COLOMBIA POTENCIA DE LA VIDA

Gobierno del Cambio

# ERPD

# Emissions Reduction Program

Biocarbono

Paisajes sostenibles bajos en carbono

GRUPO BANCO MUNDIAL

Embajada de la República Federal de Alemania Bogotá

EMBAJADA de ESTADOS UNIDOS BOGOTÁ

UK Government

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NORECCO Nodo Regional de Cambio Climático Orinoquia

The project is part of The BioCarbon Fund Initiative for Sustainable Forest Landscapes (ISFL)

BioCarbon Fund
Initiative for Sustainable Forest Landscapes

# BIOCARBON PROGRAM ORINOQUIA[1] COLOMBIA

[1] According to the electronic version of the Pan-Hispanic Dictionary of Doubts published in 2005, the region of South America corresponding to the Orinoquia River basin is called Orinoquia or Orinoquía. However, the form with diphthong Orinoquia is the most widespread in general use..

BioCarbon Fund
Initiative for Sustainable Forest Landscapes

# BIOCARBON PROGRAM ORINOQUIA COLOMBIA

## EMISSION REDUCTION PROGRAM (ERP)

## Version 5.0

**June 2023**

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# Abbreviations

| | |
|---|---|
| **3CN** | Tercera Comunicación Nacional (Third National Communication) |
| **ADR** | Agencia de Desarrollo Rural (Rural Development Agency) |
| **AFOLU** | Agricultural, forestry and other land-use activities |
| **AGRONET** | Red de información y comunicación del sector agropecuario colombiano (Information and Communication Network of the Colombian Agricultural and Livestock Sector) |
| **AGROSAVIA** | Corporación colombiana de investigación agropecuaria (Colombian Corporation of Agricultural Research) |
| **AHN** | Agencia Nacional de Hhidrocarburos (National Hydrocarbons Agency |
| **ALIMEN TRO** | Recursos alimenticios para animales del trópico (Food resources for tropical animals) |
| **AMEM** | Área de Manejo Especial de la Macarena (Macarena Special Management Area) |
| **APC** | Agencia Presidencial para la Cooperación Internacional (Presidential Agency for International Cooperation) |
| **ANT** | Agencia Nacional de Tierras (National Land Agency) |
| **BANCOLDEX** | Banco de Desarrollo Empresarial de Colombia (Business Development Bank of Colombia) |
| **IADB** | Inter-American Development Bank |
| **IBRD** | Inter-American Bank for Reconstruction and Development |
| **BM** | Banco Mundial (World Bank) |
| **BMF** | Bancos mixtos de forrajes (Mixed Fodder Banks) |
| **BNC** | Beneficios no carbono (Non-carbon benefits) |
| **BUR** | Biennial Update Report |
| **CARs** | Corporaciones Autónomas Regionales (Regional Autonomous Corporations) |
| **CBIT** | Construcción de capacidades para la transparencia (Capacity building for transparency) |
| **CC** | Código Civil Colombiano (Colombian Civil Code) |
| **CDB** | Convenio de Diversidad Biológica (Convention on Biological Diversity) |
| **CENICAFÉ** | Centro Nacional de Investigaciones del Café (National Coffee Research Center) |
| **CENIPALMA** | Corporación Centro de Investigación en Palma de Aceite (Oil Palm Research Center Corporation) |
| **CIAT** | Centro Internacional de Agricultura Tropical (International Center for Tropical Agriculture) |

