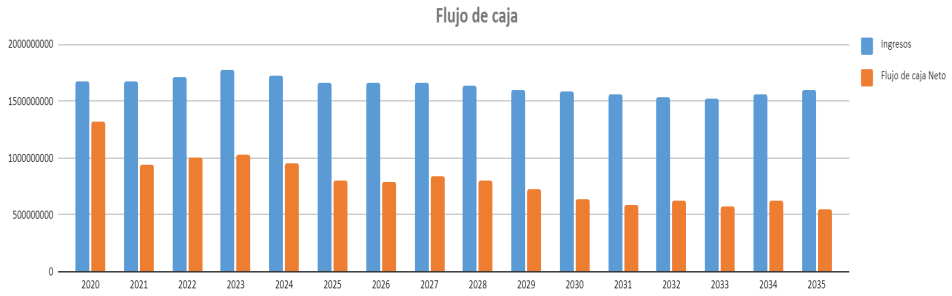


Figure 16. Cash flow of the CO2Bio project. Source: Cataruben Foundation

11. QUANTIFICATION METHODOLOGIES

The project has been developed using the guidelines of the Colombian Technical Standard NTC 6208 Mitigation Actions In The Land Use, Land Use Change And Forestry Sector (Uscuss) At The Rural Level, Incorporating Social And Biodiversity Considerations, for the quantification of GHG emission reductions and removals generated in REDD+ projects at the mosaic and landscape scale.

This project follows and uses the following documents and tools:

- PROCLIMA. 2020. AFOLU SECTOR METHODOLOGY DOCUMENT. Quantification of GHG Emission Reductions or Removals from REDD+ Projects. Version 2.2.
- Resolution 1447 of 2018 Ministry of Environment and Sustainable Development, which aims to regulate the Monitoring, Reporting and Verification System (MRV) of mitigation actions at the national level, as related to the GHG Emissions Reduction and Removal Accounting System and the National Registry of Reduction of Greenhouse Gas (GHG) Emissions.
- Protocol for national and subnational biomass estimation in Colombia. Institute of Hydrology, Meteorology and Environmental Studies - IDEAM.

At the same time the entire project was developed taking as a normative basis Law 164 of 1994 approving the United Nations Framework Convention on Climate Change, the implementation of the carbon tax by Law 1819 of 2016, Decree 926 of 2017 for the non-causation of the carbon tax, Law 1844 of 2017 ratifying the Paris Agreement, the regulation of payments for environmental services Decree 1007 of 2018, Law 1931 of 2018 establishing mechanisms for the management of climate change and Resolution 1447 of 2018.

11.1. APPLICABILITY OF THE NTC

This Technical Standard establishes guidelines for the formulation and minimum requirements for certifying mitigation actions in the Land Use, Land Use Change and Forestry (LULUCF) sector at the rural level, incorporating social and biodiversity considerations, ensuring that they are transparent, relevant, reliable, continuous and accurate.

This Technical Standard is limited to actions related to the quantification and management of GHG emission reductions/removals generated by activities in the USCUSS sector. In the case of the CO_2 Bio project, it is based on item b) Reduction of GHG emissions due to REDD+ activities, which covers activities carried out during the time of project implementation.

11.2. APPLICABILITY OF THE REDD METHODOLOGY:

The following applicability conditions are met:

1. The RFO has used maps generated from satellite imagery (optical/radar) for the areas within the geographical boundaries of the project and corresponding to the forest category (as defined by the Forest and Carbon Monitoring System) at the start of project activities and ten years prior to the project start date.

2. The different activities that are part of the REDD+ project will not result in the violation of any applicable law.
3. It is possible that in deforested areas carbon stocks in soil organic matter, litter and dead wood decrease, or remain stable.
4. In the absence of the project, no reduction in deforestation or forest degradation is expected to occur.
5. The causes of forest degradation identified include: selective logging, firewood extraction, forest fires, forest grazing and expansion of the agricultural frontier.
6. The causes of deforestation identified should include timber extraction, expansion of the agricultural frontier and infrastructure expansion.
7. It is optional to exclude or include the quantification of some of the carbon pools for calculation purposes.

12. CARBON RESERVOIRS AND GHG SOURCES

The following table shows the carbon pools used to account for the carbon stocks in the CO_2 Bio project, which were taken from the IPCC good practices (2003, 2006), and taken from IDEAM (2011) taking into account the 5 carbon pool compartments that can be measured and that have representative quantities for the project:

Table 16. Carbon compartments applied to the project

COMPARTMENT		DEPOSIT SELECTION	JUSTIFICATION OF CHOICE
Living Biomass	Aerial biomass	including	Considering that it is the deposit that undergoes the greatest change as a consequence of anthropogenic activities
	Subway biomass (Roots)	including	Its total value is representative of carbon stocks, taking into account roots larger than 2 mm in diameter.
Dead Organic Matter	Dead wood detritus	excluded	Its total value is not representative of carbon stocks.
	Leaf litter	excluded	Its total value is not representative of carbon stocks.
Soils	Soil organic matter	including	Considering the carbon sequestration in mineral and organic soils in the project area is representative.

Source: Adapted from Protocol for the national and subnational estimation of biomass - carbon in Colombia (2011).

13. LAND ELIGIBILITY

The project activities have been designed as part of the REDD+ project with the intention of reducing CO2 emissions from deforestation and degradation compared to reference levels. As required by NTC 6208, the land in the project area consists of separate and discrete project areas covered by forests that meet the definition of forest as defined by the government of Colombia (IDEAM, 2015). These areas were forest for a minimum of 10 years prior to the project start date. The project area would be degraded or deforested in the absence of the REDD+ project activity and the deforested and degraded areas are mosaic in nature. Drivers of deforestation and forest degradation, in order of importance, include:

- Timber harvesting for commercial sale
- Conversion of forest land into cropland for subsistence farming
- Conversion of forests into settlements.

As a result of the selection process developed by the grouped project CO2Bio, 44 private rural properties were obtained and the mitigation actions of the CO_2 Bio project demonstrated that the linked areas comply with the condition of being covered by forests for at least ten (10) years before the start of the project due to the fact that this project will implement activities related to emissions reduction (NTC 6208).

The project foresees the inclusion of new participants, and the eligibility criteria for project expansion are as follows:

- Signed letter of intent
- Conservation contract signed between the landowner and the Cataruben Foundation, which includes a clause in which the landowner agrees to conserve the forests and the Foundation agrees to implement advisory activities on the steps to be taken by each landowner and his collaborators within each property.
- A representative GIS analysis of the forest cover is carried out to determine the potential forest areas that will be deforested if conservation activities are not carried out.
- Future properties that decide to integrate CO_2 Bio must adopt the project activities specified in this Project Design Document.
- Free, prior and informed consent approved. To include a new instance, a local consultation must be carried out.

Expansion of the project is expected to occur during monitoring following certification of the first plots.
- Meet the applicability conditions established in the methodology and tools applied in this project. The new instances must meet 5 criteria:
- Unplanned deforestation (agriculture, grazing, firewood, timber, charcoal) as long as it complies with the most recent Guidelines.
- It may include one or more activities.
- It can include multiple forest types, ages, successional stages, agroforestry, natural.
- Must have a minimum forestry classification of 10 years prior to start date
- May include wetland forests unless growing on peat (at least 65% organic matter, minimum thickness 50 cm).

- Have the same baseline scenario determined in the project description, which are agriculture and grazing livestock. The determination of the baseline scenario is based on the initial instances of project activity.
- The new instances will implement the same project activities.
- A non-permanence risk buffer assessment will be conducted for each new instance.

In order to demonstrate that the project boundaries complied with the presence (a) or absence (b) of forests, satellite images were used for the reference dates, complemented with data collected in the field, which allowed verifying the land cover and/or land use in the project boundaries.

13.1. Land eligibility criteria

For land eligibility criteria for the REDD project, it was based on the fact that the areas in which the project boundaries are defined were covered by forest for at least 10 years before the start of the project, for activities related to emission reductions due to REDD+ activities. To demonstrate this, satellite images of the project areas for the time before the start of the project and existing map of forest and non-forest cover (IDEAM) for the years 2005 and 2015 in the project boundaries were included in the PDD.

We started with the identification of forest area zones using the forest and non-forest layers generated and published by IDEAM for the years 2005 and 2015. The IDEAM layers were reviewed and improved only when necessary, using remote sensing (radar (SAR) and optical) in order to better categorize and detail, the information that in the satellite images was considered without information due to the presence of areas with cloudiness/shadows. The information provided by IDEAM contains information for all of Colombia under the classes of "no forest", "forest" and areas "without information" (areas with the presence of clouds/shadows or other factors that prevent their adequate and complete interpretation), the data generated are obtained using LANDSAT satellite images with ETM+ and TM sensors, with a spatial resolution of 30 meters, complemented with other types of optical and Radar (SAR) images with medium resolution such as Sentinel 1/2 and Planet Lab images.

According to IDEAM, all "no information" areas that occur during any of the periods should be excluded. Once the "no information" areas were excluded, using geographic information systems software, an analysis of the IDEAM 2005 and 2015 layers was performed to find the areas that have preserved the forest class for the ten-year period. These are the eligible areas. On the contrary, the ineligible areas were those that went from forest to non-forest (deforestation) and those that are conserved under the "non-forest" class.

The following table shows the areas for the non-forest and forest classes within the project boundaries, and the following figure shows the spatial distribution of eligible areas.

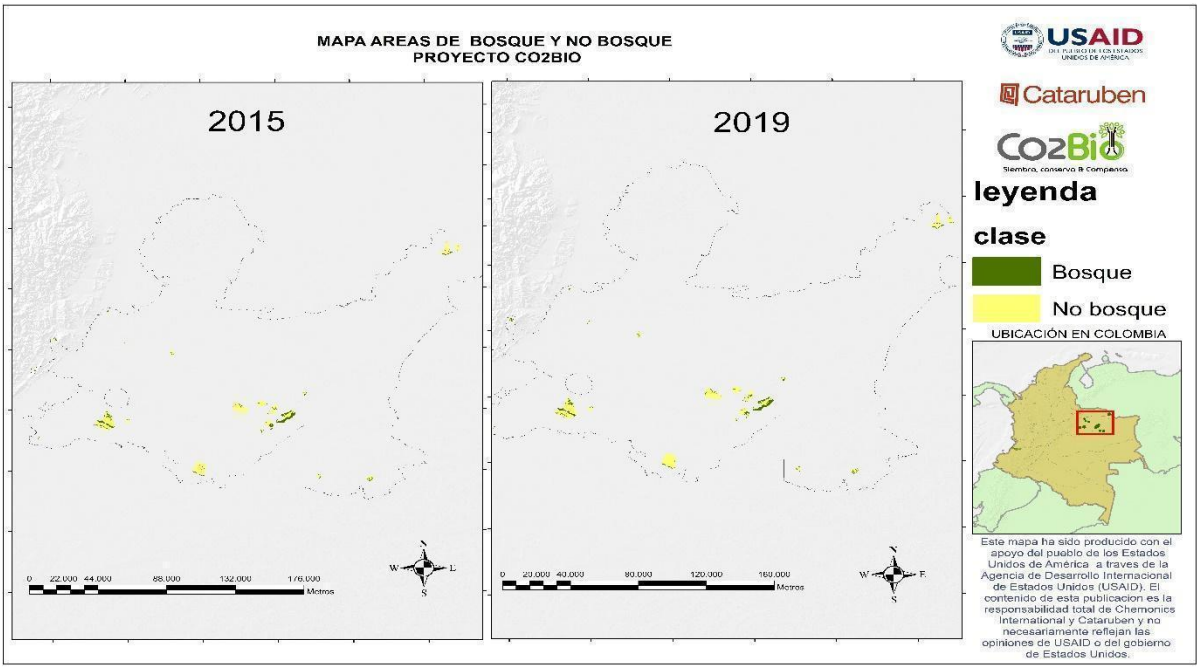
Table 17. Eligible project areas

Eligibility	Area (ha)	Percentage (%)
Eligible	8958	31

Not Eligible	33448	79
Total	42406	100

Source: Cataruben Foundation

Finally, it should be clarified that an inventory has recently been carried out to verify the land cover and land use of most of the properties for which information has been provided and photographs of most of the plots surveyed in the field have been attached.



Map of forest and non-forest reference region 2005 and 2015.
Source: Cataruben Foundation

14. COMPLIANCE AND LEGAL REQUIREMENTS FOR CARBON SEQUESTRATION

Cataruben Foundation, as owner of the initiative, must demonstrate the land tenure according to the provisions of CONPES 3859 of 2016, as owner (who holds the real right of ownership that appears in a real estate registration folio), possessor (who acts on a real estate of private nature with the intention of being the owner with the conviction of being it, but without being able to demonstrate compliance with the requirements of the real estate tradition that legally validly accredits him as owner) or holder (who uses and enjoys a real estate property for which the existence of an owner is recognized), at least during the period of quantification of GHG reductions or removals.

For this reason, in the process of linking land to the CO_2 Bio project, a procedure of clarification and demonstration of the ownership of the property is carried out through a legal study based mainly on the public deed, adjudication resolution and/or sound tenure of the real estate.

As a result of this process, a binding contract is signed in which the total area to be bound to the project is stipulated, in clause six Obligations of the beneficiary it is defined that the owner of the property must demonstrate the rights of use of the land on which the forestry activity is being developed for a period of time greater than or equal to the duration of the project.

To support what is described in this clause and to comply with Article 45 of Resolution 1447/2018, the following documents are attached, these demonstrate the veracity and legality of each of the project participants, as well as their properties, so in Annex E1, the following information can be corroborated: citizenship card, public deed document, INCODER resolution, the certificate of tradition and freedom, the cadastral certificate and the title study of each property with its contract of linkage with the CO_2 Bio project.

Table 20 below shows the total list of properties, their respective owners, and the identification of each property, according to the real estate registration number registered in the cadastral certificate or the resolution number assigned by the Colombian Institute for Rural Development (Incoder).

Table 18. List of the 44 properties, with their real estate identification, respective owners and consultation of land restitution processes.

N°	PROPERTY	REAL ESTATE REGISTRATION /INCODER	OWNER	LAND RESTITUTION PROCESSES
1	Versalles	475-22962	Liseth Isabel Dalel Martinez	Not Applicable
2	Tabloncito	470-12570	Rodrigo Leal	Not Applicable
3	Palmarito	470-29108	Maria Tulia Fonseca	Not Applicable
4	Aquí Me Quedo	470-14061	Maria Tulia Fonseca	Not Applicable
5	Coco 2	470-27332	Maria Fernanda Wilches	Not Applicable
6	Buena Vista 1	086-6346	Carlos Arturo Zambrano Fuentes	Not Applicable
7	Buena Vista 2	086-6344	Karin Ferreira Paez	Not Applicable
8	Charanga 1	086-6345	Maria Fernanda Zambrano Endara	Not Applicable
9	Charanga 2	086-6315	Mary Lizeth Zambrano Endara	Not Applicable
10	Caimán 1	086-6347	Leonardo Andres Zambrano Endara	Not Applicable
11	Caimán 2	086-6318	Carlos Gerardo Zambrano Endara	Not Applicable
12	Sarrapios	086-8188	Carmen Mariela Zambrano	Not Applicable
13	Villa Aurora	475-13947	Aurora Camargo Caballero	Not Applicable
14	Las Islas Rn Aves de Jah	475-10648	Jose Ramiro Tellez	Not Applicable

15	Macarena	475-6395	Elsi Gabriela Rincon Silva	Not Applicable
16	Mata De Palma	475-3384	Inversiones Vargas Zambrano Sas-Juan Carlos Vargas	Not Applicable
17	Altamira	475-3382	German Roberto Rodriguez Zambrano	Not Applicable
18	El Boral	475-3385	Martha Beatriz Zambrano	Not Applicable
19	Montana	475-3781	Gerardo Zambrano	Not Applicable
20	Buena Vista	475-2773	Dory Consuelo Barreto	Not Applicable
21	El Campín	475-12167	Luis Eduardo Arenas Rojas	Not Applicable
22	San Cristóbal	475-31495	Genrri Alveiro Parada Vargas	Not Applicable
23	San Andrés	475-31493	Eduar Parada Vargas	Not Applicable
24	Sonrisa	475-12539	Nery Cuevas De Castro	Not Applicable
25	El Limonal	475-0012330	Carlos Alberto Cabrera García	Not Applicable
26	Palmera	475-0012363	Victor Segundo Morales Rodriguez	Not Applicable
27	El Clavo (Medano los Morrucos)	475-0003170	Mirta Lucy Pan Avella	Not Applicable
28	Regadera	475-31499	Martha Rocio Parada	Not Applicable
29	Padrote 1	475-22837	Alexander Arenas Oropeza	Not Applicable
30	Padrote 2	475-18114	Juan Gabriel Arenas	Not Applicable
31	Padrote 3	475-19029	Jenny Judith Arenas Oropeza	Not Applicable
32	Maricelas	475-28462	Juan Manuel Arenas	Not Applicable
33	Miravalle	475-2974	Fernando Arenas Riaño	Not Applicable
34	La Mapora	475-3483	Luis Eduardo Arenas	Not Applicable
35	Progreso	475-3826	Maria Nini Garcia Farfan	Not Applicable
36	Flor Amarillo	475-3946	Juth Fredy Arenas Castro	Not Applicable
37	Arizona	475-3411	Alberto Arenas Riaño	Not Applicable
38	El Valle	410-64801	Javier Antonio Romero	Not Applicable
39	La Calzada	410-58413	Javier Antonio Romero	Not Applicable
40	La Guajira	410-64800	Javier Antonio Romero	Not Applicable
41	Los Toros	INCODER-0460	Javier Antonio Romero	Not Applicable
42	Trikuti	540-7303	Ilda Mercedes Becerra Vergara	Not Applicable
43	Shambala	540-7476	Sat Gavassa Becerra	Not Applicable
44	El Dera	540-919	Ruben Virgilio Gavassa Morantes	Not Applicable

Source: Cataruben Foundation

As mentioned above, there are a series of documents required to support the ownership of the properties in question, corresponding to the letter of sale, public deed, or the resolution of the Colombian Institute of Rural Development INCODER, which accurately reflect particularities of the property such as: owner of the property, geographic location, disposition of boundaries and in

some cases detailing the historical heritage of the property. These documents are provided by each owner and are considered legal and effective arguments to recognize the ownership of the property linked to the CO_2 Bio project.

Also included is the cadastral certificate, which has a unique reference code for each property, this allows the unequivocal identification of the property and avoids difficulties in the recognition, another document that is attached is the certificate of tradition and freedom, this is provided by the owner linked to the project, with the information obtained from this certificate is developed and argued the Legal Study document.

This document details aspects such as the current ownership of the property, the mode of acquisition, the identification of the property, and describes the historical and tradition review of the property, that is to say, the legal status is known in detail, each legal figure through which the property has passed, and the respective owners involved as owners of the property over time.

In this way, it is demonstrated that each linked property does not have any boundary claim processes, embargo processes, inheritance processes, easement processes, expropriations, or any other figure that alters the stability of the project, the good management of the forests or the commercialization of the certificates.

In addition, the land restitution unit has verified that none of the properties linked to the CO_2 Bio project are in the process of restitution, as shown in Table No. 20, which shows that the properties in question do not have conflicts of dispossession or abandonment due to the armed conflict.

For the CO_2 Bio project, it is extremely important to determine the property ownership rights of the property, since the person who is recognized as the owner of the property where the conservation forestry activity is being developed will be the same person who has the right to the ownership of the carbon. Once this right has been determined, the biophysical, environmental and socioeconomic characterization of the property and its inhabitants is carried out. This information allows the quantification of the CO2 stored in the forest areas and finally the commercialization process, the latter requires security and transparency since in this phase the income generated by the certificates is obtained and the distribution of these monies must be carried out.

For the above, in the linkage contract in the thirteenth clause signed between the landowner and Cataruben Foundation, the distribution of resources is described exactly as follows: 70% for the landowner and 30% for the project owner, where 30% of the income generated will be used for the sustainability of the project; In other words, the follow-up, monitoring and accompaniment of technical visits by professionals who verify compliance with REDD+ activities, as well as monitoring the trend of changes in forest cover and generating alerts if required or any other type of expense generated during the implementation of the project.

The remaining 70% of the income corresponds to the owners of the property since they are in charge of carrying out governance, restoration, protection, monitoring, surveillance, supervision and constant maintenance of the forest areas included in the contract.

Understanding the way in which the distribution of economic resources will be carried out, it is important to consider the organizational structure that governs the CO_2 Bio project. $_2$"This role has been played by the Cataruben Foundation by contributing to the sustainable management of natural resources through scientific research, technology and innovation; in this way it has achieved recognition as the organization responsible for the execution and viability of the project, acting as an articulator or mediator between landowners and potential buyers of carbon certificates, generating commercial alliances that favor the conservation and mitigation strategy.

As mentioned above, the landowners are also a fundamental part of the organizational structure of the project since they are in charge of leading or managing the conservation strategy and thanks to their commitment and responsibility, the effectiveness and transparency of the CO_2 Bio project is recognized.

On the other hand, the United States Agency for International Development (USAID) is a strategic ally, acting as a leveraging entity for foreign resources to be invested in the development and support of agricultural projects or climate change mitigation projects, such as the CO_2 Bio project, which has the backing and support of this agency.

14.1. ENVIRONMENTAL LEGAL REQUIREMENTS

The project proponents and project beneficiaries undertake to comply with all applicable laws, statutes, property rights and other regulatory frameworks. The following is a list of the different environmental regulations related to the implementation of this project.

Table 19. Standards and their context of application in the CO project$_2$ Bio

NORM	CONTEXT OF APPLICATION
Decree 2811/1974	Compliance with Article 44, which establishes principles for the management of natural resources to promote a balance between economic development, environmental protection and the efficient use of resources.
Law 164 of 1994	The UNFCCC is ratified and, in accordance with national circumstances, measures are adopted to reduce emissions from deforestation and forest degradation.
Forestry policy (1996)	The overall objective is to achieve a sustainable use of forests to conserve them, consolidate the incorporation of the forestry sector into the national economy and improve the population's standard of living.
The Forest Reserves Law (Law 2 of 1959)	Establishes a classification and management regime for lands under its scope, including public lands, indigenous reserves and Afro-Colombian lands.
Green Plan 1998	Its main objective is the inclusion of agroforestry, conservation and ecological restoration in the environmental management of the territory and the recovery of degraded ecosystems.