| | |
|---|---|
| **CICC** | Comisión Intersectorial de Cambio Climático (Intersectoral Commission on Climate Change) |
| **CIDEA** | Comités Interinstitucionales de Educación Ambiental (Interinstitutional Committees on Environmental Education |
| **CP** | Constitución Política de Colombia (Political Constitution of Colombia) |
| **CLPI** | Consentimiento libre, previo e informado (Free, prior and informed consent) |
| **CONPES** | Consejo Nacional de Política Económica y Social (National Council for Economic and Social Policy) |
| **CORMACARENA** | Corporación para el Desarrollo Sostenible del Área de Manejo Especial de la Macarena (Corporation for the Sustainable Development of the Macarena Special Management Area) |
| **DANE** | Departamento Administrativo Nacional de Estadística (National Administrative Department of Statistics) |
| **DNP** | Departamento Nacional de Planeación (National Planning Department) |
| **EAS** | Estándar Ambiental y Social (Environmental and Social Standard) |
| **ERPA** | Emission Reduction Payment Agreement |
| **EVA** | Evaluaciones Agropecuarias (Agricultural Assessments) |
| **FEB** | Factor de expansión de biomasa (Biomass Expansion Factor) |
| **FDA** | Fibra detergente ácida (Acid detergent fiber) |
| **FEDECACAO** | Federación Nacional de Cacaoteros (National Cocoa Growers Federation) |
| **FDN** | Fibra detergente neutra (Neutral detergent fiber) |
| **FINAGRO** | Fondo para el Financiamiento del Sector Agropecuario (Fund for the Financing of the Agricultural and Livestock Sector) |
| **FNC** | Federación Nacional de Cafeteros (National Federation of Coffee Growers) |
| **FREL** | Nivel de Referencia de emisiones Forestales de Colombia (Forest Reference Emissions Level) |
| **GGGI** | Global Green Growth Institute |
| **GRM** | Grievance Redress Mechanism |
| **GHG** | Greenhouse Gases |
| **ICA** | Instituto Colombiano Agropecuario (Colombian Agricultural Institute) |
| **IDEAM** | Instituto de Hidrología, Meteorología y Estudios Ambientales (Institute of Hydrology, Meteorology and Environmental Studies) |
| **IFN** | Inventario Forestal Nacional (National Forest Inventory) |
| **NGGI** | National Greenhouse Gas Inventory |
| **IMA** | Incremento Medio Anual (Average Annual Increase) |

| | |
|---|---|
| **IPCC** | Intergovernmental Panel on Climate Change |
| **ISFL** | Sustainable Forest Landscapes Strategy |
| **ODS** | Sustainable Development Objective |
| **MADR** | Minterio de Agricultura y Desarrollo Rural (Agriculture and Rural Development Ministry) |
| **MADS** | Ministerio de Ambiente y Desarrollo Sostenible (Environment and Sustainable Development Ministry) |
| **MDL** | Mecanismo de Desarrollo Limpio (Clean Development Mechanism) |
| **MGAS** | Marco de Gestión Ambiental y Social (Environmental and Social Management Framework) |
| **MRV** | Monitoring, Reporting and Verification |
| **NAD** | Núcleos de Alta Deforestación (High Deforestation Nuclei) |
| **NDC** | Nationally Determined Contribution |
| **NORECCO** | Nodo Regional de Cambio Climático de la Orinoquia (Orinoquia Regional Climate Change Node) |
| **ILO** | International Labor Organization |
| **OWV** | Other woody vegetation |
| **BSP** | Benefit Sharing Plan |
| **PND** | Plan de Nacional de Desarrollo (National Development Plan) |
| **PNCTE** | Programa nacional de cupos transables de emisión de GEI (National GHG Emission Trading Quotas Program) |
| **POAI** | Plan Operativo y de Inversión (Operational and Investment Plan) |
| **PPPI** | Plan de Participación de las Partes Interesadas (Stakeholder Participation Plan) |
| **PQRSD** | Peticiones, quejas, reclamaciones, solicitudes, y/o denuncias (Petitions, Complaints, Claims, Requests, and/or Denunciations) |
| **ERP** | Emission Reduction Program |
| **REDD+** | Reducing emissions from deforestation and forest degradation |
| **RENARE** | Registro Nacional de Emisiones de Gases Efecto Invernadero (National GHG Emissions Registry) |
| **SIAC** | Sistema de Información Ambiental de Colombia (Colombian Environmental Information System) |
| **SINGEI** | Sistema de Inventario de Gases Efecto Invernadero (Greenhouse Gas Inventory System) |
| **SISCLIMA** | Sistema Nacional de Cambio Climático (National Climate Change System) |
| **SMByC** | Sistema de Monitoreo de Bosques y Carbono (Forest and Carbon Monitoring System) |
| **SNIA** | Sistema Nacional de Innovación Agropecuaria (National Agricultural Innovation System) |
| **UIPRE** | Unidad Implementadora del Programa de Reducción de |

| | |
|---|---|
| | Emisiones Emission Reduction Program Implementing Unit |
| **UNCCD** | United Nations Convention to Combat Desertification |
| **UNFCCC** | United Nations Framework Convention on Climate Change |
| **UPRA** | Unidad de Planeación Rural Agropecuaria (Rural Agricultural and Livestock Planning Unit) |
| **UPME** | Unidad de Planificación Minero-Energética (Mining and Energy Planning Unit) |
| **PRZ** | Peasant Reserve Zones |
| **ZIDRES** | Zonas de Interés de Desarrollo Rural, Económico y Social (Rural, Economic and Social Development Interest Zones) |
| **ZRFN** | Zonas de Reserva Forestal Nacional (National Forest Reserve Zones) |

# Annexes

**ANNEX I** Characterization of causes and agents of GHG emissions and removals in the AFOLU sector in the Orinoquia region

**ANNEX II** Financing plan for the ISFL ER Program

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# SECTION 1: GENERAL INFORMATION AND GUIDELINES

## 1.1. PURPOSE OF THE EMISSION REDUCTION PROGRAM DOCUMENT (ERPD)

ISFL Emission Reduction Programs (ERPs) that have been included in the BioCarbon Fund Initiative for Sustainable Forest Landscapes (ISFL) portfolio are expected to provide detailed information on ISFL ERP design using the template provided in this document.

ISFL ERPs should be designed in accordance with the ISFL ER Program Requirements (Requirements). The Emission Reduction Program Document (ERPD), in combination with other documents such as the World Bank ISFL Program documents, demonstrates how an ERP complies with the Requirements. Upon receipt of the final ERPD, the World Bank and the ISFL participants (Participants) will decide whether to proceed to negotiate an Emission Reduction Purchase Agreement (ERPA) for the proposed ERP.

The ERPD model is intended to help an ISFL RE Program provide information to demonstrate how it conforms to the Requirements. Before an ERPD is considered final, drafts will be subject to review and comments by the World Bank, which serves as the implementing agency for the ISFL, the Participants and an independent firm. For ease of reference, and where appropriate, sections of this ERPD note the corresponding paragraph numbers specified in the Requirements.

The Requirements document contains a glossary defining the specific terms used in the Requirements. Unless otherwise defined in this model ERPD, any capitalized term used herein shall have the same meaning ascribed to such term in the Requirements document.

## 1.2. ORIENTATION IN COMPLETING THE PD

The PD should contain the most relevant data and information to evaluate the ISFL ER Program. Supporting data and information should be presented in specific annexes, when necessary.

Please complete all sections of this PD. If there are sections of the PD that are not applicable, explicitly state that the section has been left blank on purpose and provide an explanation as to why this section is not applicable.

If there is a specific section where the information provided must be "brief", limit yourself to the number of words specified for that section.

Provide definitions of key terms that are used and use these key terms, as well as variables, etc., Coherently using the same abbreviations, formats, subscripts, etc.

The presentation of values in the PD, including those used for the calculation of emission reductions, should be in an international standard format, e.g. 1.000 represents one thousand and 1,0 represents one. Please use International System units (SI units - see http://www.bipm.fr/enus/3_SI/si.html) and if other units are used for weights/currencies (Lakh/crore, etc.), they should be accompanied by their equivalent S.I. units/standards (thousands/millions).