Law 620 of 2000	Approving the Kyoto Protocol of the UNFCCC, which committed countries to stabilize GHG emissions, based on the principle of common but differentiated responsibilities.
Decree 3570 of 2011	Establishes functions for the Ministry of Environment and its dependencies and affiliated institutions. Establishes that the Directorate of Forests, Biodiversity and Ecosystem Services is responsible for developing and coordinating the implementation of the National Forestry Development Plan.
Law 1753 of 2015	Guidance for the Implementation of the National Strategy for Reducing Emissions from Deforestation and Forest Degradation
Decree 926 of 2017	Its purpose is to regulate the procedure to make effective the non-payment of the national carbon tax.
Resolution 1447 of 2018	By which the system for monitoring, reporting and verification of mitigation actions at the national level is regulated, in relation to the GHG Emissions Reduction and Removal Accounting System, which includes REDD+ actions.

Source: Cataruben Foundation

15. CAUSES AND DRIVERS OF DEFORESTATION AND DEGRADATION

Based on the importance of determining the anthropic dynamics that develop in the territory and their influence on the environment, the causes and agents of deforestation and degradation in the reference area of the project are identified, whose main purpose is to describe these actions involved in the loss of forest cover and reduction of carbon stocks within these forest areas, which added to this, allows clarity for the implementation of policies to effectively mitigate damage to ecosystems.

This observation was carried out under the IDEAM methodology "Conceptual and methodological guidelines for the characterization of causes and agents of deforestation in Colombia" using particularly the conceptual guidelines for an Intermediate Characterization Scenario (ECI).

The first step is to define the space and time, which is delimited in the reference area described in the reference region (chapter 7.1) and a period of 10 years prior to the project start date, collecting with primary and secondary information the possible activities that cause deforestation and forest degradation in the specified area.

In the regional context, the departments of Arauca, Casanare and Vichada are respectively categorized as medium alert for deforestation. According to reports available by IDEAM, between 2005 and 2015, 128,178 ha of forest were deforested in these departments, a scenario that is worrisome for the sustainability of the ecosystems belonging to the region, in addition to providing an approximate view of the situations in the reference area (IDEAM, 2015).

The direct causes of deforestation and degradation in this area can be seen in Table 22, and are mainly defined in four activities: the expansion of the agricultural frontier, the expansion of

infrastructure, timber extraction and different biophysical factors. This graph also shows the agents that directly or indirectly influence the transformation of natural forests for the development of other types of activities, thus influencing the deforestation of the territory.

The expansion of the agricultural frontier is defined by three main reasons: Agricultural production (for self-consumption or sale), livestock production (sale or self-consumption) and praderization (for rent or land tenure). Regarding agricultural production, in the reference area, there are oil palm, rice, cocoa, cotton, plantain, sorghum and soybean crops, mostly for sale. However, there is also evidence of traditional crops on a smaller scale, for self-consumption or informal commercialization, activities that have accelerated deforestation in the territory (Corporinoquia, 2014).

Livestock production has traditionally been developed in the region of reference under the system of cattle breeding and, to a lesser extent, fattening, which in turn is associated with the third direct cause, and that is the praderization, either for the rental of extensions of land where extensive cattle raising is usually developed, pasture planting or due to land tenure effects, where underpopulation dynamics, some landowners accumulate large areas of land.

Table 20. Causes and agents of deforestation and degradation.

	DIRECT ACTIVITIES	DIRECT CAUSES	AGENTS	UNDERLYING FACTORS	COPING ACTIVITIES
DEFORESTATION AND DEGRADATION OF FORESTS IN THE CO2Bio PROJECT REFERENCE AREA	Expansion of the agricultural and livestock frontier	Praderization	Prader for leasing or land grabbing	Socio-economic and cultural factors	Activities related to awareness-raising, training and support for good land use, sustainable forest management, delimitation of areas and promotion of existing agricultural land.
		Livestock production	Industrial or traditional agricultural and livestock producer for consumption and/or sale		
		Agricultural production			
	Infrastructure expansion	Transportation	Formal or informal builder of local, regional and national roads	Socio-economic factors; Cultural factors; Demographic factors; Political and institutional factors; Social and economic factors.	Activities based on the strengthening of mechanisms for citizen participation and forest governance, where citizens exercise control over their territory, as well as their right and duty to participate in territorial planning.
		Hydrocarbons	Agent formally associated with pipelines		
		Settlements	Agent formally or informally associated with electricity grids; Rural and/or urban population in expansion		
	Timber extraction	Timber extraction for sale and/or self-consumption (legal or illegal).	Self-consumption timber harvester: with or without forestry permit	Socio-economic factors; Cultural factors; Political and institutional factors; Political	It is important to implement activities related to the promotion of forest legality, both to raise awareness and to accompany the issuance of

			Timber harvester for sale: with or without logging license	and institutional factors.	these permits, also recalling the principles of sustainable forest management and biodiversity conservation.
	Biophysical factors	Natural or arson fires	Agricultural and livestock producers who carry out "controlled burns".	Cultural factors; Demographic factors	Although these events do not generate a great loss of forest cover since most of them occur in non-forest areas, it is important to implement activities to avoid burning in savannahs and cutting down trees in water courses.
		Floods			

Source: Cataruben Foundation

On the other hand, infrastructure expansion is also a direct cause of deforestation in the reference area, due to activities associated with transportation, hydrocarbons or population settlements. In the first place, these transportation activities are related to the construction of roads, in this case regional or rural access roads. The hydrocarbon industry has taken hold in this area, modifying the socioeconomic characteristics and negatively altering biodiversity. And finally, population settlements enrolled to the growth in the number of inhabitants in the region, which implies the construction of housing and other infrastructure necessary for the community, causing land use to change more and more in the rural sector.

Thus, timber extraction is the third direct cause of deforestation in the reference area, both for commercialization (sometimes illegal) and for self-consumption. Forestry activities in the defined area include the harvesting of species such as mosco, cedar, hawthorn, carob, yopo, and pine, among others. Finally, biophysical factors are defined as the fourth direct cause, taking into account mass removals and forest fires, which, although they are not the focus or driver of deforestation, they are occasional in the reference area (Rozo, 2018).

It is important to mention that, just as biophysical factors are a direct cause of deforestation in this case, other underlying causes of this problem must also be taken into account, mainly economic (increased production), demographic (population growth) and cultural (indigenous beliefs) factors that influence social dynamics and productive activities in the area in question.

However, they are also the main causes (direct or indirect) of forest ecosystem degradation. Specifically, the expansion of the agricultural and livestock frontier, selective logging, timber extraction and forest fires are the activities that mainly influence the loss of biomass and prevent forest regeneration.

15.1. EMISSION FACTORS

The emission factors specific to Colombia in agriculture and forestry according to the biennial report issued by IDEAM (2015), are stacked in four important groups in land use processes such as livestock, permanent land use, land use that are converted, aggregate sources and N2O and CO2 emissions from deforestation processes due to land use change and management, generating

a high variability of GHG emissions. The following is a description of the group of interest for the project, defined in land use change:

15.1.1. Transforming Lands

These are emissions caused by land use change management processes in three types of land: forest land, cropland, and pasture.

Forest land: Changes in biomass carbon and dead organic matter due to land change, such as crops, pastures, wetlands, settlements and other lands that became natural forest under the concept of regeneration are considered.

Farmland: Processes where emissions occur due to loss of carbon from biomass, dead organic matter and mineral soils, caused by the change from natural forest to permanent crops, transitory crops and heterogeneous agricultural areas.

Pastures: Emissions due to loss of carbon from biomass, dead organic matter and mineral soils, caused by the change of natural forest or pasture (clean pasture, wooded and thinned) and grasslands.

15.2. STRATA IDENTIFICATION

Land cover change analyses were conducted for the period between 2005 and 2015, following the guidelines described in section 5.5.2.1 of the Colombian technical standard (NTC 6208). For which information on Land Cover for Colombia from the IDEAM at a scale of 1:100,000 was used as a basis, following the methodology of the "Corine Land Cover" coverage classification system and which has been adapted for Colombia and available in the SIAC (Colombian Environmental Information System).

Table 21. Conversion of hedging classes

TYPE OF CORINE LAND COVER	TYPE OF COVERAGE NTC 6208
Airports	Settlements
Industrial or commercial areas	
Discontinuous urban fabric	
Mining extraction areas	Other lands
Mosaic of crops with natural spaces	Heterogeneous agricultural areas
Mosaic of pastures and crops	
Mosaic of crops, pastures and natural areas	
Weedy pastures	
Dense forest	Natural Forest
Fragmented forest	
Clean pastures	Pastures
Herbazal	

Secondary or transitional vegetation	Secondary vegetation
Sediments exposed at low tide	Wetlands
Seas and oceans	
Rivers	

Source: Table COLOMBIAN TECHNICAL STANDARD NTC 6208

The procedure carried out to interpret the changes in land cover and analyze the process of change involves three main steps: the first was carried out through spatial and thematic detection and interpretation of the change, then an analysis of the patterns of land cover and land use change was carried out, and finally an analysis of the causes of land use change was made (see Chapter 15).

The intersection is performed based on the files generated with the same coverage classes for the years 2005 and 2015 and the corresponding land use change matrix is generated, in the following table, the comparison of hectares is performed taking into account the NTC 6208 and the analysis of coverage changes for the year 2005 and 2015, in which the changes present in the project reference area are identified.

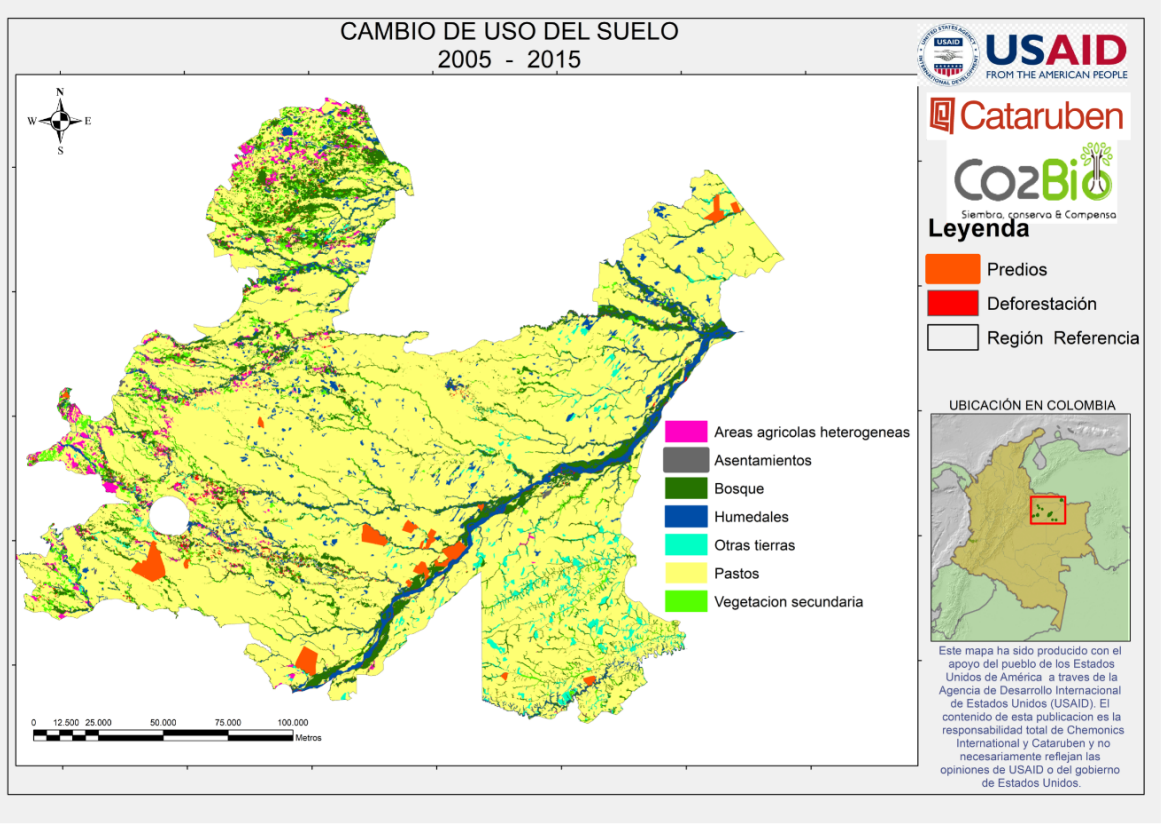
Table 22. Matrix of changes in coverage

Categories NTC 6208	Wetlands	Natural Forest	Heterogeneous agricultural areas	Pastures	Settlement	Other lands	Secondary vegetation	Total 2015
Wetlands	114165,3	7953,2	1526,9	8125,8	0	1652	4067,5	137490,8
Natural Forest	0	409551,208	0	0	0	0	0	409551,2
Heterogeneous agricultural areas	1841,3	4328,2	23573,2	11673,4	0	1724,5	5246,9	48387,6
Pastures	11045,6	13504,1	8043,5	2716670,7	0	8611,2	10984,8	2768859,9
Settlement	148,4	72,5	566,3	1085,7	990	28,7	246,1	3137,7
Other lands	4914,7	1653,8	1288,6	7680,5	911,3	26338,6	4179,8	46967,4
Secondary vegetation	2426,5	5281,7	3272,4	14607	284,9	1784,9	53039,3	80696,7
Total 2005	134541,9	442344,8	38270,9	2759843,1	2186,3	40140	77764,4	3495091

Source: Cataruben Foundation

Table 24 shows the changes in land cover areas between 2005 and 2015, this matrix allows us to observe and orient the major changes present in the reference region, for which we can identify changes in the natural forest cover, heterogeneous agricultural areas and pastures, secondary vegetation, if an analysis is established only for the natural forest areas, it is identified that of the 442344.8 ha that existed in 2005, only 409551.2 ha remained in 2015, while the remaining areas were transformed by various anthropogenic or natural causes.2 ha in 2015, while the remaining areas were transformed by various anthropogenic or natural causes.

The following map shows the land cover changes of the 2005 and 2015 layers used to create Table 22 of the land cover change matrix.



Map of land use change for the years 2005 to 2015.

Land use changes in the reference region for the forest class in 2005 and that changed to other non-forest classes in 2015 are 32794 hectares (Ha) distributed as follows:

Pastures 13504 ha (41.2%), Wetlands 7953 ha (24.3%), Secondary vegetation 5281 ha (16.1%), Heterogeneous agricultural areas 4328 ha (13.2%), Other lands 1653 ha (5.0%) and smaller area Settlements 72 ha (0.2%).

Table 23. Analysis of cover change and its percentage of occupancy in the project area.

Coverage	2005		2015		Difference in hectares
	Area	%	Area	%	Area
Wetlands	134541,9	3,849453419	137490,8	3,933826043	2948,9
Natural Forest	442344,8	12,65617405	409551,2	11,71789805	-32793,6
Heterogeneous agricultural areas	38270,9	1,094990088	48387,6	1,38444464	10116,7
Pastures	2759843,1	78,96341183	2768859,9	79,22139652	9016,8
Settlement	2186,3	0,06255345	3137,7	0,089774487	951,4
Other lands	40140	1,148467951	46967,4	1,343810505	6827,4
Secondary vegetation	77764,4	2,224960666	80696,7	2,308858339	2932,3
TOTAL	3495091,4	100	3495091,3	100	-

15.2.1. Land use land cover change analysis

In order to perform the land use change analysis, a land use change matrix was generated for the reference region between the years under comparison (2005 and 2015). The steps from obtaining the land use change matrix in the reference area are as follows:

According to methodological requirements and guidelines of section 5.5.2.1 of NTC 6208, a period of 10 years prior to the start of the project (2005 to 2015) was selected. This was based on land cover information for Colombia generated by the IDEAM at a scale of 1:100,000, which uses the "Corine Land Cover" methodology, adapted for Colombia and available in the SIAC (Environmental Information System of Colombia).

The Forest-Non Forest raster layers of the selected reference area were then cut and buffered to avoid empty spaces when crossing the layer information. These layers were then converted to vector format (shape) and checked for areas without information and with clouds in the layers used, since these areas cannot be compared for the analysis and cross-referencing of coverages.

Finally, for each available category of the Corine Land Cover map, the corresponding land cover categories with aerial biomass values were homologated according to the emission factors presented by IDEAM. (See PDD Figure 17. Map of land use change for the years 2005 to 2015).

15.3. PROJECT AREA

The REDD+ project area and its land uses related to the amount of hectares of forest and non-forest are specified below.

Table 24. Total forest and non-forest areas of REDD+ projects

Class	Area (ha)

forest	8958
No forest	33448
Total	42406

Source: Cataruben Foundation

The total forest and non-forest project area is 42406 hectares and the eligible area (forest) is 8958 hectares.

Table 25. Detailed areas of forest and non-forest for each property

OBJECT ID	Property Name	forest	No forest
1	Buenavista	49	586
2	Villa Aurora	77	21
3	Padrote 1	87	70
4	Padrote	145	75
5	La Regadera	47	277
6	San Cristobal	84	430
7	Flor Amarillo	127	746
8	La Mapora	95	141
9	Las Palmeras	122	702
10	Villa Rica	2969	1431
11	San Andres	89	355
12	La Calzada	357	1368
13	La Guajira	107	536
14	Los Toros	33	1253
15	El Valle	88	960
16	Altamira	794	2123
17	Aquí me quedo	15	5
18	Hato el boral	472	1410
19	El campin	177	253
20	Coco 2	4	7
21	Dera	122	421
22	Las Islas	128	555
23	Macarena	47	70
24	Mata de Palma	382	2311
25	Montana	631	2385

26	Palmarito	35	26
27	Shambala	130	295
28	Trikuti	216	558
29	Arizona	194	689
30	Sonrisa	12	97
31	Buena vista 1	0	912
32	Buena vista 2	63	647
33	Caiman1	32	841
34	Caiman2	69	654
35	Charanga 1	40	791
36	Padrote3	78	102
37	Sarrapios	21	1638
38	Charanga 2	45	684
39	Maricelas	113	155
40	Tabloncito	47	74
41	Versalles	186	245
42	Limonal	81	1607
43	El progreso	34	198
44	Los morrucos	310	4745
Total		8958	33448

Source: Cataruben Foundation

15.4. DETECTION OF CHANGES AND HISTORICAL DEFORESTATION RATES

The formula for the deforestation rate for the quantification of changes due to future deforestation was calculated using the formula recommended by Puyravaud (2003), which is accepted in the application methodology for this project, under the historical average approach. This formula expresses the percentage of forest area decreased per year through the following equation.

The steps to obtain the deforestation rate of land use change in the reference area begin with the cutting of the reference area using the IDEAM maps of forest and non-forest for the period under comparison.

According to the methodological guidelines, the deforestation rate was calculated using the formula given by Puyravaud (2003), according to section 5.5.2.2 of NTC 6208. This formula expresses the percentage of forest area decreased per year, with the following equation:

Being:

R: annual rate of deforestation,

t2 and t1: are the time period for the analysis, in this case 2005 and 2015, respectively.

A2 and A1: are the area of forest at the end and beginning of the analysis period. Replacing the values of the equation with the forest data in the reference area for the years 2005 and 2015 gives an annual rate of 0.77%.

$$r = (\frac{1}{(t_2 - t_1)} * Ln\frac{(A_2)}{(A_1)} * 100$$

This formula is derived from the Compound Interest Law, it is also derived from the average annual rate of change, where, r corresponds to the annual rate of deforestation, t_2 and t_1 are the time period for the analysis, in this case corresponding to the years 2005 and 2015 respectively, and A_2 and A_1 are the area of forest at the end and beginning of the analysis period. Replacing the parameters of the equation with the forest data in the reference area for the years 2005 and 2015 we have an annual rate of **0.77%** and an expected deforestation in the first year of 69 hectares.

For the CO_2 Bio project, removals were calculated by projecting deforestation based on a linear estimate of the loss of forest cover by multiplying the area of the project in 2015 and the deforestation rate. The deforestation projection was made for 40 years until the year 2054 and with a deforestation rate of -0.0077 and an expected deforestation for the first year of 69 hectares, then it is expected to decrease as the remaining forest.

The analysis of the calculation of the removals of the deforestation projection was carried out. For this purpose, a linear estimate of forest loss was taken into account based on the multiplication of the deforestation rate and the current area of the project in 2015.

The deforested area data is generated by comparing the area covered by natural forest in two different time periods, applying operations tools between the maps in raster format to obtain as a result a map of forest cover change (See Chapter 9 Non-forest forest map 2005 2015).

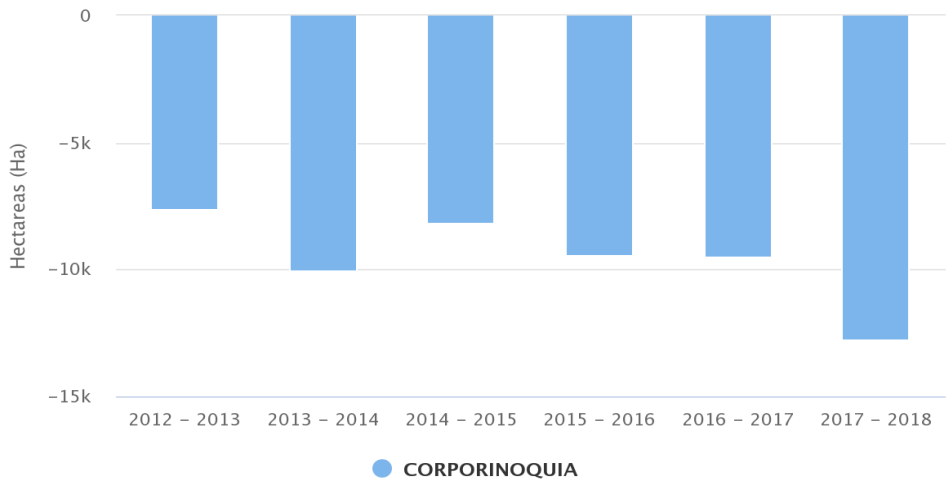


Figure 19. Change in the area of natural forest cover in Corporinoquia's jurisdiction.
Source: (Institute of Hydrology, Meteorology and Environmental Studies - IDEAM. , 2019)

The data reflected in Figure 17 correspond to changes in forest area in the Corporinoquia area and were obtained from the satellite images used and the methodological processes according to IDEAM methodology. And they were designed to identify and quantify deforestation between the years 2012 to 2018 with a scale of 1:100,000 (Galindo G., 2014)) being for the project area the deforestation data presented in this document reflect a local analysis of the reference area.

15.4.1. Deforestation in the project area during the period verified.

From the base information of forest and non-forest maps available and published by IDEAM for the years in comparison. The analysis of change was carried out and it was found that deforestation was 69 hectares for the first year. Using the following equation:

$$A_{BSL,RR,unplanned,t} = A_{BSL,RRD,unplanned,t} * P_{RRL}$$

15.5. LEAKAGE BELT DETERMINATION

The leakage belt (delimitation of the 500 m buffer area around each polygon) has been determined, following the methodologies used in this project.

According to Proclima, the leakage area corresponds to the area of forest to which deforestation activity may be displaced, and which is beyond the control of the REDD+ project holder. In other words, areas to which deforestation agents may be displaced as a consequence of project activities.

The leakage area was delimited based on the following criteria:

a) Includes all areas in forest that are within the range of mobility of deforestation agents.

b) Areas of restricted access to deforestation agents were not included.

c) The areas adjacent to the project area (500m buffer) have similar characteristics to the project area in terms of slope, climate, forest type, elevation, mobility (rivers, roads, etc.).

-The change in land use in the monitored period (2015 to 2019) in that area was 4 hectares and was considered for the purpose of calculating emissions reductions to discount the negative effect of leakage on the project.

$$A_{BSL,RR,unplanned,t} = A_{BSL,RRD,unplanned,t} * P_{RRL}$$

Table 26. Forest and non-forest categories for the leakage area (Buffer).

Category	2015	2019
forest	4254	4250
No forest	16956	16961

Source: Cataruben Foundation

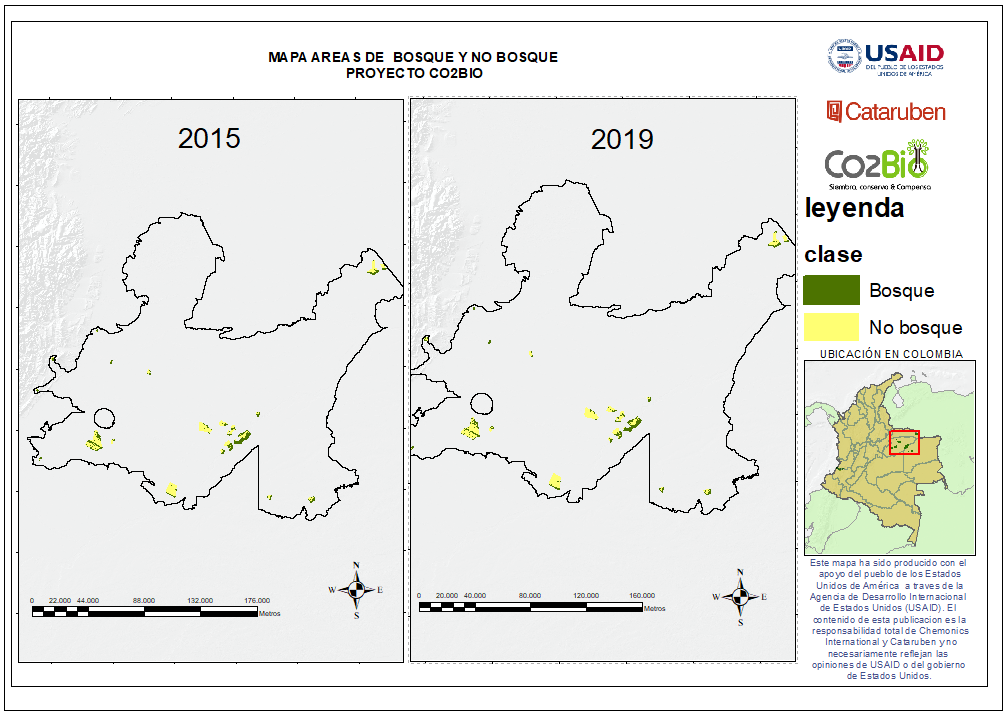


Figure 20. Map of forest and non-forest areas of the CO_2 Bio project.
Source: Cataruben Foundation

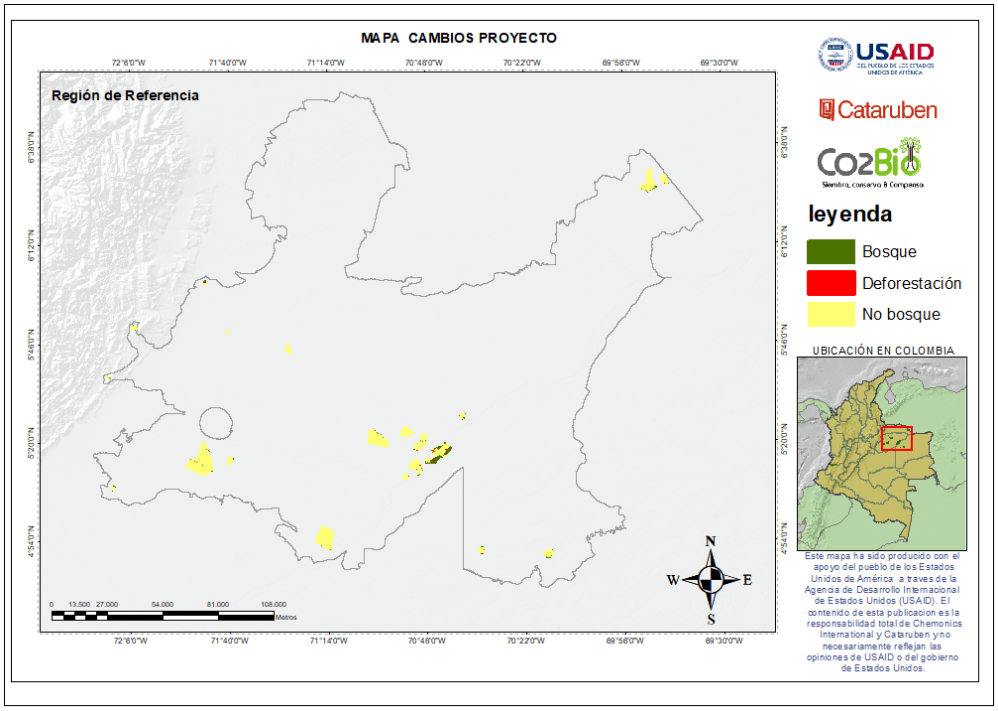


Figure 21. Map of Change of the CO project$_2$ Bio.
Source: Cataruben Foundation

16. CONSIDERATION OF CARBON AND GHG RESERVOIRS

To carry out the analysis of carbon stocks, permanent monitoring plots were implemented, located in the project areas (see Annex F1 of Procedure for the selection and survey of plots), and represented in an unbiased manner for the determination of biomass and subsequent quantification of carbon credits.

For the estimation of the biomass present in the selected carbon pools, the indirect method was used, making use of the allometric equations for biomass estimation provided by NTC 6208 and applicable to estimate the biomass of natural forests in Colombia, which, taking into account our reference region, corresponds to BH-T.

16.1. ABOVEGROUND BIOMASS OF INDIVIDUAL TREES

To estimate the aerial biomass of the CO_2 Bio project, the procedure for the selection and survey of plots was followed (see Annex F2 field inventory by plots), and after this, through office work and with the data collected in the field, allometric equations were used, in this case the one corresponding to the Tropical Rainforest developed by Álvarez et al. (2012), taking into account the Holdridge classification characteristics, all the properties are located in this life zone, characterized according to their temperature and life zones and reflected in the NTC 6208 in Table 4 (Allometric equations used for the estimation of aboveground biomass in natural forests in Colombia).

It should be noted that in the procedure for the selection and survey of plots, additional data to those required for the calculation of biomass according to the selected allometric equation were taken, taking into account possible changes or situations that may arise during the development of the project and that will represent cost overruns in the field data collection.

Thus, the height data of the individuals sampled were disregarded, since the NTC 6208 for the allometric equations in Table 4, the aerial biomass (BA) models are only expressed as a function of the normal diameter (D) of the individuals and the basic density of the wood (ρ); The same happened with the estimates of dead organic matter, specifically for litter, which had been contemplated for sampling, but when the cost-benefit study was carried out with respect to obtaining biomass, its contribution was not significant; therefore, it was decided to exclude this compartment from the calculation of the carbon stock.

Finally, the data obtained for the basic wood density (ρ), (See Annex F2 field inventory by plots - final page of the document), due to the complexity of determining it in the field, the guidelines of the protocol for the national and subnational estimation of the potential carbon stocks stored in the aboveground biomass in natural forests of Colombia were followed, which proposes using the databases reported by the IPCC (2003, 2006), Chave *et al.* among others for tropical species (all of them are available on the websites of the respective institutions). When wood density values are not available for a given species, the average of the higher taxonomic level (Genus or Family) should be used. For individuals without taxonomic information (e.g. indeterminate) the average of the density of the species found in the whole plot should be used, therefore, for

individuals, where the specific wood density was not found, the guidelines described above were followed.

$$BA = exp^{(-2,406+(1,289ln(D))+(1,169(ln(D))2)-(0,122(ln(D))3)+(0,445(\rho)))}$$

16.2. AERIAL BIOMASS FOR PLOTS AND PER HECTARE

Once the suitable allometric equation was selected, the aboveground biomass (BA) was calculated for each tree and the total aboveground biomass (BAT) for each plot. The latter is calculated as the sum of the biomass of all living trees. However, the aboveground biomass value is reported in units of tons per hectare (t ha-1). For this, the value obtained per plot must be multiplied by the conversion factor according to the plot size used. Table 9 of the protocol for the national and subnational estimation of potential carbon stocks stored in aboveground biomass in natural forests in Colombia presents the conversion factors for each of the suggested plot sizes, in this case for the CO_2 Bio project, the correction factor of 4 was taken taking into account that the plot is 0.25 ha; after this, the resulting value is divided by 1000 to take it to tons (Equation 14) of the protocol.

$$BA = (\sum BA) * (\frac{1\,t}{1000\,kg})$$

Where, BA is the aerial biomass; kg is the unit of kilograms; t is the unit of tons; and FC is the conversion factor to be used according to the plot size used.

16.2.1. Conversion of aboveground biomass to carbon

Most studies on carbon storage in tropical forest biomass assume that the biomass of living trees contains approximately 50% carbon (e.g., MacDicken 1997, Fearneside et al. 1999, Clark et al. 2001b, Malhi et al. 2004, Chave et al. 2005, Aragão et al. 2009); therefore, it is suggested to use the factor of 0.5 to transform biomass to carbon.

16.2.2. Conversion of calculated carbon to CO2 equivalent

To convert the amount of carbon (stored or emitted) by forest ecosystems, the IPCC (2003 - 2006) recommends using the factor of 44/12 = 3.67. This factor results from dividing the atomic weight of a molecule of carbon dioxide by the specific weight of carbon.) In other words, the amount of tons of carbon stored in forests is multiplied by 3.67.

$$CBFeq = BT\ x\ f\ x\ \frac{44}{12}$$

Where:

CBFeq = carbon dioxide equivalent contained in total biomass; tCO2eha-1

BT = Total biomass; t ha-1 *f* = Carbon fraction of dry matter.

The following table shows the geographic coordinates of the location of the plots where the primary information for the biomass calculation was obtained.

Table 27. Location of permanent monitoring plots.

DEPARTMENT	MUNICIPALITY	#	PROPERTY	COORDINATES N	W
Casanare	Tamara	1	Versalles	05°43'44.8"	72° 5'6.19"
	Cravo Norte	2	Valle	6°27'41.38"	69°44'59.28"
	Orocue	3	Buena Vista 2	04° 53' 43.1"	71° 17' 16.4"
		4	Charanga 2	4°52'13.17"	71°15'12.16"
		5	Caimán 2	4°52'7.25"	71°14'24.37"
	Hato Corozal	6	Villa Aurora	06°02'18.3"	71°46'29.6"
	Paz De Ariporo	7	Las Islas Rn Aves de Jah	05°43'44.8"	71°24'24.97"
		8	Macarena	5°49'40.35"	71°40'15.81"
	San Luis de Palenque	9	Mata De Palma	05° 17' 12.9"	071° 46' 13.6"
		10	Altamira	05° 14' 29.8"	071° 47' 55.6"
		11	El Boral	5° 18' 4.68"	71° 46' 41.699"
		12	Montana	05° 12' 33.8"	71° 44' 33.7
		13	Buena Vista	5°15'49.15"	71°39'55.36"
	Trinidad	14	El Campín	5°27'2.91"	70°37'56.69"
		15	San Cristóbal	05° 19' 55.21"	70° 48' 54.15"
		16	San Andrés	05° 18' 1.46"	70° 50' 26.15"
		17	Sonrisa	05° 22' 15.96"	70° 51' 34.85"
		18	El Limonal	05° 22' 28.64"	70° 52' 5.79"
		19	Palmeras	05° 20' 6.7"	70° 48 49.645
		20	Medano los Morrucos	5°21'28.53"	71° 0'51.34"
		21	Regadera	5°18'5.33"	70°51'9.40"
		22	Padrote 1	05° 12' 10.49"	70° 49' 40.16"
		23	Padrote 3	5°13'3.50"	70°50'24.25"
		24	Maricelas	05°14' 59.453"	70° 47' 52.987"

		25	Miravalle	05° 16' 10.05"	70° 44' 1.24"
		26	La Mapora	05° 10' 2.693"	70° 53' 28.36"
		27	Progreso	05° 11' 15.2"	070° 53' 46.9"
		28	Flor Amarillo	05° 13' 19.01"	70° 51' 59.7"
		29	Arizona	05° 13' 29.6"	70° 50' 13.9"
Arauca	Cravo Norte	30	Calzada	6°26'18.57"	69°50'39.54"
Vichada	Nazareth	31	Shambala	4°49'22.86"	70°16'10.78"

Source: Cataruben 2020 Foundation

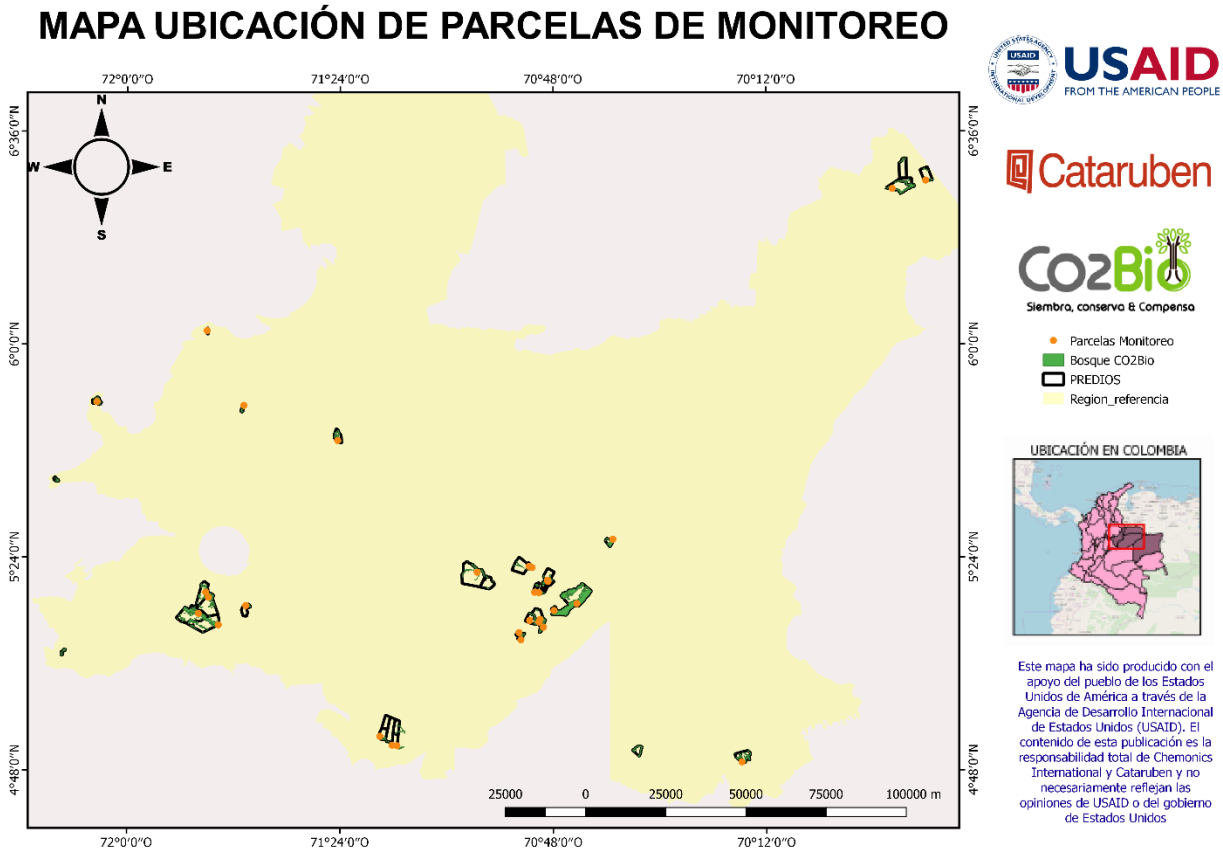


Figure 22. Location map of permanent monitoring plots. Source: Cataruben Foundation

For the 31 permanent monitoring plots, the protocol for the national and subnational estimation of biomass - carbon in Colombia (IDEAM 2011) was followed as established in section 3.1. Type, size and number of plots. Taking into account the above, the type of plot established corresponds to a permanent measurement, which is statistically more efficient and allows monitoring the changes registered in the carbon compartments of interest over time, regarding

the size of the plots according to the protocol, it is recommended to use plots of 0,25 ha (50 m x 50 m) because it is the most appropriate size to reach the required error in carbon estimates (±10% with 95% confidence) in forestry projects and finally the number of plots which complies with the summary in Table 4 of the protocol (Plot size and number of sampling units to reach the required error (with 95% confidence) in carbon estimates.), finding that for a margin of error of ± 10 a minimum of 27 plots of 0.25 ha should be implemented, however, this information was verified with the decision tables in Annex 2, since, with this procedure any project developer dispenses with investing resources in pre-sampling, and omits the step of calculating the number of plots (n) described in section 4.3 of Chapter I of the protocol, therefore, in Annex 2 (Decision matrices for the selection of the number of plots according to the required size and error) of Table 4 corresponding to the local analysis of seasonal tropical rainforest, with 31 monitoring plots of 50 X 50, identifies the percentage of error of **9.168, which** is within the required range of ±10% with 95% confidence. (See Annex C 1.4 Photographic record).

16.3. ESTIMATION OF BIOMASS CARBON CONTENT IN SOILS.

It was determined from the Proposed Reference Level of Forest Emissions from Deforestation in Colombia for Payment for REDD+ Results under the UNFCCC (Table 3. Soil organic carbon (COS), COS20Years and COSeq for five natural regions. For the Orinoquia).

$$COSeq = \frac{COS}{20} \; x \; \frac{44}{12}$$

Where:

COSeq = Carbon dioxide equivalent contained in soils; tCO2e ha-1.

COOS = Soil carbon content; tC ha-1.

(attachment: CATARUBEN_PROJECT_CALCULOS_CARBON_V4).

Figure 23. Soil organic carbon (COS), COS 20 YEARS and COSeq for five natural regions.

Bioma	COS (TC/ha)	$COS_{20AÑOS}$ (TC/ha)	COSeq (tCO_2eq/ha)
Amazonía	74	4	14
Andes	125	6	23
Caribe	101	5	19
Orinoquía	65	3	12
Pacífico	92	5	17

Source: Proposal For A Reference Level Of Forest Emissions From Deforestation In Colombia For Payment For Redd+ Results Under The Unfccc. Minambiente And Ideam, 2019.

Table 28. ESTIMATION OF BIOMASS CARBON CONTENT IN SOILS.

project forest area	Carbon stored (t/ha)	CO2 Soils,stratum, i (tCO2 ha-1)	Total
8958	65	238,3	2.134.990,0

Source: Cataruben Foundation

16.4. ESTIMATION OF CARBON CONTENT IN BELOW-GROUND BIOMASS.

According to IPCC definitions, belowground biomass is all living root biomass excluding fine roots less than 2MM in diameter.

To estimate the below-ground biomass, the IPCC provides guidance for national GHG inventories, establishing a relationship between above-ground and below-ground biomass based on the region where it is located. The existing ratio according to the area where the project is located is 0.24, value given for the ecological zone "Tropical rainforest".

Table 29. Ratio of belowground biomass to aboveground biomass (R).

Domain	Ecological zone	Aerial biomass	R
			[t root d.m. (t d.m.)]$^{-1}$
Tropical	Tropical rainforest	-	0,37
Tropical	Tropical moist deciduous forest	aboveground biomass <125 t ha^{-1}	0,20 (0,09 - 0,25)
Tropical	Tropical moist deciduous forest	aboveground biomass >125 t ha^{-1}	0,24 (0,22 - 0,33)
Tropical	Tropical dry forest	aboveground biomass <20 t ha^{-1}	0,56 (0,28 - 0,68)
Tropical	Tropical dry forest	aboveground biomass >20 t ha^{-1}	0,28 (0,27 - 0,28)
Tropical	Tropical shrubs	-	0,4
Tropical	Tropical mountain systems	-	0,27 (0,27 - 0,28)
Subtropical	Subtropical rainforest	aboveground biomass <125 t ha^{-1}	0,20 (0,09 - 0,25)
Subtropical	Subtropical rainforest	aboveground biomass >125 t ha^{-1}	0,24 (0,22 - 0,33)
Subtropical	Subtropical dry forest	aboveground biomass <20 t ha^{-1}	0,56 (0,28 - 0,68)
Subtropical	Subtropical dry forest	aboveground biomass >20 t ha^{-1}	0,28 (0,27 - 0,28)
Subtropical	Subtropical steppe	-	0,32 (0,26 - 0,71)

Source: IPCC

(2006)

Table 30. ESTIMATION OF CARBON CONTENT IN BELOW-GROUND BIOMASS.