If the PD contains equations, number all equations and define all variables used in them, indicating the units.

## 1.3. ERPD ASSESSMENT PROCESS

ISFL grant host countries are required to prepare relevant ERPs and ERPDs and submit them to the World Bank as their implementing agency. The WB will review the draft DPs for completeness and quality before sharing them with the ISFL Participants for them to provide feedback, and will request the appraisal of the advanced draft of the DP by an independent firm (selected by the administrator). The ISFL host country will revise the PD for resubmission, the independent firm will prepare a final appraisal report, and both the PD and the appraisal report will be made public. The World Bank, as part of its due diligence process, will assume primary responsibility for assessing the implementation of WB policies and procedures.

# SECTION 2: EXECUTIVE SUMMARY

## 2.1 DESCRIPTION OF THE ORINOQUIA BIOCARBON REDUCTION EMISSIONS PROGRAM – PRE-BIOCARBON

### 2.1.1 PRE-BIOCARBON INFORMATION AREA

The Orinoquía GHG Emissions Reduction Program, hereinafter Biocarbon ERP, is developed following the structure proposed by the World Bank Model published in January 2020 for the

Sustainable Forest Landscapes Initiative (ISFL in English)[2].

The Biocarbon ERP covers the four jurisdictional areas of the Orinoquia region (see Figure 1 and Table 1): Meta, Casanare, Vichada, and Arauca.