Carbon AB_tree,stratum,i (t C ha-1)	Root to shoot ratio	C_BB_tree,stratum,i (tC ha-1)	CO2_BB_tree,stratum,i (tCO2 ha-1)	Area (hectares)	C_BB_tree,stratum,total (tCO2)
186,0	0,24	44,6	163,7	8.958,0	1.466.245,4

Source: Cataruben Foundation

16.5. CARBON IN END-USE LAND USE CATEGORIES AFTER DEFORESTATION

The post-deforestation land use categories were calculated from the results of the land use change matrix, the carbon values in the aboveground biomass of the non-forest classes specified in table 6 of the NTC 6208 protocol and the aboveground biomass/underground biomass ratio according to IPCC (2006). As with aboveground carbon in forest areas, a weighted average of aboveground and belowground carbon in relation to the percentage of the area that has been deforested in each of the non-forest categories was performed.

16.6. REMOVALS BY AVOIDING LAND USE CHANGE

To calculate the 40-year emission removals in the current project area, the carbon content avoided by the change in use was multiplied by the area to be deforested annually. The removals expected from avoided deforestation processes in the project area include the discount of a 15% reserve for uncertainty and non-permanence (see annex F3 CATARUBEN_PROJECT_CALCULOS_CARBONO_V3.1).

16.7. AVOIDED DEFORESTATION REMOVALS

The analyses were performed using the formulas for calculating reductions from avoided deforestation processes throughout the project area. These include the corresponding leakage projected in the ex ante analysis for the entire period 2020 to 2054 and also the subtraction of the leakage issued in the ex post assessment for the corresponding time period 2015 to 2019. Finally, as stipulated to cover uncertainty and non-permanence risks, 15% of the potential carbon reduction was subtracted (Annex: CATARUBEN_PROJECT_CALCULOS_CARBON_V3.1).

The data found in Table 31 were determined from the following formulas:

- **Total carbon emission factor**

$$CTeq = CBFeq + COSeq$$

Where:

CTeq = total carbon dioxide equivalent; tCO2e ha-1

CBFeq = carbon dioxide equivalent contained in total biomass; tCO2eha-1

COSeq = Carbon dioxide equivalent contained in soils; tCO2e ha-1.

- **GHG emissions in the period of analysis**

The annual emission from deforestation in the without-project scenario is calculated according to

$$EAlb = CSBlb\ x\ CT_{eq}$$

Eq.

Where:

EAlb = annual emission in the without-project scenario; tCO2 ha-1

CSBlb = annual historical deforestation in the without project scenario; ha

CTeq = total carbon dioxide equivalent; tCO2e ha-1

The annual emission from deforestation in the project scenario is calculated according to the

$$EAim = CSBim\ x\ CT_{eq}$$

equation:

Where:

EAim = Annual emission in the with-project scenario; tCO2 ha-1

CSBim = annual projected deforestation with REDD project; ha

CTeq = total carbon dioxide equivalent; tCO2e ha-1

The annual emission from deforestation in the leakage area is calculated following the equation:

$$EAf = CSBf\ x\ CT_{eq}$$

Where:

EAf = annual emission in the leakage area; tCO2 ha-1

CSBf = annual projected deforestation in the leakage area; ha.

CTeq = total carbon dioxide equivalent; tCO2e ha-1

- **GHG emission reductions expected from the implementation of REDD+ activities**

Emission reductions from avoided deforestation in the project scenario are estimated according

$$RE = (t_2 - t_1)\ x\ (EAlb - EAim - EAf)$$

to the equation:

Where:

RE = avoided deforestation emissions reduction in the with-project scenario; tCO2e

*t*2 = Final year of the reference period.

*t*1 = Start year of the reference period.

EAlb = annual emission from deforestation in the baseline scenario; tCO2e

EAim = annual emission from deforestation in the project area; tCO2e

EAf = annual emission from deforestation in the area of leakage; tCO2e

Table 31. Estimated emission reductions from deforestation

TIME (YEARLY)	Annual reduction of deforestation (t CO2)	Projected leakage (t /CO2e)	Emission reductions per year (tCO2e)	Non-permanence risk 15% (t CO2)	Net annual emission reductions (t CO2)	Cumulative net annual emissions reduction (t CO2)
2015	53.901	1.076	52.826	7.924	44.902	44.902
2016	53.382	1.076	52.306	7.846	44.460	89.362
2017	52.866	1.076	51.790	7.769	44.022	133.383
2018	52.354	1.076	51.278	7.692	43.587	176.970
2019	51.846	1.076	50.770	7.616	43.155	220.125
2020	64.057	860	63.197	9.480	53.717	273.842
2021	63.557	860	62.697	9.405	53.292	327.135
2022	63.061	860	62.201	9.330	52.871	380.006
2023	62.569	860	61.709	9.256	52.453	432.458
2024	62.080	859	61.221	9.183	52.038	484.496
2025	61.596	859	60.736	9.110	51.626	536.122
2026	61.115	859	60.256	9.038	51.217	587.339
2027	60.638	859	59.779	8.967	50.812	638.151
2028	60.164	859	59.305	8.896	50.409	688.561
2029	59.694	859	58.835	8.825	50.010	738.571
2030	59.228	859	58.369	8.755	49.614	788.185
2031	58.765	858	57.907	8.686	49.221	837.406
2032	58.306	858	57.448	8.617	48.831	886.236
2033	57.851	858	56.993	8.549	48.444	934.680
2034	57.399	858	56.541	8.481	48.060	982.740
2035	56.950	858	56.092	8.414	47.678	1.030.418
2036	56.505	858	55.647	8.347	47.300	1.077.718
2037	56.063	857	55.206	8.281	46.925	1.124.643
2038	55.625	857	54.768	8.215	46.552	1.171.195
2039	55.190	857	54.333	8.150	46.183	1.217.378
2040	54.758	857	53.901	8.085	45.816	1.263.195
2041	54.330	857	53.473	8.021	45.452	1.308.647

2042	53.905	857	53.049	7.957	45.091	1.353.738
2043	53.484	856	52.627	7.894	44.733	1.398.472
2044	53.065	856	52.209	7.831	44.378	1.442.849
2045	52.650	856	51.794	7.769	44.025	1.486.874
2046	52.238	856	51.382	7.707	43.675	1.530.549
2047	51.829	856	50.973	7.646	43.327	1.573.876
2048	51.424	856	50.568	7.585	42.983	1.616.859
2049	51.021	855	50.166	7.525	42.641	1.659.500
2050	50.622	855	49.766	7.465	42.301	1.701.801
2051	50.225	855	49.370	7.406	41.965	1.743.765
2052	49.832	855	48.977	7.347	41.630	1.785.396
2053	49.442	855	48.587	7.288	41.299	1.826.695
2054	49.054	855	48.200	7.230	40.970	1.867.664

Source: Cataruben Foundation

The total value of the project's emissions reduction over the 40-year crediting period is 2,197,252 (t CO2) and taking into account the 15% discount is 1,867,664 (t CO2).

Finally, the value of the emissions reduction of the project in the 5-year monitoring period is 258,970 (t CO2) and taking into account the 15% discount is 220,125 (t CO2).

16.8. ESTIMATED EMISSION REDUCTIONS FOR THE MONITORING PERIOD

The total project emissions without discounts required for the period 2015 to 2019 (5 years) is 264,348.8 (t CO2). Of which a leakage discount of 5,378.4 (t CO2) and a non-permanence discount of 15% of 38,845.6 (t CO2) were made to obtain and claim this first year an amount of 258,970 (t CO2).

The respective ex post emissions of the project were added to the deforestation transition observed during this verification period corresponding to the period from 2015 to 2019.
On the other hand, no events of any type of disturbance have been recorded between the monitoring period from 2005 to 2015, which have altered the calculated greenhouse gas emission reductions, as defined by the NTC 6208 Standard (see Annex F3 CATARUBEN_PROJECT_CALCULOS_CALCULOS_CARBON_V4).

- **GHG emissions during the period of analysis**

The annual emission from deforestation in the project area is calculated following the equation:

$$EAim, m = CSBim, m \; x \; CT_{eq}$$

Where:

EAim, *m* = annual emission in the project area; tCO2 ha-1

CSBim, *m* = Annual deforestation in the project area; ha.

CTeq = total carbon dioxide equivalent; tCO2e ha-1

The annual emission from deforestation in the leakage area is calculated following the equation:

$$EAfm = (CSBfm\ x\ CT_{eq}) - EAf$$

Where:

EAfm = annual emission in the leakage area; tCO2 ha-1

CSBfm = Annual deforestation in the leakage area; ha.

CTeq = total carbon dioxide equivalent; tCO2e ha-1

EAf = Annual emission of deforestation in the leakage area in the baseline scenario; tCO2e

- **Quantification of the Project's emission reductions**

Emission reductions from avoided deforestation in the monitoring period are estimated according to the equation:

$$REm = (t_2 - t_1)\ x\ (EAlb - EAim, m - EAf, m)$$

Where:

REm = avoided deforestation emission reductions in the monitoring period; tCO2e

*t*2 = End year of monitoring period.

*t*1 = Year of start of monitoring period.

EAlb = annual emission from deforestation in the baseline scenario; tCO2e

EAim, *m* = annual emission of deforestation in the project area for the monitored period; tCO2e

EAf, *m* = annual emission of deforestation in the leakage area for the monitored period; tCO2e

17. MAXIMUM GHG MITIGATION POTENTIAL PROJECT

The stipulations of the Ministry of Environment, IDEAM through RENARE where the project was registered to be subject to national accounting of GHG emission reductions and removals as indicated in paragraph 1 of Article 41 Resolution No. 1447.

For the Orinoquia region where the project is located, IDEAM (SMByC) presented the official data on activities and carbon deposits submitted by Colombia to the UNFCCC. In the case of the CO2BIO project, the variables used by IDEAM were used, such as the definition of forest, global warming potentials, historical deforestation data for the project area and reference region. However, in the case of emissions by forest type, a forest inventory was carried out in the project area strictly following the national methodology for information gathering, analysis and obtaining the amount of aerial forest biomass for the project area.

18. DOUBLE COUNTING

The project will trade carbon reduction units in a single certification program and will be traded in the Colombian voluntary market and through PROCLIMA's platform and is expected to make use of the RENARE platform established in resolution 1447 of 2018 for the management of climate change project information. In the case of quantification calculations in carbon accounting, double counting or the use of overlapping areas is reduced to zero.

19. EVALUATION OF NON-PERMANENCE

In accordance with the PROCLIMA standard (Version 2.3-2020), a reserve of 15% of the total GHG reductions or removals quantified for each verified period is discounted and maintained. This reserve is made in order to guarantee that if events occur that require the replacement of credits placed on the market, the 15% will be used to cover those affected; this discount is already applied to the calculations in the Carbon Calculation V3 annex.

20. REDD+ ACTIVITIES

Project activities have been designed taking into account the problems present in the reference area and working closely with the local community, owners and workers of the properties that are part of CO2Bio. As main agents, they have participated in the identification of the main factors of land use change, deforestation and forest degradation and at the same time have provided suggestions on the types of measures to mitigate the identified agents.

Below are the main activities of the project that will be the fundamental basis for emission reductions, as they will help prevent or reduce deforestation and forest degradation and will allow the regeneration of deforested areas and through this the conservation of biodiversity in the work areas.

20.1. ACTIVITIES TO REDUCE EMISSIONS FROM DEFORESTATION AND FOREST DEGRADATION

Taking into account the causes and agents of deforestation and degradation named in Chapter 15, which are defined for the project reference area, in addition to the environmental conditions of the project area defined in Chapter 9.1, activities are designed and implemented to remove or

reduce Greenhouse Gas (GHG) emissions resulting from deforestation and degradation of natural forests. These REDD+ activities are solid and consistent initiatives that generate environmental and social benefits, in addition to being continuous, thus guaranteeing the short, medium and long term permanence of the CO2Bio project.

The activities are proposed and executed under ten specific purposes, referred to as components, and are defined as follows:

1. Strengthen citizen participation mechanisms related to sustainable forest management.
2. Implement training and monitoring processes to strengthen sustainable forest management and biodiversity conservation.
3. Strengthen the principles of forest governance for landowners in the management of forest resources.
4. Promote forest legality.
5. Promote the delimitation of forests and forest protection areas.
6. Promote agriculture on existing agricultural land.
7. Frequent and detailed monitoring of changes due to deforestation and forest degradation in the CO2BIO project area and its surroundings.
8. Delimit and monitor the environmental conditions of forest regeneration processes of the CO_2 Bio project and its surroundings.
9. Monitor biodiversity variables or indicators in land cover with the use of remote sensing for the project area and its surroundings.
10. Promoting sustainable livestock

It is important to mention that the success of the project activities depends especially on the constant and active participation of all the stakeholders involved in the development of the project, especially the landowners and their residents, since they are one of the main sources for enabling the implementation and preparation of all project activities.

Table 34 shows a. the general components, b. the justification by which this component defines the objectives of the activities and the contribution to the effective development of the project, c. the specific activities, and d. the relationship of each one of them with the causes of deforestation. However, in addition to the above, the annex shows the people responsible for each activity, the deliverable, and the implementation time. Also, in the monitoring section for these mitigation activities.

Finally, it is relevant to indicate that the document Bosques territorio de vida, 2018, designed by the Colombian government as an Integral Strategy to Control Deforestation and Forest Management was taken into account, which provides a global and inter-institutional vision of the protection of our forests.

Table 32. Activities to reduce emissions due to deforestation

ID	Component	JUSTIFICATION/METHODOLOGY	ACTIVITY	RESPONSIBLE	RELATION TO THE CAUSES OF DEFORESTATION	MONITORING FREQUENCY	IMPLEMENTATION DATE
1	Strengthen citizen participation mechanisms related to sustainable forest management.	It is necessary to promote the participation of citizens, especially project beneficiaries, in the different mechanisms for citizen participation: civil society nature reserve networks, community action boards, vigilance boards, rural environmental associations, among other initiatives of rural and peri-urban landowners, since these are spaces for the management, execution and monitoring of rural development, especially projects and activities that affect natural resources or enrich the ecosystem services provided by their properties. It is also important to note that declaring a property as a CSER not only brings ecological benefits, but also allows access to technical support and projects by the National System of Protected Areas (SINAP), as well as economic benefits (exemption from property tax).	a. Training: whose main objective is to raise awareness of the role and importance of citizen participation mechanisms, specifically those mechanisms that are exercised in the area of reference of the project and that can contribute to the fulfillment of mitigation activities.	Cataruben Foundation is responsible for the execution of these trainings.	Underlying causes: social and cultural factors	One time only	Short term: 2021
			b. Provide technical and procedural support to landowners in the declaration of their land as Civil Society Nature Reserves.	Cataruben Foundation is responsible for technical support. For the rest, and in order to make the declaration, the responsible parties are the owners.	Underlying causes: social, economic and cultural factors	Continua	Short, medium and long term (2015-2054)
2	Implement training and support processes to strengthen sustainable forest management and biodiversity conservation.	Pedagogy is a key tool to give value and proper management to the environment, particularly to forests and their biodiversity. Specifically, it seeks to embrace the ancestral and traditional knowledge of the peasant communities, to give it traceability with technical and scientific knowledge, having as a result, guidance in decision making around land use planning and sustainable forest	a. Train landowners on climate change and Greenhouse Gases (GHG), and the relationship with the CO2BIO project.	The Cataruben Foundation is responsible for initially training people on GHG issues.	Underlying causes: social and cultural factors	One time only	Short term: 2015-2020
			b. To train the community in the conservation of biodiversity associated with forests.	Cataruben Foundation	Direct and underlying causes	One time only	Short, medium and long term (2015-2054)

		management. However, the teaching must be accompanied by technical and scientific products that support all the knowledge already acquired and facilitate the conservation and preservation of natural resources.	c. Train the community in sustainable ecosystem management, specifically in forest management.	Cataruben Foundation	Direct and underlying causes	One time only	Short, medium and long term (2015-2054)
			d. Generate an Environmental Management Plan (EMP), which involves actions around the sustainable management of the forest, based on the ancestral knowledge of the owners and the technical-scientific knowledge of the foundation.	Cataruben Foundation is in charge of generating the PMA.	Direct cause: Expansion of the agricultural and livestock frontier	Continua	Short, medium and long term (2021-2054)
			e. Provide technical and scientific support for the fulfillment of the conservation agreements acquired for the execution of the CO2BIO project.	The landowners are responsible for the implementation of the conservation agreements on their properties. The Cataruben Foundation provides technical and scientific support when necessary.	Direct cause: Expansion of the agricultural and livestock frontier	Continua	Short, medium and long term (2015-2054)
			f. Support the resolution of conflicts between humans and felines, through the identification and appropriate management of these and other species.	The Cataruben Foundation is in charge of accompanying and providing scientific knowledge to support this activity.	Underlying cause: Cultural factors	Continua	Short, medium and long term (2021-2054)

3	Strengthen the principles of forest governance for landowners in the management of forest resources.	Forest governance is necessary to strengthen the authority of all actors involved in the management of forest resources, one of them being the landowners. The main purpose is to make known practices that communities can adopt to exercise control over their forests, first of all, protecting them from encroachment, and having clarity on the land use allowed within the forests. One of the relevant and indispensable products for the correct management of the forest and restoration areas are the Forest Management Plans, which propose a series of activities that must be carried out by the owners, in addition to providing stability to the environmental projects to be implemented on the property.	a. Promote and strengthen the issues of laws, organization, leadership, oversight and inter-institutionality, so that forest governance is exercised in the forest lands.	Cataruben Foundation as responsible for the trainings.	Underlying causes: social and institutional factors	One time only	Short term: 2020
			b. Define and implement the Management Plan for the project area, which will allow the owners to exercise this forest governance.	The design and monitoring of the Management Plan is technically and scientifically led by Cataruben. The owner is responsible for its correct implementation.	Underlying cause: cultural factors	Continua	Short, medium and long term (2015-2054)
4	Promote forest legality.	This measure is a forceful strategy to prevent deforestation and degradation of natural forests. It involves training landowners and land managers to recognize the productive actors of legal forest markets and related activities in order to comply with the different requirements at the local level, as required by the environmental authorities.	a. Accompaniment and technical advice in the issuance of permits, licenses and safe-conducts, and related to the forestry industry.	The Cataruben Foundation is in charge of the training. The application and the procedure must be carried out by the owner.	Direct cause: timber extraction	Continua	Short, medium and long term (2015-2054)
5	Promote the delimitation of forests and forest protection areas.	The zoning and delimitation of the project area, through the installation of fences or informative signs, is an activity that contributes to strengthening land tenure status. In addition, physical reminders reinforce proper land use practices to both beneficiaries and outsiders, avoiding deforestation, with emphasis on avoiding the conversion of	a. Workshops and support on how to demarcate forest boundaries in a didactic and legible way that is easy for the whole community to understand.	The responsibility for delimiting the areas of the property is the responsibility of the owner. Cataruben Foundation provides advice for zoning.	Direct cause: Expansion of the agricultural frontier	Continua	Short, medium and long term (2021-2054)

		forests for cropland, settlement and grazing, as well as the illegal extraction of timber.	b. Specify the property zoning card to facilitate this delimitation of conservation areas.	The Cataruben Foundation is responsible for generating the Property Management Plan for each property.	Underlying cause: social factors	One time only	Short term: 2021
6	Promote agriculture on existing agricultural land.	As a result of deforestation and forest degradation due to subsistence agriculture and/or grazing activities in these areas, the sustainable intensification of agriculture in the existing cultivation areas is relevant, whose main purpose is to increase their productivity, with specific actions such as the improvement of agroforestry techniques in these crops.	a. Workshops based on agroforestry techniques according to local crops that can be implemented by the project beneficiaries.	Cataruben Foundation is in charge of the agroforestry workshops in the area.	Direct cause: Expansion of the agricultural frontier	One time only	Short term: 2019
7	Frequent and detailed monitoring of changes due to deforestation and forest degradation in the CO2BIO project area and its surroundings.	Due to the type of forest and multiple natural or anthropogenic threats that could occur and deteriorate the forest, frequent and detailed monitoring of changes due to deforestation and forest degradation in the CO2BIO project area and its surroundings should be carried out. This is necessary for rapid decision making and forest management.	a. Perform image acquisition, processing and analysis with the use of multisensor drone technology (RGB, multispectral, thermal).	Cataruben Foundation	Direct cause: Expansion of the agricultural frontier and natural and anthropic disturbances.	Continua	Short and medium term (2019-2054)
			b. Develop guidance documents for monitoring forest cover change with the use of remote sensing.	Cataruben Foundation	Direct cause: Expansion of the agricultural frontier and natural and anthropic disturbances.	One time only	Short term: 2020
			c. Conduct detailed monitoring of the project area and its surroundings with the use of remote sensing (optical /Radar).	Cataruben Foundation	Direct cause: Expansion of the agricultural frontier and natural and anthropic disturbances.	Continua	Short and medium term (2015-2054)
				Cataruben Foundation		Continua	Short and medium term (2015-2054)

8	Delimit and monitor the environmental conditions of forest regeneration processes of the CO2BIO project and its surroundings.	According to the dynamics of the project area, there are frequent regeneration processes that must be identified and monitored in order to secure new forest areas in the future and a greater number of carbon credits that could help to invest more resources in the region.	a. Identify and map areas of regeneration gain or loss.	Cataruben Foundation	Direct cause: Expansion of the agricultural frontier and natural and anthropic disturbances.	Continua	Short and medium term (2015-2054)
			b. Monitor environmental conditions of forest regeneration processes and possible management alerts.			Continua	Short and medium term (2015-2054)
9	Monitor biodiversity variables or indicators in land cover with the use of remote sensing for the project area and its surroundings.	The project area and surrounding area is a strategic area of great biodiversity richness that must be known and monitored to maintain and increase its potential.	a. Document monitoring of biodiversity variables or indicators in coverages with the use of remote sensors for the project area and its surroundings.	Cataruben Foundation	Direct cause: Expansion of the agricultural frontier and natural and anthropic disturbances.	One time only	Short term: 2021
			b. Conduct detailed monitoring of the project area and its surroundings with the use of remote sensing (optical /Radar).			Continua	Short and medium term (2015-2054)
10	Promoting sustainable livestock	Sustainable livestock farming is one of the actions that will improve the production of the livestock business through environmentally friendly work, with the use of different types of trees integrated into livestock production (silvopastoral systems), and the conservation of native forests on your farm.	a. Train owners and collaborators in sustainable livestock practices.	Cataruben Foundation and other entities	Direct cause: Expansion of the agricultural frontier and natural and anthropic disturbances.	Continua	Short and medium term (2015-2054)
			b. Identify applicable activities (with the possibility of implementation in the short, medium and long term) on the farms to make livestock farming sustainable.	Cataruben Foundation		Continua	Short and medium term (2015-2054)
			c. Formulate a sustainable livestock plan for the project execution area.	Cataruben Foundation		Continua	Short and medium term (2015-2054)
			d. Implementation of the activities in the project area.	Owners		Continua	Short and medium term (2015-2054)

20.1.1. REDD+ Activities Implemented During the Verification Period (2015-2019)

In the project area, conservation and preservation activities have been carried out in the forest associated with the flooded savannah, which is the characteristic ecosystem of the region in question. These activities have been innate and transgenerational of farmers, who have dedicated their lives to the work of the plains, which makes them strategic connoisseurs of the natural system of the region, and who consciously or unconsciously have contributed to the care of biodiversity, and have implemented actions that, being potentialized, contribute to the reduction of emissions from deforestation and forest degradation.

As described in the previous sections, the project area is made up of different landowners located in strategic areas of the departments of Casanare, Arauca and Vichada. The landowners have directed the development of their economic activities (generally agriculture and livestock) in a way that respects the local flora and fauna, thus influencing the ecosystem of the entire region and helping to raise awareness among neighboring landowners, and have even joined forces among themselves in favor of conservation and forest governance.

The CO2Bio project formally began its activities in 2015 (See Annex C.1.11), since it is the year in which legally and contractually, technical, scientific and social activities are mixed, however, the conservation initiative began years ago, as a preparatory stage with the owners, where the seed of wanting to care for and prevent further damage to the environment and the natural paradise of the eastern plains is planted.

In this way, the results and scope of the different REDD+ activities that have been carried out in the project area are listed:

20.1.1.1. Component 1: Strengthen the intervention in citizen participation mechanisms related to sustainable forest management.

One of the goals achieved in this component is the technical and procedural support to landowners in declaring their properties as Civil Society Nature Reserves (RNSC). In total, of the 44 properties, 30 have already been declared reserves, that is, 75% of the properties representing approximately 23,102 hectares, 5 years after the accreditation of the project.

The declaration of Civil Society Nature Reserves is one of the private instruments to contribute to national strategies for the conservation and efficient and comprehensive management of natural resources and biodiversity within the scope of the country's environmental policy and legislation.

The strategy of conservation through CSERs in the region of reference will contribute to an experience that allows us to learn about the relationship between private conservation and the conservation efforts of state initiatives, where a set of protected areas on private land, add up in the construction of biological corridors for species with some category of threat and in the provision of ecosystem services of local and regional importance.

Each property linked to the project that has a declaratory resolution is shown below:

Table 33. Declared properties, with the RNSC that accredits them, and the area under this act.

No	NAME OF THE PROPERTY	RESOLUTION	NAME OF THE RESERVE	LOWLAND AREA (RNSC) Hectares
1	Versalles	RNSC Resolution No 138 November 14, 2014, and RNSC Resolution No 089 August 10, 2016.	Versailles plateaus	414,49
2	Palmarito	RNSC Resolution No 067 May 30, 2017	Sunrise in the palm grove 2	52
3	COCO 2			9,91
4	Aquí me quedo	RNSC Resolution No 048 April 27, 2017	Sunrise in the palm grove 1	17, 95
5	Buenavista 1	RNSC Resolution No 051 April 27, 2020	Buenavista	673,35
6	Buenavista 2			686,67
7	Charanga 1	RNSC Resolution No 053 April 27, 2020	Charanga	702,44
8	Charanga 2			686,26
9	Caimán 1			352,26
10	Caimán 2			352, 30
11	Sarrapios	RNSC Resolution No. 054 April 27, 2020	The Sarrapios	1380,29
12	Mata de Palma	RNSC Resolution No. 078 May 30, 2019	Palm bush	2597,56
13	Altamira	Resolution RNSC N° 043 04 April 2019	Altamira	2941, 13
14	El Boral	Resolution RNSC No. 096 June 19, 2019 and Resolution RNSC No. 042 April 04, 2019	El Boral	1572, 61
15	Montana	RNSC Resolution No. 079 May 30, 2019	Montana	2898, 82
16	El Campin	RNSC Resolution No. 082 December 21, 2012	El Campin	418,77
17	San Cristobal	RNSC Resolution No. 065 September 02, 2013	San Cristobal 2	390,81
18	San Andrés	RNSC Resolution No. 058 August 28, 2013	San Andres Caño El Garcero	593,81
19	Sonrisa	RNSC Resolution No. 081 December 21, 2012	The Smile	114,59
20	El limonal	Resolution RNSC N° 005 06 March 2013	Limonal	1625, 31
21	Palmera	RNSC Resolution No. 068 September 2, 2013 and RNSC Resolution No. 099 July 12, 2017.	Palms	804, 47
22	Los Morrucos	RNSC Resolution No. 143 September 21, 2017	Los Morrucos Dune	4.968,33
23	Padrote 1	RNSC Resolution No. 193 November 30, 2018	Padrote 1	146, 41
24	Padrote 2	RNSC Resolution No. 194 November 30, 2018	Padorte 2	110,58
25	Padrote 3	RNSC Resolution No. 192 November 30, 2018	Padrote	202, 49
26	Mira Valle	RNSC Resolution No. 191 November 30,	Miravalles	6405,38

		2018		
27	Flor Amarillo	RNSC Resolution No. 190 November 30, 2018	Yellow Flower	832,93
28	Trikuti	RNSC Resolution No. 088 July 10, 2015	Tomovida-Trikuti	775,38
29	Shambala	Resolution RNSC N° 084 09 July 2015	Tomovida-Shambala	410,96
30	El Dera	RNSC Resolution No. 087 July 10, 2015	I take life - El Dera	525,91

Source: Cataruben Foundation and RUNAP 2020

It is important to mention that the declaration of a property as an RNSC takes a step by step process that takes between one and three years approximately, from the initiation of each file to the notification that resolves the process, where the owners require constant technical and scientific support. The steps are mentioned in the following chart N°1:

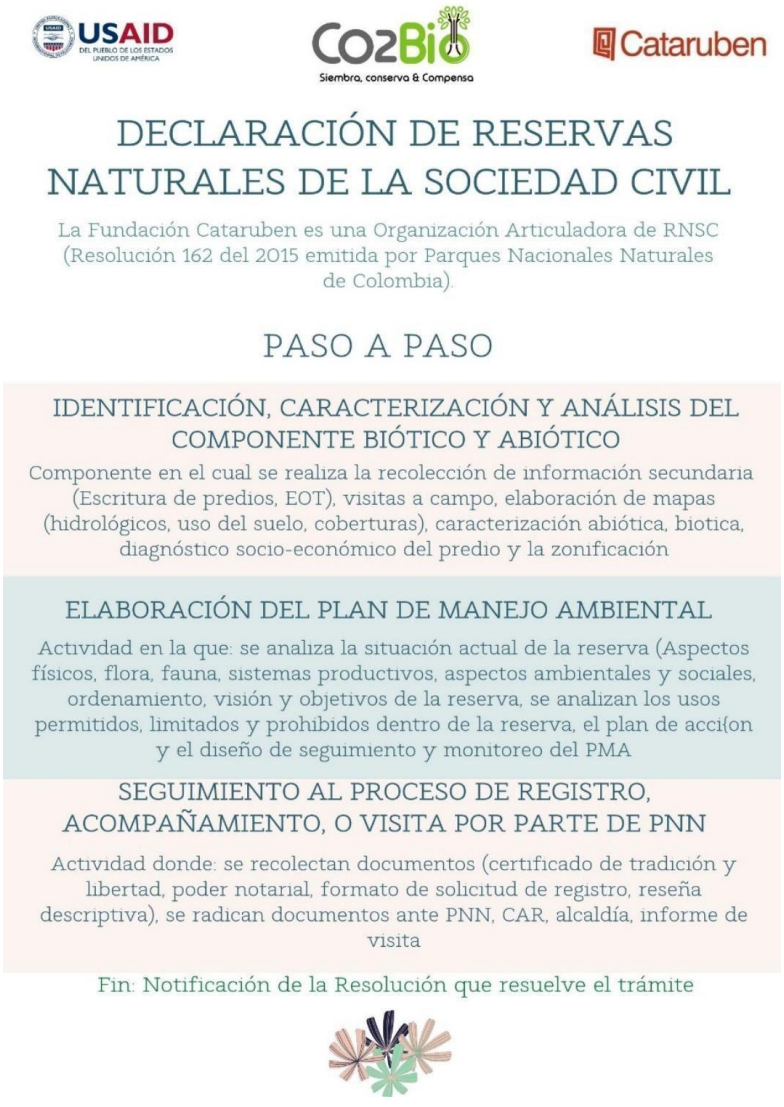


Figure 24. Step-by-step sheet for the RNSC declaration.

As mentioned above, the year of initiation of REDD+ activities is formally 2015, however, properties such as Trikuti, Shambala and El Dera were accompanied since 2013 with the initiation of each file. Starting in 2015, the implementation of their management plan began, highlighting improvements in environmental, economic and productive aspects through the application of surveillance activities, supervision of their boundaries and forest areas (forest guards), maintenance of vegetation in the protective edges of water sources, elimination of activities such as logging, burning and drying of savannas, improvements in the construction and infrastructure of the property, empowerment, commitment and access to knowledge through the training provided.

The properties with RNSC resolution issued after 2015 to the current date correspond to own products of efforts and actions carried out by the owners through the accompaniment and guidance of the CO2BIO project, in these properties the same mitigation activities and good agricultural practices mentioned in the previous paragraph were developed.

In this way, sustainable production on the land was improved and the training provided support and empowerment on issues related to land planning, sustainable forest management and biodiversity conservation, this is summarized in a greater number of hectares under better management. Finally, there are 14 properties that are not legally reported as a civil society nature reserve (RNSC), however, they have the same concept of conservation, mitigation and adequate management of their territory (See Annex C.1.1).

20.1.1.2. Component 2: Implement training and accompaniment processes to strengthen sustainable forest management and biodiversity conservation.

Throughout these years (2015-2020), pedagogy has been used as a key tool to guide the decision making process of the landowners regarding their activities, and the forms of conservation and preservation of forests and the ecosystem in general in the region. Although REDD+ actions are materialized in a specific topic, this takes a process that begins with training, awareness, and knowledge formation in each one, where not only the landowners learn, but also the technical and scientific group is nourished by ancestral and traditional knowledge, thus forming synergies of knowledge that are applicable to the CO2Bio project.

a) Train landowners on climate change and Greenhouse Gases (GHG), and the relationship with the CO2BIO project.

Since 2015, in the training for the different declarations of reserves or in the execution of other types of activities, the topic of climate change has been present, not only in mitigation, but also in adaptation to the different natural phenomena that may occur in the region. Likewise, with the legislative changes in the last 5 years in terms of climate change, this has allowed this specific issue to gain more strength, and also supports the objective of the CO2BIO project.

In Annex C.1.3 of trainings, evidence of some meetings that have been documented in relation to this topic can be found, in addition to the Forum called "Biodiversity and Carbon Credits" held in February 2020, which was attended by more than 600 people, and more than 3,000 viewers on the Facebook platform.

b) Train the community in the conservation of biodiversity associated with forests.

One of the strategies to get the owners and farmers of the region involved in the care of the forest is to highlight the biodiversity associated with them, specifying the richness in flora and fauna that characterizes the region, allowing a greater sense of belonging to biodiversity. Annex C.1.3 shows a record on this topic.

c) Train the community in the sustainable management of ecosystems, specifically in forest management

Sustainable forest management is reflected in specific actions by landowners, according to the economic activity they carry out on their properties, but with the same objective of conserving the ecosystem in general. Therefore, training is focused on avoiding, for example, the expansion of the agricultural frontier, which is one of the main causes of deforestation and forest degradation in the reference area, or strengthening the exercise of forest governance on the properties, in order to prevent third parties from damaging the forest. Annex C.1.3 shows a record on this issue.

d) Generate an Environmental Management Plan (EMP) that involves actions for the sustainable management of the forest, based on the ancestral knowledge of the owners and the technical-scientific knowledge of the foundation.

The Environmental Management Plans are an integral tool that allows us to understand the environmental, social and economic context of the properties; based on this, the activities that are key to the conservation process and the implementation of REDD+ activities are generated.

e) Provide technical and scientific support for the fulfillment of the conservation agreements acquired for the execution of the CO2Bio project.

This activity has been carried out from the moment the landowners initiate the conservation process, starting with knowing the socioeconomic context of the landowners, doing reconnaissance on the property, gathering information of environmental interest, among others.

This point is transversal to all other activities, since technical and scientific support is provided, from the signing of the letters of intent, technical visits, training, and CSR declarations, and not only in person, but also via telephone and general interest mailings. Annex C.1.2 shows field logs related to the different visits that have taken place throughout the project.

f) Support the resolution of conflicts between humans and felines, through the identification and appropriate management of these and other species.

The development of this activity has been strengthened by the alliance with the Panthera organization, where they have joined forces for conservation and proper management of possible conflicts that may arise between the population and the felines in the area.

This support begins specifically with the recognition of the felines that surround the area, with the use of camera traps that rest in strategic points of the region of reference, training and

documents of general interest are also taken into account so that they appropriate the type of felines and the ways to resolve conflicts in the area of the project. Annex C.1.5 shows a record on this subject.

20.1.1.3. Component 3: Strengthen the principles of forest governance for landowners in the management of forest resources.

a) Promote and strengthen the issues of laws, organization, leadership, oversight and inter-institutionality, so that forest governance is exercised in the properties.

One of the issues that sustains this project, and any conservation exercise, is the issue of forest governance, where the owners take control of their properties, and seek alliances first with nearby neighbors, and also the support of governmental entities such as the Community Action Boards, municipalities, and other strategies for this activity. Annex C.1.6 shows some records of the basic information on forest governance on the properties.

b) Define and implement the Management Plan for the project area, which will allow the owners to exercise this forest governance.

The management plan is a document that is generated for the properties, which not only takes into account the environmental aspects, but also determines activities that allow for proper execution (see Annex C.1.6 for evidence of some characterizations and management plans).

20.1.1.4. Component 4: Promoting forest legality.

a) Accompaniment and technical assistance in the issuance of permits, licenses and safe-conducts, and related to the forestry industry.

However, it should be noted that in order to issue a permit, license or safe-conduct related to forestry, there must be technical data on the property, such as: the type of forest to be harvested, exact area in hectares, species of trees to be harvested, among other data and documents that can be provided by the professional support of the CO2Bio project, so that when the permit is required, there is already a previous process in place. Annex C.1.7 shows the form requested by the Regional Environmental Corporation.

20.1.1.5. Component 5: Promoting the delimitation of forests and forest protection areas.

a) Specify the property zoning card to facilitate the delimitation of conservation areas.

Property zoning is an activity that is also transversal to the different products generated by the project. For Civil Society Nature Reserve declarations, the property is zoned to distinguish between conservation, buffer and economic activity areas. Likewise, for the Management Plans, the topic of land planning is the main focus, where activities that contribute to the conservation of the forest and to fulfill the REDD+ actions of the project are strategically defined. Annex C.1.1 shows the zoning for the properties declared as RNSC, and Annex C.1.6 shows the zoning described for the management plans of some properties.

The purpose is to ensure that all the properties have Management Plans with their respective zoning, and to carry out a periodic review to monitor compliance with the activities specified therein.

20.1.1.6. Component 6: Promote agriculture on existing agricultural land.
As mentioned in the section on causes and agents of deforestation and degradation, the expansion of the agricultural and livestock frontier is one of the most influential activities, which is why, from the land planning related in the previous annexes, as well as in the environmental management plans and reserve declarations, the areas to develop this type of activities are specified in detail.

However, there are plans to develop workshops based on agroforestry techniques to improve crop productivity without the need to further expand the agroforestry frontier.

20.1.1.7. Component 7: Frequent and detailed monitoring of changes due to deforestation and forest degradation in the CO2BIO project area and its surroundings.
Based on the national IDEAM methodology, adjusted to the project area, frequent monitoring of potential areas with deforestation processes is being carried out in order to activate forest damage protocols in case of deforestation events (Annex C.1.8: Protocol for monitoring deforestation).

20.1.1.8. Component 8: Delimit and monitor environmental conditions of CO2BIO project forest regeneration processes and surroundings.
Identification and monitoring of potential new areas undergoing natural regeneration processes is underway.

20.1.1.9. Component 9: Conduct monitoring of biodiversity variables or indicators in land cover with the use of remote sensing for the project area and its surroundings.
A protocol for the monitoring of biodiversity variables was developed to start with its implementation and the generation of information from the project area (Annex C.1.9. Study and monitoring of indicators, essential biodiversity variables_CO2BIO).

20.1.1.10. Component 10. Promoting sustainable livestock farming
Sustainable livestock farming allows the production of the business to be boosted, developing this practice while respecting the environment, implementing silvopastoral systems, and conserving the forests on the farms.

It is important to mention that Cataruben Foundation is a participating member of the Casanare sustainable livestock roundtable (See Annex C.1.10). The plan is to develop actions in the following areas:

- Climate change mitigation
- Land management in livestock ecosystems (activity mentioned in previous sections)
- Formalization of livestock properties as RNSC
- Social appropriation of scientific knowledge by livestock farm owners

a) Training owners and collaborators in sustainable livestock practices

In the development of training courses such as "Sustainable Forest Management", it is emphasized that one of the practices that allows an adequate management of the forest is sustainable cattle ranching.

Likewise, this year La Palmita -Research Center- developed a cycle of trainings on "cattle raising and conservation in the savannas of Casanare", whose objective was to strengthen the knowledge and capacities of the owners of cattle farms in floodable savannas, allowing them to improve the integral planning and management of their farms as companies, through traceability, which guarantees a productive and sustainable cattle raising that contributes to the conservation of the ecosystems.

The owners of the CO2BIO project were enrolled in this training, who, through the radio, were able to understand topics such as: implementation of sustainable livestock practices, management of floodable savannahs and water resource management, among others (see Annex C.1.10).

b) Identify applicable activities (with the possibility of implementation in the short, medium and long term) on the farms to make livestock farming sustainable.

The project area, made up of different properties that have already advanced with Civil Society Nature Reserve declarations, has already implemented actions related to sustainable cattle ranching management, consistent with the conservation agreements to which they committed themselves and which are specified in the RNSC resolutions.

Annex C 1.1 shows the commitments of each RNSC, which are basically summarized in reducing the density of livestock per hectare, facilitating natural regeneration, maintaining or increasing the areas of improved pastures, or failing that, as in the case of the VERSALLES property, the economic activity of cattle ranching is prohibited and these areas are set aside for natural regeneration.

In addition, the owners of the project area, in agreement with USAID, the Cattlemen's Committee and the Cataruben Foundation, have implemented specific activities to promote the proper management of pastures to maintain soil cover, protect and expand areas of forests, morichal forests and strategic aquifers, organize sustainable cattle raising activities and value ancestral knowledge and cultural traditions (See Annex C.1.10_Sustainable Cattle Raising Database).

However, and as a result of the participation of the Cataruben Foundation in the Casanare Sustainable Livestock Board, and all the knowledge acquired in recent years, we intend to generate a Sustainable Livestock Plan for the project area, in such a way that concrete actions are implemented on the farms and thus contribute to environmental and economic aspects of the landowners.

To conclude, the activities implemented in the period (2015-2020-I) represent 58% of the total activities planned for a period of 40 years, which allows us to demonstrate that, five years after project accreditation, the project proponents are committed to implementing REDD+ actions,

and this is also evident in the reduction of emissions and the deforestation rate detailed in section 16.

However, it is important to mention that certain activities are continuous, so even if the goal has already been achieved, it is essential to continue developing them, in such a way that they provide added value and allow the improvement of sustainable practices on their property, not only in forest conservation, but in the entire socio-economic area related to the implementation of the CO2BIO project.

Therefore, the idea is that the activities implemented and proposed are a basis for amplifying new strategies that are progressively identified during the accreditation period, since the economic, social and environmental context is changing progressively, so from the professional areas of the project, special attention will be paid to expand and implement REDD+ actions to meet the main objective of the CO2BIO project.

20.2. NATIONAL AND REGIONAL POLICIES IN RELATION TO THE PROJECT

Taking into account the mitigation activities defined in the previous section, this chapter specifies the list of international, national and regional policies or goals on issues that directly or indirectly address the objectives of the CO_2 Bio project, taking into account the Sustainable Development Goals (SDGs), the development plans of the previous and current national government, the Orinoco Regional Environmental Plan, and the Orinoco Regional Integrated Climate Change Plan (PRICCO).