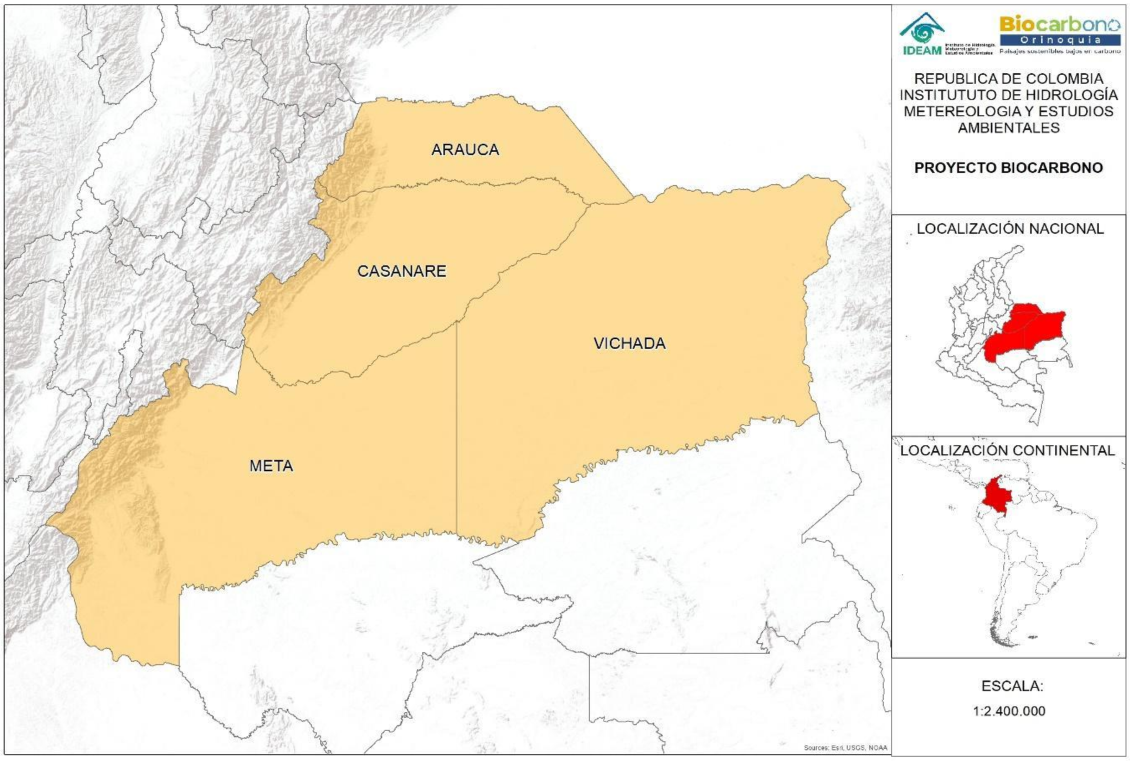


**Figure 1: ERP jurisdictional coverage.**

The reference period chosen to gather baseline information was 2009-2018, projecting the baseline and mitigation trend for the period 2019-2029, following the guidelines of the ISFL methodological framework. The Biocarbon ERP proposes that the program will be implemented at least from 2024 to 2029, however, the national government can modify this period if it is able to demonstrate results from previous years, if it complies with the standards proposed by the ISFL. This option coincides with the Nationally Determined Contribution (NDC) implementation period, which proposes a national commitment to reduce 51% of the GHG emissions generated in the year 2030 in the national territory[3].

The 10-year analysis period is pertinent since it allows taking into account the behavior of some emission reduction activities during the formulation period of the Biocarbon ERP (2021-2023), prior to possible direct interventions, this will allow adjusting the possible expected results, especially

[2] The current phase of technical assistance (phase 2) is called the Orinoquia Biocarbon Project. Component 3 of this phase (Design of the emission reduction program and MRV system) has consolidated the proposal described here (see template: ISFL PD Template January 2020.pdf (biocarbonfund-isfl.org). It is expected that once the proposal designed is approved, the implementation phase (phase 3) begins, called the Orinoquia Biocarbon Emissions Reduction Program (Biocarbon ERP).

[3] Microsoft Word - NDC de Colombia - VersiÃ³n Final.docx (minambiente.gov.co).

those associated with agricultural and livestock conversion, ecosystem restoration, the implementation of forest plantations, as well as the control and management of the causes and agents of deforestation, which are generally achieved in the medium and long term.

Based on the evidence gathered from 2009 to 2018, the Biocarbon ERP must promote GHG Emissions Reduction (ER) activities associated with the main sources, such as GHG emissions resulting from forest deforestation and cattle farming. Additionally, the Biocarbon ERP intends to strengthen activities that promote the removal[4] of GHG through natural restoration and regeneration processes, implementation of commercial forest plantations, including rubber, oil palm, cocoa, and marañon crops, as well as reduce GHG emissions associated with the cultivation of rice and processes with loss of surface with the presence of woody vegetation.

The forest degradation category, which is mandatory in the ISFL methodological framework, requires that more accurate information is gathered before being considered in the Biocarbon ERP accounting (see section 4.3), an issue that will be solved during the negotiation phase of the potential ERPA and/or the initial period of implementation of direct activities of the Biocarbon ERP, prior to the first period of monitoring and verification of GHG results planned.

In the event that the Biocarbon ERP decides to include a category that has not been considered in the NDC (e.g. harvested wood products – HWPs and Other Woody Vegetation (OWV)), this must be accounted for separately (i.e. not included in the NDC), until the NDC is updated with the new inclusion.

**Table 1. ERP area information**

| | |
|---|---|
| **ERP ISFL-Name** | GHG Emissions reduction program in Orinoquia – Biocarbon ERP |
| **Area's Name** | Colombian Orinoquia |
| **Geographic Extension[5]** | Arauca: 23.855 $km^2$<br>Casanare: 44.477 $km^2$<br>Meta: 85.469 $km^2$<br>Vichada: 100.036 $km^2$<br><br>Total: 253.837 $km^2$ |
| **Population[6]** | Arauca: 270.708<br>Casanare: 375.249<br>Meta: 1.016.701<br>Vichada: 77.246 |