Table 34. Lines of action in common with the SDGs

SDG	CO2BIO PROJECT RELATIONSHIP
Direct objectives	
	Taking into account the substantial change in climate variables in recent years, and the climate catastrophe that would arise if GHG emissions are not reduced, the CO2Bio project aims to prevent forest deforestation, a dynamic that is one of the main sources of GHG emissions, through forest conservation activities in the project's reference area, taking into account the owners of properties with large areas of forest and specific actions such as: apply training and accompaniment processes, for the strengthening of sustainable forest management, trainings on climate change, declaration of Natural Reserves of the Civil Society, strengthen principles of forest governance, promote the delimitation of forests, and implement the forest management plan that allows the preservation of this ecosystem, among other activities in favor of forest conservation. Forests function as habitat for millions of species, besides being indispensable for the water cycle and undoubtedly to combat climate change, offering clean air and capturing tons of CO2, so preserving them is relevant for all forms of life. From the CO2Bio project, initiatives are created for the conservation of forests, which directly become actions that preserve the life of this terrestrial ecosystem, reducing the loss of natural habitats and biodiversity that is part of it, which are mainly based on: collective construction and capacity building for biodiversity conservation, implementation of an

	environmental management plan for the properties, recognition of flora and fauna species in the project area, resolution of conflict with felines, and undoubtedly the strengthening of forest governance that allows control over the forest, which also allows taking care of the fauna species there.
Indirect objectives	
	For the CO2BIO project, the participation of women in conservation activities is important; about 43% of the landowners are women, which in the first place reveals that land tenure is no longer only a matter of male gender, however, it also reveals that many of the activities that are developed in each property will be led by women, which favors gender equality. In addition, it is expected to train not only women landowners, but also those in charge of the farms and girls, in forest conservation and preservation, climate change, biodiversity care and other topics related to the CO2BIO project.
	Economic growth is centralized in urban areas, disqualifying the decent work that has been carried out for years by landowners with extensions of land where they keep, care for, and conserve natural resources that in the short or long term benefit all species. Therefore, the CO2Bio project dignifies this work, recognizing what these owners have done for years without any remuneration, and now they can access economic income for preserving and conserving the ecosystem services that are being generated on their own land.
	Inequality is presented in different ways and in different scenarios, an example of this is the rural community, which over the years has been forgotten by the economic dynamism that focuses its attention on urban territories, becoming of little importance to rural areas. The CO2Bio project focuses its activities in the rural perimeter, where the ecosystem services that sustain the different forms of life on the planet are found, these actions allow people who depend on their land far from the municipalities, to find economic relief, preserving these ecosystems that for many years ago were ignored the importance for life in general.
	The efficient management of natural resources is essential to achieve sustainable development in the community, so in the CO2Bio project, activities are developed in favor of sustainable production, where the area intended for production is used in the first place, understanding the productive dynamics of this area, as well as promoting decisive actions to get more out of these areas. In addition, responsible consumption is encouraged, to eliminate linear consumerism and move towards circular and sensitive consumption.

Source: Cataruben Foundation

Table 35. Lines of action in common with the National Development Plan 2018-2022.

Government covenants	Objectives	CO2Bio Project Relationship
Sustainability pact: producing by conserving and conserving by producing	Sectors committed to sustainability and climate change mitigation	The CO2Bio project, in its essence, seeks to mitigate climate change by reducing greenhouse gases generated by the deforestation of forests for other activities, through the conservation of this ecosystem, which is susceptible to other anthropic activities.
	Biodiversity and natural wealth: strategic assets of the Nation	The direct relationship between forests and biodiversity in general, allows the CO2Bio project to generate actions for the conservation of the ecosystem in general.
	Resilient Colombia: knowledge and prevention for disaster risk management and climate change adaptation	Among the activities of the CO2Bio project, is to train people who are part of the CO2Bio project, on climate change issues, and the importance of forest conservation in the face of this challenge of adaptation and mitigation.
	Modern environmental institutions, social appropriation of biodiversity and effective management of socio-environmental conflicts.	By promoting the care of the forest ecosystem in private properties, and strengthening the intervention in participation mechanisms that bring together different owners and the local community in general, it allows the appropriation of biodiversity to become a social issue, and also to strengthen institutions related to this issue.
Pact for the protection and promotion of our culture and development of the orange economy	We are all culture: the essence of a country that transforms itself from its territories	The conservation activities proposed in the CO2Bio project take into account the cultural and traditional knowledge of the communities belonging to the project region, constantly involving them in the actions that strengthen the project.
Women's equity pact	Equity for women in peace building	About 43% of the owners of the land belonging to the CO2Bio project are women, which first of all reveals that land tenure is no longer only a matter of male gender, however, it also reveals that many of the activities that are developed in each property will be led by women, which favors gender equality. In addition, it is expected to train not only women landowners, but also those in charge of the farms and girls, in forest conservation and preservation, climate change, biodiversity care and other topics related to the CO2BIO project.
Plains-Orinoquia Region Pact: Connecting and enhancing the region's sustainable food pantry with the country and the world.	To boost productivity and improve the efficiency of agricultural, agroindustrial and tourism clusters and value chains.	Directly, the CO2Bio project seeks to promote new economic activities such as eco-tourism in favor of the conservation of the forest ecosystem.

Table 36. Lines of action in common with the National Development Plan 2018-2022.

CHAPTER	OBJECTIVE	CO2BIO PROJECT ACTIVITIES
Equitable Colombia without extreme poverty	Objective 2: Reduce population gaps in terms of income	In general, the CO2Bio project proposes biodiversity conservation initiatives, especially the forest ecosystem, which, in the market, functions as an economic income mechanism for the environmental services offered by these ecosystems, so that the owners of the land where these natural resources are located can receive economic values for their conservation.
Transformation of the field	Accelerate the emergence from poverty and the expansion of the rural middle class through a commitment to productive inclusion of rural dwellers.	Farmers who have an economic deficit even if they have land to take advantage of, find in the CO2BIo project, first of all, the possibility of acquiring economic resources for the conservation of the natural forest, however, they also find technical and scientific support to promote agriculture in existing areas, strengthening productivity from the respect for the zoning of the property.
Green growth	Objective 2: To protect and ensure the sustainable use of natural capital and improve environmental quality and governance.	The CO2Bio project is related to this objective since it protects natural capital, conserving, restoring and reducing forest degradation, which leads directly to the reduction of deforestation, strengthening the capacity of forests to be carbon sinks and providers of other ecosystem services.
	Objective 3: Achieve resilient growth and reduce vulnerability to disaster risks and climate change.	The CO2Bio project strengthens knowledge through training and workshops on issues related to climate change and its management in adaptation and mitigation measures.
Environment, agribusiness and human development: growth and wellbeing for the Plains	Objective 2: Manage the territory prospectively according to its environmental, agricultural, mining-energy and cultural vocation, by increasing institutional capacities throughout the region.	According to the strategies of this objective, the CO2Bio project is related to it, since it intends to comprehensively manage the forests, implementing strategies such as the declaration of Natural Reserves of the Civil Society, and other conservation initiatives.

Source: Cataruben Foundation

Table 37. Lines of action in common with the Regional Environmental Plan 2013-2025.

Strategic line 2	Strategic component	Goals	CO2Bio Activities
		Forming the network of civil society nature reserves in the Orinoco region	Provide technical and procedural support to landowners in the declaration of their properties as civil society nature reserves.

	Conformation of the regional system of protected areas	Ecological restoration of degraded ecosystems strategic for the conservation of biological diversity.	Define and implement the forest management plan for the project area, which will allow the owners to exercise this forest governance, one of the proposals of the FMP is natural restoration, which promotes the conservation of biological diversity
			Train the community in the conservation of biodiversity associated with forests.
			Train the community in the sustainable management of ecosystems, specifically in forest management
			Provide technical and scientific support for the fulfillment of the conservation agreements acquired for the execution of the co2bio project.
			Workshops and support on how to demarcate forest boundaries in a didactic and legible way that is easily understood by the entire community.
			Workshops based on agroforestry techniques according to local crops, which can be implemented by project beneficiaries.
Strategic line 5	Preparedness for environmental risk management	Raise awareness and train communities in climate change mitigation and adaptation practices in Corporinoquia's jurisdiction.	Training landowners on climate change and greenhouse gases (GHG) and the relationship with the co2bio project.
Strategic line 6	Community stakeholders involved in the environmental processes of the territory	Consolidate a network of environmental allies in the jurisdiction's territory.	Training: whose main objective is to raise awareness of the role and importance of citizen participation mechanisms, specifically those mechanisms that are exercised in the project's area of reference and that can contribute to the fulfillment of mitigation activities.
		Consolidate a citizen participation strategy focused on socio-environmental monitoring.	

Source: Cataruben Foundation

Table 38. *Lines of action in common with PRICCO*

Adaptation measures	CO2BIO Activities
Recovery and rehabilitation of water catchment areas:	Forest management plan: Preserve the protective vegetation of water sources.
Recovery of riparian forest:	Forestry management plan: Minimize the use of agrochemicals in productive activities on the property and avoid their use in nearby areas or directly in the watershed of bodies of water, rivers, streams or ponds.
Site-specific agriculture:	Promote agriculture on existing agricultural land.
Landscape connectivity:	Forest management plan (OBJ 2): Establish silvicultural, restoration, rehabilitation and recovery activities and techniques for forest areas with some degree of anthropogenic intervention.

Promotion of civil society reserve areas:	Provide technical and procedural support to landowners in the declaration of their properties as Civil Society Nature Reserves.
Mitigation measures	**CO2BIO Activities**
Programs and campaigns aimed at reducing deforestation:	In general, all the initiatives and actions targeted by the CO2Bio project are aimed at reducing deforestation in the project's reference area.
Landscape connectivity through biological corridors:	Forest management plan: Natural restoration allows the connectivity of the landscape where it had been lost, which also influences the conservation of biodiversity related to this habitat.
Forest restoration:	Forest management plan (OBJ 3): Ensure the protection and conservation of biodiversity and biological integrity of the forest impact and buffer area through activities that favor its stability over time.
Natural regeneration in paddocks:	Forest management plan (OBJ 2): Establish silvicultural, restoration, rehabilitation and recovery activities and techniques for forest areas with some degree of anthropogenic intervention.

Source: Cataruben Foundation

20.3. SUSTAINABLE FOREST MANAGEMENT

Sustainable forest management is regulated at the national level by the Ministry of Environment and Sustainable Development (MADS), at the regional level by the Regional Autonomous Corporations (CAR) and the Sustainable Development Corporations (CDS), which are responsible for managing the forest resource, including the management of forest areas, the granting and monitoring of their use, as well as the restoration of degraded areas.

The Special Administrative Unit called National Natural Parks of Colombia (PNN) is responsible for administering the forests within the National System of Protected Areas - SINAP. The IDEAM is in charge of the national monitoring of the natural forest, as part of forest management, through three systems: the Forest and Carbon Monitoring System (SMByC), the Forest Information System (SNIF) and the National Forest Inventory (IFN). Also, at the regional level, the Alexander von Humboldt Biological Resources Research Institute (IAvH), the Amazon Scientific Research Institute (SINCHI), the Jhon von Neumann Pacific Environmental Research Institute (IIAP); the Marine and Coastal Research Institute "José Benito Vives de Andres" (Invemar) have as their fundamental mission basic environmental research with the aim of achieving conservation and sustainable use of resources, including forests, within the framework of the National Environmental System (SINA) (Ministry of Environment and Sustainable Development, 2020).

In this opportunity the area of impact of the project is under the regulation of the Corporación Autónoma Regional de la Orinoquia-CORPORINOQUIA, who in its role of procedural guidelines for sustainable management of forests in the region in its action plan 2020-2015, which is aligned to the objectives of the PGAR 2013-2023 and the national restoration plan where the strategies and tools for its development are established, implementation and monitoring, in order to generate actions that promote the sustainable management of natural forests and thus minimize deforestation and degradation rates of strategic ecosystems that play an important role in climate change mitigation and is the pillar for the development of the project

under the REDD+ strategy, which is why a management plan is generated (Annex C.1.6.) for the forest areas linked to the CO_2 Bio project, which establishes the activities to be implemented in the short, medium and long term, in order to minimize the project's leakage belts and contribute to the strengthening of forest governance in the project's reference area.

21. CO-BENEFIT ASSESSMENT

The main objectives of the CO_2 Bio project on community and biodiversity issues are related to the local strengthening of landowners, increasing governance through planning and implementation of land use; at the same time, it seeks to encourage and support the development of economic alternatives and sustainable livelihoods through training on climate, forestry, agriculture and livestock issues to generate an increase in the income chains that are generated.

The project seeks to improve the administrative capacity of the farms, preserving customs and cultural roots, and environmental awareness through activities and strengthening the inclusion of women, including women who are part of the communities where the project is implemented, and finally, contributing to and increasing employment associated with the implementation of various activities.

In terms of biodiversity, in Colombia and more specifically in the Orinoquia, there is a great richness, not only in flora, but also in fauna indices present and that with the various anthropic activities, has been in decline in recent years, therefore, the project CO_2 Bio, seeks to ensure the permanence and growth of the number of species in the areas that are part of the project, As an example, the project seeks to conserve and guarantee the biological corridors of the jaguar and puma, species that are part of the present biodiversity and seek to conserve and connect the different jaguar populations throughout Latin America, covering multiple aspects of conservation, not only reducing human-animal conflicts, but also guaranteeing optimal conditions for their stay or passage through these areas.

21.1 SOCIAL BENEFITS

21.1.1 Land governance Land use planning and implementation

For the CO_2 Bio project, it is important to highlight the validity of the land tenure of each of the owners, since they have a public deed, a resolution that verifies the land tenure for several decades, and additional documents such as certificates of tradition and freedom, property tax and title study, however in most of the properties the current use of the land is not clear and there is limited awareness about the distribution and different uses that can be given to the property, affecting in many cases, the natural resources present. Given the current lack of resources and capacity at the local level, it is hoped that through the declaration of Civil Society Nature Reserves, the formulation and implementation of environmental and land management plans will provide new opportunities for land administration and governance.

The project will allow and support the establishment of reserve areas, which will allow the forest to recover and guarantee an increase in biodiversity and water resources. Community members,

particularly the inhabitants of the villages, will benefit from the employment opportunities provided at each of the project's stages and activities. Communities will also benefit indirectly as the conservation of the forest, ecosystems, which contain high conservation values, provide critical ecosystem services, fundamental community needs and cultural identity.

20.1.1.1 Development of economic alternatives

Currently, the landowners have very limited activities for the generation of "cash" with the majority corresponding to livestock activities and their derivatives, as well as depending on agricultural activities based on crops that generate small incomes. These factors, combined, result in the degradation and loss of vegetation cover, resorting to logging to increase work areas for their sources of household income. Given the above, there is no indication that these conditions would change in a scenario without the project.

20.1.1.2 Employment generation

The adoption of good practices is a strategy that allows compensation for the conservation and restoration of forests that generates benefits to the people involved in the sale of carbon credits. For this reason, the owners of the properties that benefit from the CO_2 Bio project are recognized the cost/opportunity value that the natural wealth generates for them when it is protected by them; since the owners obtain their livelihood through the agricultural and livestock activities that they carry out in each of their properties; In addition, they should have people inspecting the forests to identify areas that are being intervened by third parties, i.e., logging for timber or suspected forest fires or logging to expand the agricultural and livestock frontier and the formation of crops and pastures.

Carbon credits are a source of income for foresters or those in charge of the properties, since by contributing to the reduction of emissions of polluting gases that cause global warming, they offer incentives for the improvement of their quality of life, since they are responsible for monitoring the properties or forests that are the object of monitoring, both with instrumentation and in the field.

20.1.1.3 Capacity Building with Training

It is estimated that at least 290 people will be trained in various topics related to climate change, environmental education, cultural activities, water resource management and conservation, biodiversity conservation, Reducing Emissions from Deforestation and Forest Degradation (REDD+), forest management, recovery and conservation, good practices, and Payment for Environmental Services (PES), good practices, Payment for Environmental Services (PES), by conducting trainings it is expected that the communities will take charge of the resource management and the continuous flow of the CO_2 Bio project, this will ensure the long-term extension and sustainability of the project long after the accreditation period. In addition, the project will support courses, forums, workshops and awareness campaigns to increase awareness of the effect of greenhouse gases GHG.

The workshops will also include environmental education modules that inform participants about the importance of conservation and natural resources, and will be specifically designed to include and address the needs of women. The increased capacity of these activities will lead to a net positive impact on the community by increasing knowledge, leadership and participation in the

project. Fundamental business and management training and education are paramount to encourage not only the landowners and their families, but the entire local community to contribute fully to the project and the economic development of the area as a whole. Without the project, there would be no resources to implement these programs. These skills will lead to more resilient and self-sufficient communities, ultimately reducing poverty and illiteracy in the project area.

21.2 BIODIVERSITY BENEFITS

21.2.1 Conservation of natural habitats

The CO_2 Bio project seeks to achieve the care and conservation of the flora and fauna present in the areas of project execution and therefore the increase and conservation of biological corridors, taking into account that the Orinoquia has numerous plant and animal species in the Savannah and Piedmont plains, which have been depleted over the years but even many of which have not yet been discovered. While civilization and industrial agricultural and livestock activities continue to advance, an increasing percentage of these forests are being cleared for commercial purposes. Both local and global market demand for palm oil, livestock and other products has led to the clearing of large tracts of forest, along with countless species that have been affected by these anthropogenic activities.

Therefore, during the 10 years of project execution, a synergy between the foundation and the different landowners will be created in order to guarantee the forest areas and join efforts for the conservation of the bird, mammal, feline and insect species present in these ecosystems.

The owners, their families and employees of the properties will be the first to benefit indirectly as the conservation of the forest and ecosystems, which provide many ecosystem services to meet their needs, will be the first to benefit as the project activities are designed primarily to reduce the levels of deforestation and forest degradation in the project area, the estimate of biodiversity impact is mainly linked to changes in forest vegetation, measurable in terms of tree cover and therefore a change in biodiversity and ecology.

Changes in forest conditions are also expected to reflect impacts on biodiversity, under the influence of the project and attributable to project activities, which will result in an increase in the richness and abundance of fauna species in the project area. This will be justified and verified through transect-based monitoring of fauna species such as understory birds, large mammals, insects such as frogs and toads, and finally butterflies; however, this component may be affected to some extent by factors outside the direct project area due to agricultural and industrial activities and even problems with the neighboring community that, through hunting or habitat destruction outside the project area, do not guarantee optimal habitat conditions for the various species inside and outside the project.

This is the case of the jaguar, a species distributed from northern Mexico to northern Argentina, whose populations, at the continental level, have already been identified in what are called Jaguar Conservation Units (UCJ). The Jaguar Corridor was built in Colombia, a map of jaguar distribution and the design of new UCJs by experts.

The fact that the properties are located in areas corresponding to biological corridors is a great opportunity for biodiversity conservation through sustainable productive practices such as ecotourism and agroforestry systems with native species, but at the same time a threat is posed by the repopulation of the area and the risks of an inappropriate transformation of land use; There are fears about the undesirable effects on the environment of the territories occupied by the camps. There are also concerns about the emergence of new practices and projects that expand into reserve areas, because the new projects and ways of life and production do not have levels of respect and responsibility towards the local population and the owners of the territories.

It should be noted that the various activities carried out during the implementation of the project will not guarantee the perpetuity of the species, considering that different natural and anthropogenic factors are at play, therefore, the estimate of the impact on biodiversity is based mainly on the core activity of the project of retaining the forest cover and its broader positive correlation with biodiversity.

Overall, project activities are designed in different ways and based on different drivers to reduce rates of deforestation and forest degradation, as noted above, reducing these rates of deforestation and forest degradation will result in better maintenance and, in many cases, will result in the recovery (through natural regeneration) of forest biodiversity attributes compared to conditions in the without-project scenario, which will reflect improved natural and sustainable natural habitat conditions for native wildlife. Improvements in the amount of intact and partially intact forest vegetation cover also support the continuation of functional biodiversity attributes including ecosystem productivity and nutrient cycling, water purification and erosion reduction, and reduced vulnerability to invasive species. They also enhance landscape connectivity that contributes to processes including seed dispersal, reproduction, gene flow and associated capacity to adapt to climate change. Together, these changes correlate to a net biodiversity benefit for flora in the project area, and provide habitat conditions conducive to the well-being of a greater number of wildlife species than would be the case without the project.

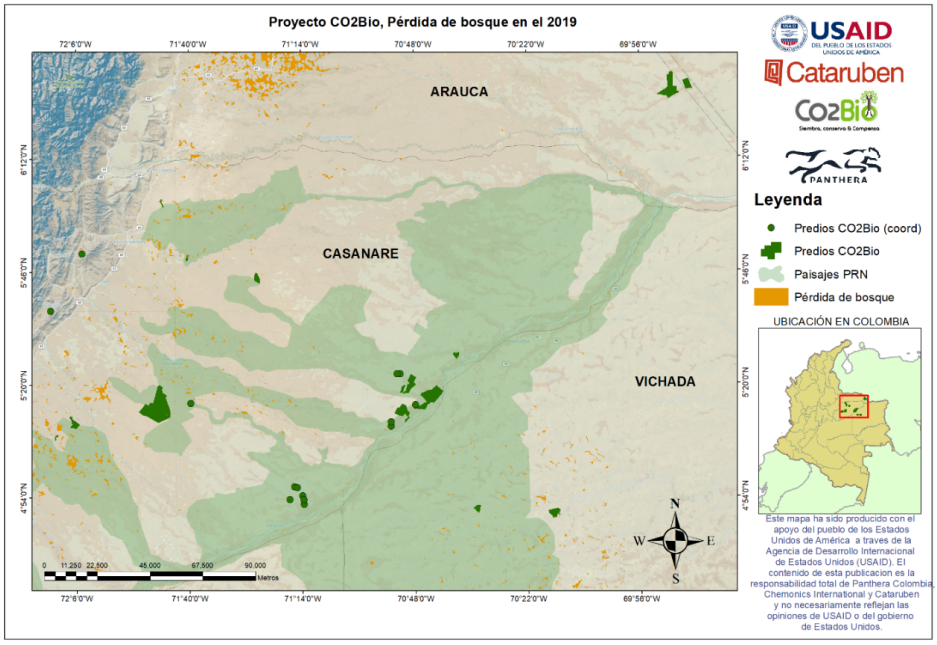
21.2.2. Preliminary Analysis of Biodiversity Threats and Vulnerabilities

- General threats to high-value species

The project properties are located in areas with varying degrees of threats and pressures to the ecosystem; however, some of these are repeated throughout the Llanos region, endangering wildlife if they are not detected and controlled in time. The main threats include habitat degradation and fragmentation due to changes in land use or poor farming practices, hunting for subsistence, commercial and retaliatory purposes, contamination of water bodies, and overexploitation of resources.

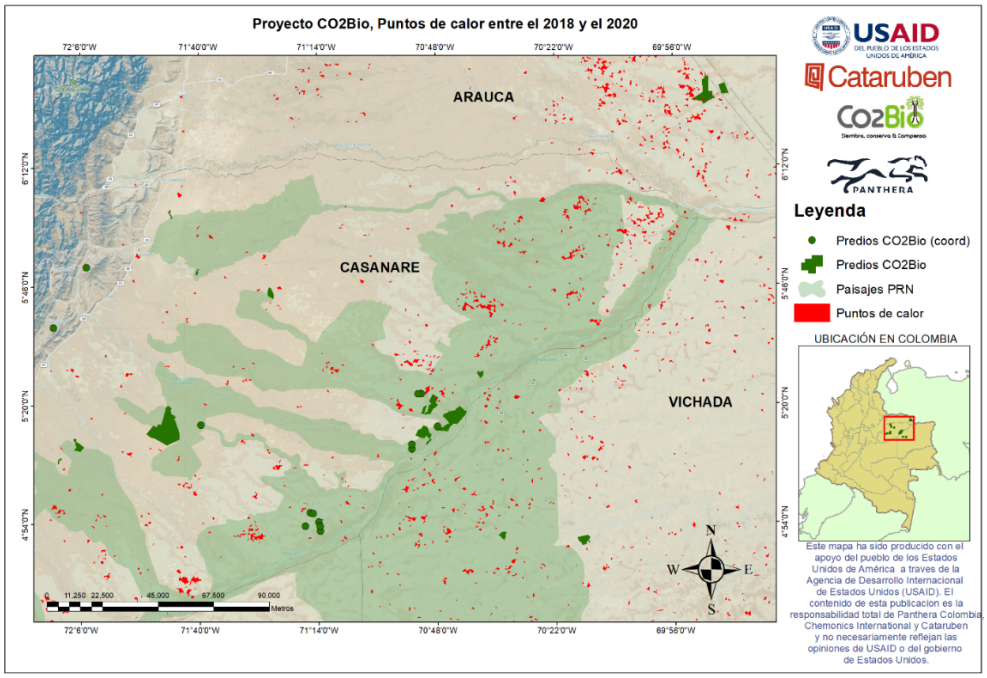
In the Map, the forest loss in 2019 for the study area is presented, while in Figure 23, the hot spots identified for the period 2018-2020 are presented. Forest loss processes are identified as a threat especially associated with the expansion of the agricultural frontier for the establishment of monocultures such as rice and palm, while hot spots are concentrated mainly in the dry season (December-April) in which some pasture burning practices get out of control and can affect large areas by spreading rapidly.

Figure 25. *Forest loss in 2019 at the regional scale.*



Source: Panthera Colombia, Cataruben Foundation, Mapbox, 2020.

Figure 26. Fire hot spots identified at the regional level for the CO2Bio project area.



Source: Panthera Colombia, Cataruben Foundation, Mapbox, 2020.

Particularly, for the Cinaruco area in the department of Arauca, low anthropogenic intervention of its ecosystems is reported due to the difficulties of access to the area (Alviz, 2014). For the department of Vichada, the transformation and degradation of natural habitats due to uncontrolled burning during the dry season, the impact generated by cattle and feral pigs (Sus scrofa) that prevent the regeneration of ecosystems such as morichales by consuming fruits and shoots, as well as the presence of human-feline conflict and conflict between fishermen and giant otters are reported as threats (Garrote et al., 2016; Fernando Trujillo & Lasso, 2017). In the foothills of Casanare, habitat transformation for the expansion of the livestock frontier and hunting for subsistence and commercialization purposes is identified as the main threat (Resolution No. 1315, 2014), while in the savanna ecosystems of the department, one of the main threats is the accelerated growth of rice crops (DANE, 2020), which generates impacts such as soil degradation and contamination from the use of agrochemicals and pesticides (Muñoz, 2016; Rojano, 2014).

Species of high conservation value are generally more susceptible to changes in their habitat. The following are threats to some of the high-value species that may be found on the properties:

Pteronura brasiliensis: The giant otter has been recorded in CO_2 Bio de El Dera, Shambala and Trikuti in Vichada; Padrote 1, 2 and 3, Miravalle, Flor Amarillo, Arizona, Montana and San Cristóbal in Casanare. It is considered by some fishing communities as competition, so it suffers from retaliation hunting (Fernando Trujillo et al., 2015; Velasco Gómez, 2004). In addition, their populations are affected by agro-industrial processes (use of pesticides and chemical fertilizers) together with urban expansion, which cause water pollution by sewage and mercury, causing habitat loss and loss of prey (Franco-Rozo et al., 2015; Mosquera Guerra et al., 2019; F. Trujillo et al., 2013). Additionally, the increase in population settlements on riverbanks also leads to the destruction of habitat associated with gallery forests, decreasing the availability of burrowing and resting sites (Franco-Rozo et al., 2015).

Figure 27. *Giant otter (Pteronura brasiliensis) recorded in El Cairo, Bocas del Pauto, Casanare. Source: Panthera Colombia, 2019.*

Tayassu pecari: The species has only confirmed records for the Shambala property in Vichada. It is highly susceptible to habitat loss and fragmentation, and is hunted for consumption and commercially. In addition, the presence of introduced animals such as pigs (*Sus scrofa*) are considered a threat due to their abundance and spread of diseases to ungulates (García-Londoño & Trujillo, 2015).

Tapirus terrestris: The species is reported in El Dera, Shambala and Trikuti in Vichada, El Horizonte, Los Clavellinos, Los Paragüitos and Bombay in Arauca. The main threats to the lowland tapir are the loss and fragmentation of its habitat, in addition to the pressure from subsistence hunting (Alviz et al., 2015; F. Trujillo et al., 2010). Additionally, it is identified that its populations have increased in the departments of Arauca and Vichada due to the decrease in hunting and low population density in some areas, while for the department of Casanare the populations of the species have decreased due to the strong pressure from threats of habitat loss and hunting (Alviz et al., 2015). Its susceptibility to different pressures increases due to its ecological characteristics such as long periods of gestation, lactation and sexual maturation (Alviz et al., 2015; Mosquera Guerra et al., 2019).

Priodontes maximus: There are records of this species in El Dera, Shambala and Trikuti in Vichada. Among its main threats are subsistence hunting, especially trade and overexploitation during breeding months (Mosquera Guerra et al., 2019; Rodríguez et al., 2013; Trujillo González & Superina, 2013). In addition, the transformation of their habitats by erosion and removal of matter accompanied by the use of agrochemicals, reduces the component of invertebrates that constitute their diet and compacts the soil that serves as their refuge (Mosquera Guerra et al., 2019; Rodríguez et al., 2013).

Myrmecophaga tridactyla: The palm bear has been recorded in CO_2 Bio de Shambala in Vichada; El Horizonte, Los Clavellinos, Los Paragüitos and Bombay in Arauca; La Regadera, Aquí me quedo, Coco 2, Palmarito, Padrote 1, 2 and 3, Miravalle, Flor Amarillo, Arizona, Mata de Palma, Altamira and Montana in Casanare. Its populations have been reduced by the loss and modification of its habitat due to forest fires and the creation of areas for cultivation, cattle ranching and new urban centers (Hernández, 2007; Mosquera Guerra et al., 2019). In addition, it has been the target of hunting for subsistence and for various magical-religious and medicinal beliefs (Mosquera Guerra et al., 2019), as well as the capture of hatchlings for sale as pets (García-Londoño & Trujillo, 2015). For the Llanos region, roadkill has been reported as one of the main threats to this species (Rojano, 2014).

Figure 28. Palm bear (Myrmecophaga tridactyla) recorded at the Arizona property, Bocas del Pauto, Casanare. Source: Panthera Colombia, 2019.

***Panthera onca*:** For the jaguar, there are records in El Dera, Shambala and Trikuti in Vichada; El Horizonte, Los Clavellinos, Los Paragüitos and Bombay in Arauca; Padrote 1, 2 and 3, Miravalle, Flor Amarillo, Arizona, Mata de Palma, Altamira and Montana in Casanare. The causes of their population decline are mainly habitat loss due to crop extension and burning, conflicts with ranchers generating retaliation hunting, and hunting for the illegal fur market and traditional medicine (Garrote et al..., 2016; Mosquera Guerra et al., 2019; Sarmiento-Giraldo et al., 2016; Fernando Trujillo et al., 2016; Valderrama-Vásquez et al., 2016); in addition to the decrease in their natural prey due to competition with human hunters (Valderrama-Vásquez et al.,-2016) Payan et al 2013. In the Llanos area, the absence of protected areas threatens the permanence of jaguar populations in the area (Fernando Trujillo et al., 2016) Payan et al 2013.

Jaguar (Panthera onca) recorded in El Cairo, Bocas del Pauto, Casanare. Source: Panthera Colombia, 2019.

22. MONITORING REPORT

22.1. PROJECT EMISSIONS MONITORING

The methodology describes a monitoring plan for the variables that will make it possible to calculate the project's emissions and leakage during operation. For this purpose, the variables to be monitored, the manner in which they should be monitored, and their frequency are determined during the project execution period, and it is expected that emissions verification procedures will be carried out every two years.

Table 39. Monitoring of deforestation rate

Data/parameter	r
Unit	%/year
Description	Annual deforestation
Source of data	Satellite analysis to determine the area of forest cover at a given time.
Procedure	To calculate the deforestation rate, a multitemporal analysis and monitoring of land cover is carried out using remote sensing images and finally, the Puyravaud formula is applied to determine the percentage of forest cover loss.
Frequency of monitoring	Each year
Comments	-

Table 40. Chest Circumference Monitoring

Data/parameter	**CAP**
Unit	cm
Description	circumference at chest height
Source of data	To be taken from each permanent monitoring plot in the project areas.
Procedure	A tape measure is used to measure the forest species present in the plot at a standard height of 1.30 meters.
Frequency of monitoring	Each time, a forest inventory is conducted in the project area.
Comments	See appendix procedure for plot survey

Table 41. Chest Diameter Monitoring

Data/parameter	**DAP = (prom CAP/π)**
Unit	cm
Description	Diameter at chest height
Source of data	CAP calculated in the field

Procedure	It is calculated from the average KAP taken in the field for each of the individuals present in the plot.
Frequency of monitoring	Each time a forest inventory is conducted in the project area.
Comments	See appendix for plot survey procedure

Table 42. Height monitoring of individuals

Data/parameter	**h**
Unit	m
Description	Height of the individual
Source of data	h calculated in the field
Procedure	It is determined indirectly using a clinometer and calculated by trigonometric principles with data taken in the field for each of the individuals present in the plot.
Frequency of monitoring	Each time a forest inventory is conducted in the project area.
Comments	See appendix procedure for plot survey

Table 43. Aerial biomass monitoring per plot

Data/parameter	BA=exp(-2,406+(1,289ln(D))+(1,169(ln(D))2)-(0,122(ln(D))3)+(0,445(ρ)))
Unit	BA (tHA-1)
Description	Aerial biomass per plot
Source of data	NTC 6208
Application	Carbon stock calculation
Procedure	It is applied taking into account the stratification by forest type by life zones proposed by Holdridge.
Frequency of monitoring	Each plot survey verification to quantify aboveground biomass.
Comments	

Table 44. Biomass monitoring per hectare

Data/parameter	ΣBA= BA*(1/1000) *FC
Unit	BA (tHA-1)
Description	Estimated biomass per hectare
Source of data	Estimation of forest carbon stocks in above-ground biomass in natural forests in Colombia (IDEAM)
Application	Carbon stock calculation
Procedure	It is applied taking into account the sum of the biomass per individual.
Frequency of monitoring	Each plot survey verification to quantify aboveground biomass.

Comments	

Table 45. Below ground biomass monitoring

Data/parameter	BRG R x BA
Unit	BRG (tHA-1)
Description	Estimation of belowground biomass
Source of data	R =IPCC (2006) BA=Allometric Equations
Application	Calculation of carbon stocks in roots
Procedure	It is applied taking into account the ratio of belowground biomass to aboveground biomass (R).
Frequency of monitoring	Each plot survey verification to quantify aboveground biomass.
Comments	

Table 46. Monitoring of GHG emissions reductions

Data/parameter	-
Unit	Annual (tons of CO2e)
Description	GHG emission reduction/mitigation actions
Source of data	NTC 6208
Application	Carbon stock calculation
Procedure	Applicable taking into account forest cover and implementation of REDD activities.
Frequency of monitoring	Each plot survey verification to quantify aboveground biomass.
Comments	

Table 47. Monitoring the permanence of the REDD+ project

Data/parameter	fires
Unit	Area affected (hectares)
Description	Identification and mapping of the area affected by project fires
Source of data	PROCLAIMED. 2020. Quantification of GHG Emission Reductions or Removals from REDD+ Projects.
Application	Reduction of airborne carbon (degradation)
Procedure	Applicable taking into account forest cover and implementation of REDD activities.
Frequency of monitoring	Frequent monitoring and mapping of areas at least every 2 months.
Comments	

Table 48. Monitoring of project emissions

Data/parameter	Annual deforestation in the project area $CSB_{im,m} = \left(\frac{1}{t_2 - t_1}\right) x\ (A_i - A_m)$
Unit	*CSBim,m* = Annual change in area covered by forest in the project area; ha.
Description	GHG emission reductions/mitigation actions
Source of data	PROCLAIMED. 2020. Quantification of GHG Emission Reductions or Removals from REDD+ Projects.
Application	Calculation of changes in aerial biomass
Procedure	It is applied taking into account changes in forest cover and the implementation of REDD activities.
Frequency of monitoring	Annual
Comments	In the scenario with project activity data is monitored. The validated emission factors can be applied in the estimation of monitored emissions.

Table 49. Annual deforestation in the leakage area.

Data/parameter	Annual deforestation in the leakage area $CSB_{m,f} = \left(\frac{1}{t_2 - t_1}\right) x\ (A_{i,f} - A_{m,f})$
Unit	*CSBlb,f*= Annual change in area covered by forest in the leakage area; ha.
Description	GHG emission reductions/mitigation actions
Source of data	PROCLAIMED. 2020. Quantification of GHG Emission Reductions or Removals from REDD+ Projects.
Application	Calculation of changes in aerial biomass
Procedure	It is applied taking into account changes in forest cover and the implementation of REDD activities.
Frequency of monitoring	Annual
Comments	In the scenario with project activity data is monitored. The validated emission factors can be applied in the estimation of monitored emissions.

Table 50. GHG emissions in the period of analysis

Data/parameter	Deforestation project area *EAim, m = CSBim, m x CTeq*
Unit	*EAim, m* = annual emission in the project area; tCO2 ha-1
Description	GHG emission reductions/mitigation actions
Source of data	PROCLAIMED. 2020. Quantification of GHG Emission Reductions or Removals from REDD+ Projects.
Application	Calculation of changes in forest area
Procedure	It is applied taking into account changes in forest cover and the implementation of REDD activities.
Frequency of monitoring	annual
Comments	In the scenario with project activity data is monitored. The validated emission factors can be applied in the estimation of monitored emissions.

Table 51. GHG emissions in the period of analysis

Data/parameter	Leakage area deforestation *EAfm* = (*CSBfm x CTeq*) - *EAf*
Unit	*EAfm* = Annual emission in the leakage area; tCO2 ha-1.
Description	GHG emission reductions/mitigation actions
Source of data	PROCLAIMED. 2020. Quantification of GHG Emission Reductions or Removals from REDD+ Projects.
Application	Calculation of changes in forest area
Procedure	It is applied taking into account changes in forest cover and the implementation of REDD activities.
Frequency of monitoring	annual
Comments	In the scenario with project activity data is monitored. The validated emission factors can be applied in the estimation of monitored emissions.

Table 52. Quantification of the project's emission reductions.

Data/parameter	*REm* = (*t*2 - *t*1) *x* (*EAlb* - *EAim*, *m* - *EAf*, *m*)
Unit	*REm* = Avoided deforestation emissions reduction in the period of monitoring; tCO2e
Description	GHG emission reductions/mitigation actions
Source of data	PROCLAIMED. 2020. Quantification of GHG Emission Reductions or Removals from REDD+ Projects.
Application	Calculation of changes in forest area
Procedure	It is applied taking into account changes in forest cover and the implementation of REDD activities.
Frequency of monitoring	annual
Comments	In the scenario with project activity data is monitored. The validated emission factors can be applied in the estimation of monitored emissions.

22.2 MONITORING THE EXECUTION OF REDD+ ACTIVITIES

As mentioned in section 19, REDD activities are robust initiatives that involve a series of actions aimed at reducing GHG emissions caused by deforestation and degradation, therefore, these activities contribute to support and ensure compliance with conservation commitments, and effectively develop the CO_2 Bio project.

The main way to monitor mitigation activities is to define the time and implementation period for each of these activities - in order to generate the monitoring -, in addition to establishing their respective deliverable and what is the main goal with each of them (see complete table in Annex J1). The format for monitoring and compliance of REDD activities is also defined, which is defined in the project's master list, and is relevant to determine the behavior and evolution of REDD activities. The monitoring of activities carried out to date can be seen in the annex.

Table 49 below shows a summary of the monitoring methodology according to each activity, its deliverable, the measurement indicator, the target for the project duration and the percentage of the activity for the total of 100%.

Table 53. Activities with respective monitoring methodology, as well as time periods for monitoring.

ID	SECONDARY ACTIVITIES	DELIVERABLE	INDICATOR	META	% OF ACTIVITY
1	a. Training: whose main objective is to raise awareness of the role and importance of citizen participation mechanisms, specifically those mechanisms that are exercised in the area of reference of the project and that can contribute to the fulfillment of mitigation activities.	Attendance record	1a) No. of people trained 1b)No. of documents delivered	132	5
	b. Provide technical and procedural support to landowners in the declaration of their properties as Civil Society Nature Reserves.	RNSC Resolution	No. of resolutions: it is expected that more than 50% of properties will be declared RNSC	22	5
2	a. Train landowners on climate change and Greenhouse Gases (GHG), and the relationship with the CO2BIO project.	Attendance record	No. of people trained	132	5
	b. To train the community in the conservation of biodiversity associated with forests.	Attendance record	No. of people trained	20	3
	c. Train the community in sustainable ecosystem management, specifically in forest management.	Attendance record	No. of people trained	20	3
	d. Generate an Environmental Management Plan (EMP), which involves actions around the sustainable management of the forest, based on the ancestral knowledge of the owners and the technical-scientific knowledge of the foundation.	Environmental Management Plan Document	No. of documents	1	8
	e. Provide technical and scientific support for the fulfillment of the conservation agreements acquired for the execution of the CO2BIO project.	Field logs	No. of field logs	44	6
	f. Support the resolution of conflicts between humans and felines, through the identification and appropriate management of these and other species.	Attendance record	No. of people trained	132	3

3	a. Promote and strengthen laws, organization, leadership, oversight and inter-institutional issues, so that forest governance can be exercised in the forest lands.	Declaratory document	No. of Clarifying Documents	132	5
	b. Define and implement the Forest Management Plan for the project area, which allows the owners to exercise this forest governance.	Forest Management Plan Document	No. of documents	1	5
4	a. Accompaniment and technical assistance in the issuance of permits, licenses and safe-conducts, and related to the forestry industry.	Permits	No. of permits	10	5
5	a. Workshops and support on how to demarcate forest boundaries in a didactic and legible way that is easy for the whole community to understand.	Attendance record	No. of people trained	132	5
	b. Specify the property zoning card to facilitate this delimitation of conservation areas.	Document zoning sheet	No. of documents	44	7
6	a. Workshops based on agroforestry techniques according to local crops, which can be implemented by the project beneficiaries.	Attendance record	No. of people trained	10	4
7	a. Perform image acquisition, processing and analysis with the use of multisensor drone technology (RGB, multispectral, thermal).	Images and videos taken with drone	No. of drone images/mosaics N of drone videos	20	4
	b. Develop guidance documents for monitoring forest cover change with the use of remote sensing.	technical guidance documents	No. of documents	6	3
	c. Conduct detailed monitoring of the project area and surroundings with the use of remote sensing (optical/Radar).	a) Change alarm review table (fortnightly)	No. of records annual tables.	12	4
		b) Bimonthly technical report of multitemporal analysis of changes (deforestation/degradation).	No. of reports	6	4
8	a. Identify and map areas of regeneration gain or loss.	Technical report and mapping of areas with gain or loss of regeneration.	N. of hectares with regeneration	10	4
	b. Monitor environmental conditions of forest regeneration processes and possible management alerts.	Report environmental conditions of forest	No. of reports	6	4

		regeneration processes.			
9	a. Document monitoring of biodiversity variables or indicators in coverages with the use of remote sensors for the project area and its surroundings.	Document	N. documents	1	4
	b. Conduct detailed monitoring of the project area and its surroundings with the use of remote sensing (optical /Radar).	b) Bimonthly technical report of multitemporal analysis biodiversity	No. of reports	6	4
10	a. Train owners and collaborators in sustainable livestock practices.	Attendance record	No. of people trained 1a) 1b)No. of documents delivered 1a) 1b)No. of documents delivered	132	3
	b. Identify applicable activities (with the possibility of implementation in the short, medium and long term) on the farms to make livestock farming sustainable.	Document	N. documents	1	4
	c. To formulate a sustainable livestock plan for the project implementation area.	Document	N. documents	1	4
	d. Implementation of activities in the project area.	b) Biannual technical report of multitemporal biodiversity implementation.	No. of reports	1	5

Source: Cataruben Foundation

23. MONITORING OF BIODIVERSITY VARIABLES AND INDICATORS WITH THE USE OF REMOTE SENSORS FOR THE REDD+ PROJECT

The development of biodiversity indicators presents an extensive list of objectives to be achieved. Therefore, in the case of biodiversity indicators, there are few discrepancies as to what are the key factors, attributes or parameters that should be evaluated for an appropriate monitoring of the achievement of the objectives.

On the other hand, the objective of this biodiversity indicator is to report on the state of biodiversity and the existence of articulated responses for its promotion, improvement or restoration.

Based on these premises, indicators that provide local/regional information on biodiversity should be created and sought. In general, it can be said that biological diversity and landscape quality go hand in hand in natural and rural landscapes, so that a high biological diversity corresponds to a high quality landscape, and vice versa.

Taking into account all of the above, the use of biodiversity information and indices is proposed. For which it is necessary, for the areas of interest of the REDD+ forestry project, the implementation of the system, monitoring and generation of early warnings for biodiversity losses (SEMAB - REDD+), with the use of information based on remote sensing, both satellite (optical / radar), and the use of drone technology.

This SEMAB - REDD+ includes and complies with the Aichi Biodiversity Targets and the nature-based Sustainable Development Goals. The objective of this system is to generate spatial information to enable better decisions, use spatial data as a vehicle to improve transparency and accountability of the REDD+ project, and apply spatial data knowledge in and around all properties, and would also comply regionally with the Convention on Biological Diversity and the 2030 Agenda for Sustainable Development.