[4] In this text the terms of GHG remotion and GHG absorption are indistinct
[5] Source: IDEAM (2023), geographic information of *Sistema de Monitoreo de Bosques y Carbono* (SMByC) used to establish the baseline of Biocarbon ERP.
[6] Source: DNP (2020), MOTRO-*Modelo de Ordenamiento Territorial Regional Orinoquia*, population data from DANE and IGAC (2018).

| | |
|---|---|
| | **Total: 1.739.934 inhabitants**<br>Women: 869.967<br>Indigenous population: 78.521[7]<br>Afro-Colombian population: 25.949[8] |
| **Emissions reduction *ex-ante* estimation (ER)** | **50.861.179** $tCO_2$ eq[9] (Cumulative total 2024-2029; see Table 22). |

### 2.1.2 SELECTION OF THE BIOCARBON ERP AREA

The Sustainable Forest Landscapes Initiative of the Biocarbon[10] Fund began in the country in 2014 after the decisions made in the United Nations Framework Convention on Climate Change (UNFCCC) on the implementation of Mechanisms for Reducing Emissions from Deforestation and Forest Degradation (REDD+). At the end of 2014, the Agriculture and Rural Development Ministry (MADR) and the Environment and Sustainable Development Ministry (MADS) on behalf of the Government of Colombia, sent a letter of interest to the World Bank to develop the Biocarbon ERP in the regions of Vichada, Casanare and Meta (high-plain subregion); however, this initially proposed area was later adjusted.

For the selection of the Colombian Orinoquia as a strategic focal area of the country to implement the BioCF ISFL, a Pre-Technical Assistance process was carried out by the World Bank (WB) where several studies and exchanges were generated at the national and regional level; it was determined that the selection would be based mainly on environmental and economic criteria. Given the breadth and diversity of the region, this area was identified as having an incredible agroforestry potential that could be developed through the program[11]. The most relevant economic criteria were defined considering the regional contribution to the National Gross Domestic Product (GDP), which for that year 2014, reached 8%. That same year, the national government had projected the expansion of the Orinoquia's development frontier to the high-plain sub-region, through CONPES

[7] Indigenous population data in the reservation, certified in DNP in 2017; according to DNP this certified population represents 74% of natives from Orinoquia, while the rest 26% (20.180 natives) are outside the reservation in urban areas victims of "forced displacement from ethnic territories due to the social and armed conflict, insufficient and depleted land in collective territories, the advance of the latifundio and economic interests that loom over the region" (MOTRO, 2020).
[8] Afro-Colombian population is part of the ethnic population and national minorities with special legislation for the protection of their sociocultural and ethnic territorial rights. According to DNP, the Afro-Colombian population is in Arauca and Meta mainly, they are from Pacífico (Nariño and Choco), displaced by political, economic, and social factors; It is known that a settlement of the Afro-Colombian population of the "Patagonia" community was recently created within a palm plantation in Meta.
[9] See the details of the potential reduction of estimations in section 4.6, Table 22.
[10] The ISFL from BioCF is an initiative that seeks to promote the reduction of GHG emissions from land use through REDD+ strategies, sustainable agriculture, smart climate planning, and policies for sustainable land use; with jurisdictional programs that have significant impacts on land use and that adopt landscape approaches. Likewise, the role of the private sector in more sustainable land use practices.
[11] Colombia. Identification Mission: Sustainable Forest Landscapes initiative, February 2-6, 2015 in Bogotá. Memory Help. The following participated in this Mission: the World Bank and IBRD, the MADR and affiliated entities, MADS and SINA, DNP, APC institutions; likewise, NGOs and environmental consultants: WWF, TNC, WCS, Fondo Acción, Climate Focus, Earth Innovation Institute and Fundación Omacha. Likewise, different actors from the private sector participated.

3797; In this Policy document, the potential of the mining-energy[12], agro-industrial, and tourist sectors were highlighted, as well as the strategic position of Orinoquia, equidistant between the Atlantic and the Pacific[13]. The region is also on the border with Venezuela, which makes it relevant for diplomatic relations of national sovereignty and commercial exchange with the neighboring country.