From information used on a set of integrated maps of biodiversity and ecosystem services, including carbon, based on the best available science. These maps are intended to support design, planning and management aimed at limiting biodiversity loss and net greenhouse gas emissions from land use in an integrated manner. These new and innovative SEMAB - REDD+ maps represent a decision support tool for decision makers in the areas of influence of the REDD+ Project. For example, they support the identification of areas where conservation and restoration actions would provide the highest benefits for biodiversity conservation and climate change mitigation, helping the implementation of relevant and sustainable local environmental actions.

23.1. GENERAL BIODIVERSITY INDICATORS

Biodiversity indicators are not only important at the global level, but also at the national (and sub-national) level, they are an essential aspect of monitoring and reporting progress towards national and local targets in the context of government established and sustainable development strategies. They are also important in facilitating adaptive management. Experience has demonstrated a number of key factors in determining whether an identified indicator is taken and produced over time, based on scientific validity.

23.2. SYSTEMS FOR STUDYING, MONITORING AND GENERATING ALERTS FOR BIODIVERSITY LOSS.

For the areas of interest of the REDD+ forestry project, a system has been implemented for the study, monitoring and generation of early warnings for biodiversity loss (SEMAB - REDD+), with the use of information based on remote sensing, both satellite (optical / radar) and drone technology.

This Early Warning System for Biodiversity Loss should frequently analyze trends in biodiversity change at multiple levels and be able to generate scenarios based on these trends.

The first alerts should focus on the information that currently exists and evolve towards the next stages of information, taking into account tools under development, such as mobile applications, new satellites, multispectral/thermal images taken with drone technology, camera traps, among others.

The objective of this SEMAB - REDD+ system is to produce detailed spatial information to enable better decisions, to use data to improve transparency and accountability of the REDD+ project, and also to apply experiences and knowledge of spatial data in all farms.

The spatial information system for the study and monitoring of biodiversity indicators and essential biodiversity variables highlights biodiversity data, conservation properties, threats to biodiversity and data related to the Sustainable Development Goals (SDGs). Biodiversity data includes ecological land use, biodiversity hotspots, key biodiversity areas, species distribution and available secondary data. Areas of conservation interest include available information on protected areas and community conserved areas. Threats to biodiversity include human footprint, and land use changes. SDG data cover watersheds, poverty, and land tenure. The biodiversity data selected by SEMAB - REDD+ focuses on helping to further meet the Aichi Biodiversity Targets specific to Biodiversity.

23.3. INDICES OF BIODIVERSITY INDICATORS IN THE TERRITORY

Biodiversity indices for the REDD+ project territory are presented below.

23.3.1. Maps with forest integrality indexes

These maps give a general indication of forest integrity and are as follows:

- Forest Structural Condition Index (FSCI) and the Forest Structural Integrity Index (FSII).
- Forest canopy height indices

23.3.2. Maps with biodiversity indexes

- Intact biodiversity index
- Rarity-weighted richness index
- Species richness index

23.4. INDICATORS OF FAUNIOTIC BIODIVERSITY IN CO_2 Bio

The battery of indicators of the Natural Wealth Program is a key tool for monitoring progress in the environmental, productive and socioeconomic management of the benefited properties. The objective of this document is to suggest indicators to measure the factors necessary for certification in Climate, Communities and Biodiversity and other similar carbon standards.

The current environmental indicators of the Natural Wealth Program include the topics of 4) protection of strategic ecosystems and 5) connectivity and conservation strategies. Although these indicators are also relevant to understand the natural context and implementations of the properties, we suggest the incorporation of new indicators that complement the information on key issues in carbon certification. The indicators are separated into two categories, on-site biodiversity assessment and potential positive and negative off-site impacts. These indicators can

be incorporated into the documentation of the CO²Bio process and will be an input to determine the design of photo-trapping in the project.

In our proposal for biodiversity indicators, the component "6. Protection of threatened species" seeks to identify some main points that constitute relevant information for carbon certification under the CCB standard: 1. the presence of threatened species (EN, CR, VU), 2. the presence of other species of conservation interest (NT, migratory), 3. The practices or activities associated with the management and conservation of these species that are currently being carried out on the property (implementation of strategies to mitigate conflict with carnivores, hunting of threatened species, biodiversity monitoring, participation in awareness-raising or training activities associated with biodiversity conservation). For the particular case of the indicators that correspond to the presence of species, the threatened or near-threatened species that could be recorded for the area have been previously identified and the wording of the indicator scale is modified as follows: There are no reports (of the species(es)), 2. There are occasional reports (may use the property only as a place to pass through) 3. There is continuous presence of the species(es). While for the indicators that correspond to measures or activities, the original scale is maintained 1. Not being adopted 2.

Figure 30. Palm bear (Myrmecophaga tridactyla) (VU), one of the threatened species that may be present on the properties. Source: Panthera Colombia, El Encanto de Guanapalo, 2019.

Figure 31. Paujil (Mitu tomentosum), a species of conservation concern classified as Near Threatened (NT). Recorded at the Arizona property, Bocas del Pauto, Casanare. Source: Panthera Colombia, 2019.

The second indicator is aimed at impacts on neighboring areas, since the standard requires verification that there are no negative impacts on biodiversity in neighboring properties or areas, thus ensuring the protection of biodiversity on the property. This protection can lead to deforestation in neighboring areas (leakage) and increase the pressure on biodiversity if mitigation plans are not considered. Therefore, working with nearby populations through awareness-raising and socialization activities on the importance of the ecosystem and its components (whether fauna or flora) is essential for long-term conservation. Without these actions, negative impacts could alter the connectivity of wildlife populations and deforestation could cause barrier effects within the properties.

Table 54. Threatened species indicators.

6. PROTECTION OF ENDANGERED SPECIES	Refers to activities conducted and wildlife sightings with a threat level for carbon certification. For sightings of threatened species and species of concern, indicators are considered as 3-there is continuous presence; 2-there are occasional reports 1-no reports.	(CR & EN) Sightings of water dogs (*Pteronura brasiliensis*) or Orinoco caimans (*Crocodylus intermedius)* on the property.
		(VU) It has sightings of caiman (*Tayassu pecari*), tapir (*Tapirus terrestris*), ocarro (*Priodontes maximus*), palm bear *(Myrmecophaga tridactyla),* night monkeys *(Aotus brumbacki, A. lemurinus),* agami heron (*Agamia agami*).
		(NT) Has sightings of other species of concern (Near Threatened NT) or migratory species. NT: Jaguar (*Panthera onca*), wigeon (*Oressochen jubatus*), scaled sandpiper (*Calidris subruficollis,* migratory), paujil (*Mitu tomentosum*), festive parrot (*Amazona festiva*).

		No wildlife capture or hunting activities are carried out on the property for the aforementioned species.
		Participates or has participated in any training or sensitization on the importance of biodiversity.
		Have you carried out any activities to reduce conflict with carnivores?
		Do you carry out or have you carried out any wildlife monitoring or measurement activity on your property (on your own or with another organization)?
7. NEGATIVE IMPACTS ON *OFF-SITE* BIODIVERSITY	This refers to the possible consequences for the fauna and flora in the surrounding or neighboring properties, as well as for third parties in the area.	There is no retaliatory hunting of species such as water dogs (*P. brasiliensis*), jaguars (*P. onca*) or other carnivores in the area.
		Third parties are not allowed to hunt in the area.
		There are signs indicating the restrictions of the property, such as hunting or fishing.
		There is no major logging or ecosystem degradation in the surrounding areas because of the existing protection of the property.
		Awareness-raising and socialization activities are carried out with the community on biodiversity projects

Source: Cataruben Foundation

23.5. SAMPLING DESIGN FOR TERRESTRIAL VERTEBRATES

Photo-trapping is a non-invasive tool to determine the presence, behavior and monitoring of medium and large terrestrial vertebrate populations, and is especially useful for recording elusive species (Díaz-Pulido & Payán, 2012), such as the tapir (Tapirus terrestris) and the jaguar (Panthera onca). It has been determined that an inventory through photo-trapping is the ideal sampling for the CO_2Bio Program because of the data it will provide on species relevant to the standard such as the water dog (Pteronura brasiliensis) and the palm bear (Myrmecophaga tridactyla), as well as its potential for the appropriation of the practice by the owners participating in the program and the linkage with the protection of fauna.

From the exercise of identifying information gaps, it was concluded that the properties with the greatest possibility of recording species of high conservation value according to the criteria of the Gold Standard of the Climate, Communities and Biodiversity standard are those located in the Cinaruco trail in the department of Arauca and in the municipality of Santa Rosalía in the department of Vichada.

23.6. PHOTO-TRAPPING DESIGN

Once the properties were identified, the installation grid was determined using the minimum distance for recording medium and large vertebrates (Díaz-Pulido & Payán, 2012), the desired night trap effort to achieve an effective survey (Tobler et al., 2008) and the number of cameras available for the exercise (30).

The sites selected for the installation of camera traps are distributed in two blocks. The first block consists of the Valle, Los Toros, La Guajira and La Calzada plots in Arauca. Although the

four properties are not contiguous, a connected grid of camera traps will be established along the riparian forest between the four properties. This grid will consist of 16 cameras.

Of the Vichada properties, two of them are contiguous (El Trikuti and El Dera) in the village of Nazareth, while the Shambala property is located in the village of Flor Amarillo in the municipality of Santa Rosalía. In the block of the two adjacent properties, eleven cameras will be installed in a continuous grid in the riparian forest of the Tomo River, where fauna of high conservation value is expected to be found. Additionally, three cameras will be installed in the Shambala property, but this sampling will only serve to record the presence of species and cannot be analyzed as part of the same sampling due to the geographic distance.

The inventory of terrestrial vertebrates will be carried out with the objective of identifying and analyzing the populations of medium and large vertebrates (weighing more than 1 kg). Three separate samplings will be carried out in Arauca and Vichada, the one in Arauca consisting of 16 cameras, a sampling in El Dera and Trikuti consisting of 11 cameras and the last one in Shambala, Santa Rosalía with 3 cameras. The cameras will be installed in single stations (one camera) with a distance of 1000 meters between them and at an approximate height of 40 cm from the ground. The cameras will be located in suitable places where, according to the researcher's experience, the possibilities of capturing evidence of the presence of different vertebrates will be maximized. In addition, they will occupy different types of vegetation cover and will be active for more than five weeks in order to reach the minimum effort of 2000 traps per night [TN=N° stations x N° nights] (Diaz-Pulido & Payán, 2011).

Each camera will be programmed to take pictures continuously (24 hours), with an interval between pictures of 30 seconds (Carbone et al., 2001) and to take two pictures per activation. A data form will be used to fill out in the field with information required for each station: GPS location (Datum: WGS 84) in geographic coordinates, camera information (serial, reference), date and time of installation, physical description of the station, trail width, distance from camera to target, percent canopy cover, and habitat (cover type). In addition, a crawl test will be performed at each station to check the proper functioning of the camera.

23.6.1. Photo-trapping database

From the photos obtained, a database will be filled out with information on the species recorded in the study area. Consecutive photos showing different individuals of the same species or different species will be considered as independent events. In addition, those photos that are 30 minutes apart in relation to the previous event will also be considered as an independent event, regardless of whether the two photos show non-distinguishable individuals of the same species, because some species can remain for a long period of time in front of the camera (O'Brien et al., 2003).

Figure 32. Photo-trapping recording tests

Species will be identified based on specialized literature (Emmons & Feer, 1997; Wilson & Reeder, 2005) and empirical knowledge of the researchers. Taxonomic classification and nomenclature will be presented according to the International Union for Conservation of Nature (IUCN) website. Even though various animals can be recorded by photo-trapping methodology, only species above 500g in weight are considered in the database, as these activate the cameras consistently (Díaz-Pulido & Payán, 2012).

23.6.2. Data analysis

Once the database is complete with species identification and other data obtained, the following two analyses will be carried out:

- Species accumulation curve:

To evaluate the effectiveness of the sampling effort [Y = (N° cameras * effective days) * FC 100 traps-night] a species accumulation curve will be constructed (Colwell & Coddington, 1994). As a general rule, the number of species recorded increases as the effort increases, reaching an asymptote when all the species present have been recorded. The program EstimateS 9.1 (Colwell et al., 2012) will be used to calculate the Chao 1 and Jacknife species richness estimators, determining which is more reliable to be used as a parameter for total species richness (Chao et al., 2009).

- Relative Abundance Indices:

The relative abundance index (RAI) indicates the average number of photographs, which are recorded per unit of sampling effort (Hadly & Maurer, 2001), allowing temporal and spatial comparisons, even in different regions (Carbone et al., 2001; Tobler et al., 2008). The RAI of

each species detected in the photo-trapping will be estimated considering the number of independent photographs per 100 traps per night. The formula to be used to calculate the RAI is:

$$IAR = (C / Y) * 100 \text{ trap-nights}$$

Where: C= Number of independent events, Y = Sampling effort: (N° cameras * effective days) * correction factor 100 traps-night (Standard unit).

In addition, the standard deviation (SD) and standard error (SE) of the IARs obtained from species larger than 1 kg will be estimated, with the objective of determining if there are significant differences between the indices of relative abundance. The R program (3.5.1) will be used to calculate the SD and SE with 1000 randomizations, and the plots will be made with the ggplot2 package (Wickham, 2016).

23.6.3. Negative Impacts Outside the Project Area as a Consequence of Project Implementation
No possible negative impacts that could be generated from the development of project activities have been identified. However, according to the threats to biodiversity identified for the area, it is necessary to develop mitigation activities to reduce pressures on species of high conservation value in neighboring properties.

Table 55. *Negative offsite impacts and proposed mitigation measures.*

Negative *Offsite* Impacts	Mitigation measures
Poaching: Hunting pressure on wildlife may increase in areas adjacent to the project area.	1. Socialize the project with local authorities to raise awareness of the threat of bushmeat hunting and commercialization in neighboring areas. 2. Develop awareness-raising workshops on species of high conservation value to raise awareness of their threat status and generate commitments at the regional level for their conservation.
Retaliation hunting: The incidence of retaliation hunting of large and medium carnivores may increase in areas adjacent to the project area.	3. Develop awareness-raising workshops and training on human-feline coexistence to raise awareness of antipredator strategies and provide technical support. 4. Design an environmental education strategy to increase knowledge about the giant otter and its feeding preference in order to reduce its perception as competition by fishermen. 5. Train property owners as replicators of the responses to the conflict with their neighbors.

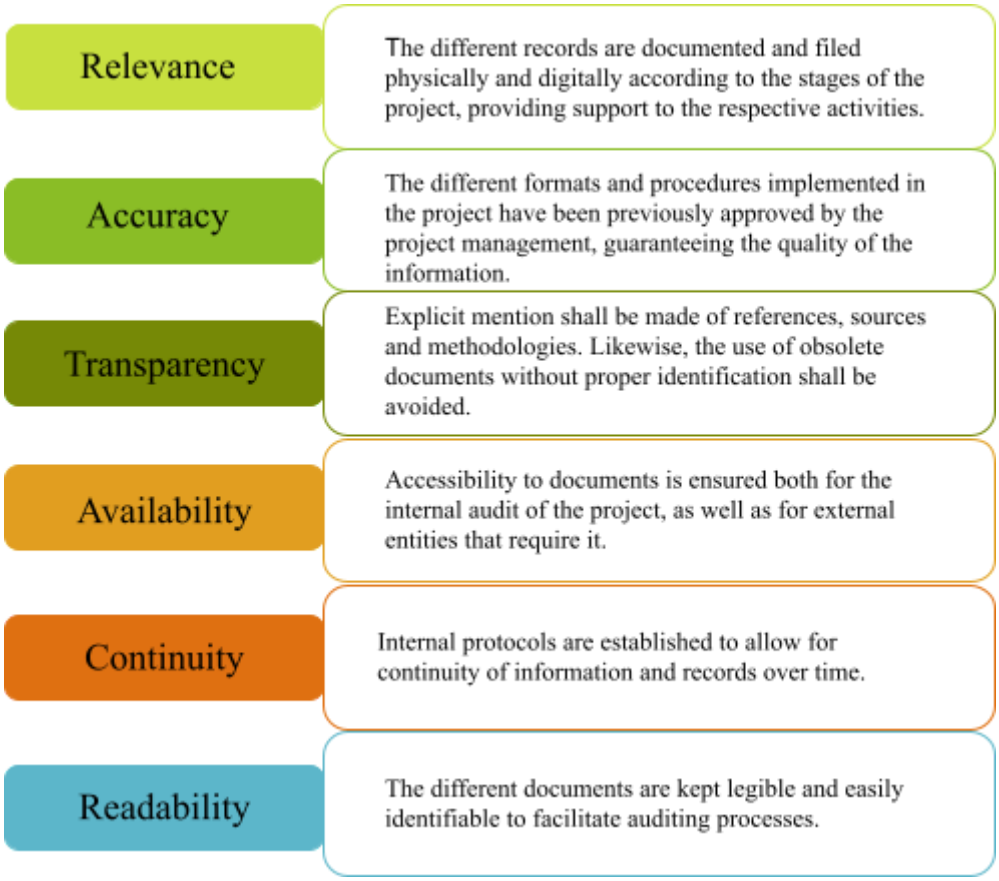
Uncontrolled burning: The practice of burning in neighboring properties can cause fires that affect wildlife populations in the project area and their habitat.	6. Design a fire response protocol identifying support authorities and a community communication strategy. 7. Train a community action group for fire response.

Source: Panthera (2020).

24. REGISTRATION, DOCUMENT MANAGEMENT AND DATA ARCHIVING SYSTEM

The present project defines the document management and control system, giving it compliance with the requirements of NTC 6208 and resolution 1447 of 2018, so 6 internal principles are defined, which are evidenced in figure 30 and are applied in the different stages of the project, with the main objective of ensuring the quality and reliability of the respective information.

Figure 33. Internal principles of the document management and control system



It is important to mention that the project follows the Cataruben Foundation's management system, which is duly certified and approved to facilitate the control of both internal and external information. Therefore, based on this statement, the entire registry, document management and archiving system is developed under the criteria defined by the document procedures (see annex K1) and the organization's archiving policy (see annex K2).

In order to correctly manage the Cataruben Foundation's documents, the first step is to identify which part of the organization's document structure the document is part of, whether they are: formats, records, manual documents, matrices, programs, procedures and instructions or, on the contrary, they are general or external documents, in order to assign them the consecutive coding and enter them in the Cataruben Foundation's master list.

Taking into account the documentary structure of each file and once they have been entered into the Master List of documents, or the importance of retaining these documents has been evaluated, they must have a location either internally or digitally, two files must be filled out to ensure the registration, monitoring and easy access of each file, these documents are: the control sheet, the single document inventory form.

- CONTROL SHEET

The file control sheet is the follow-up of each document and is oriented in such a way that the documents are inspected by project or by functionality. This format is used in the areas of the organization: anthropological area, operational area and scientific area, and according to the projects or activities that each one develops, this file control should be kept to facilitate the availability of these documents, as well as all internal and external auditing processes. The following is taken into account:

- ✔ The project of which this document is a part
- ✔ The dependence that generates it: anthropological, operational or scientific.
- ✔ The series that defines the functionality of that field
- ✔ Dossier detail and dossier number (related to possible agreements)
- ✔ Description of the file
- ✔ People involved in the project

- SINGLE DOCUMENT INVENTORY FORMAT

To facilitate document control, it should be filled out in each area of the organizational structure: anthropological area, operational area and scientific area, and will be included in the heading of the control sheet:

- ✔ The number of documents according to the consecutive number of the format
- ✔ The code assigned based on the master list above
- ✔ Start date (entry) and end date (in case it fulfills the archiving cycle)
- ✔ Conservation unit: Box, folder, other.
- ✔ Number of pages of each document to be archived

- ✔ The support of such document: Digital format on CD, USB, HARD DISK
- ✔ Remarks

Once the registration of the documents is started, it must be indicated:

- ✔ Date of document generation
- ✔ Documentary type: A list of the possible documents that may be generated in the project must be made beforehand; letters, official documents, manuals, technical documents, and others that characterize and support the development of each project and in each area.
- ✔ Table of contents: The number of pages covered by the document.
- ✔ Number of sheets of each
- ✔ Responsible for the generation of this document
- ✔ Observations related to the type of documentation

For the process of document quality control, it is the responsibility of the coordinator of the GS-OSHA to keep the documents generated by the GS-OSHA up to date, and to register them in the Master List of Documents. This magnetic file is considered controlled, the coordinator has access and permission to change, other users only for consultation. Within the Cataruben Foundation there is a hard copy that is considered controlled.

All documents and/or records used and/or made by the Directorate of Anthropological Management (DGA) for the implementation of the SG-SSTA can be delivered to each process owner, by magnetic media, mail or physical, as required to the DGA; the proper disposal and distribution of these, within each process, shall be the responsibility of the person requesting the documents, in this case, the owner of each process.

When it is considered necessary to keep a copy of an outdated document, for information purposes, it shall be clearly and visibly identified with a stamp or legend: "OBSOLETE COPY", or any equivalent, and in magnetic media it shall be stored in a separate folder identified as "OBSOLETE", the printed copies are considered not controlled. If not needed, the original obsolete document and the controlled copies of the previous versions will be destroyed.

Finally, Table 52 lists some of the documents generated to support and monitor activities related to the CO_2 Bio project, which are in the process of being annexed to the master list of documents related to manuals, formats, procedures and other records of the Cataruben Foundation, as well as to the master list of the CO_2 Bio project itself. It is also important to note that the respective location in the project's internal archive is defined in three main areas: anthropological, operational and economic.

Table 56. Documents generated for the development of the CO_2 Bio project.

ITEM	DOCUMENTS
FORMAT	Forest Management Plan Diagnosis Form
	Plot monitoring form
	Carbon inventory form (temporary plot)
	Database Management Support Formats
	Template for monitoring and compliance of REDD+ Activities
	Document inventory form
	Document control sheet form
	Disturbance report format
INSTRUCTIONS	Guide for emergency reporting (fires, floods, logging, etc.)
PROCEDURE	Procedure for area eligibility
	Procedure for satellite image processing
	Procedure for the use of forest inventory equipment
	Procedure for selection of plot size and site location
	Plot measurement procedure
	ODK filling out and downloading procedure
	Drone flight procedure
	Procedure for biomass quantification

Source: Cataruben Foundation

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