In the BM/IFC-2015 Identification Mission, the enabling conditions of the ISFL necessary to guarantee sustainability and territorial governance were also evaluated, given the low institutional capacities of the two Regional Autonomous Corporations (CARs) - Environmental Authorities, which must manage the Orinoquia and territorial entities natural resources and together they must guarantee effective improvement processes of the integral sectoral environmental management and, adequate regulation of sustainable use of the land from an integral territorial ordering, based on the existing potentials and restrictions. It was proposed to use various instruments such as economic incentives for environmental sustainability.

Likewise, the high informality in land tenure was a relevant issue in the discussions for the selection of the Biocarbon area during the project Missions; this matter is relevant due to the liabilities of the Colombian internal conflict in the region, as binding conditions forcing the development of a comprehensive rural reform model in the Orinoquia territory as a step prior to the implementation of the Program, while the history of regional colonization, location, economic dynamics, and related predominant population migrations should not be left aside. The presence of ethnic and cultural diversity and its conditions of extreme poverty, underdevelopment, and very marked inequality[14] caused by the development of productive activities that are carried out under the model of enclave economies, which do not generate enough added value to the territory and perpetuate the gaps in quality of life with respect to the rest of the country[15].

The current diagnosis and analysis of land tenure (see Annex III.docx), shows that the problems discussed persist, evidencing various types of conflicts associated, as the Orinoquia is such an extensive region where phenomena associated with the armed conflict persist, such as dispossession, forced abandonment, which generate displacement of the rural population. In summary, there are still conflicts in the territory associated with the armed conflict that generates displacement and resettlement. In addition to the above, there are civil disputes associated with land use, tenure and ownership, generated in part by the high level of informality and the absence of an institutional framework capable of resolving natural disputes related to land tenure through legal channels. These types of conflicts, disputes, and tensions associated with land tenure are present in the four departments under the Biocarbon ERP jurisdiction.

[12] In 2014, the hydrocarbon mining sector contributed 60% of the Orinoquia regional GDP.
[13] CONPES 3797 of 2014.
[14] The history of the settlement of the Orinoquia has two marked migration milestones that occurred since the middle of the last century: the violence of the 50s to date and the migrations that gave rise to the expansion of economic activities such as oil enclaves and the agro-industry of the palm from the 80s. The municipality of Villanueva (Casanare) was created as a human settlement at the service of oil palm plantations that brought with it an Afro-descendant population from the Colombian Pacific; Currently, this dynamic is maintained if one considers that a settlement for the Afro-descendant population called "La Patagonia" was recently created inside a palm plantation in Meta (MOTRO, 2020).
[15] El Gran Libro del Orinoquia, 2019. IAvH. p. 156

Consequently, the selection of the program area took place during the Identification Mission (2015) and was corroborated in recent analyses, based on the diagnosis described and considering several of the actors' visions included in the Mission (including National and regional Government institutions, NGOs and the private sector), who analyzed that the Orinoquia region requires a comprehensive and differential perspective of territorial planning and development[16], because, in addition to its economic importance, it is a strategic and sensitive region due to its potential in terms of water resources, rich biodiversity, the location of priority ecosystems for the conservation and provision of environmental services, important areas of Amazonian transition forests, protected by ethnic communities. Subsequently, the area was expanded, and additional prioritization criteria were defined in order to solve the problems identified and enhance the opportunities offered by this region to develop the Biocarbon ERP.

In general, the selection of the Biocarbon ERP area is due to the condition of Orinoquia as a biodiverse, multi-ethnic region, with a heterogeneous landscape (by integrating mountainous areas, foothills, flooded or humid savannahs, high-plain savannahs, and transition zones towards the Amazon). environmentally fragile and with agroforestry potential determined by high complexity and territorial diversity.

Regarding the problem of GHG emissions and its causes related to agricultural economic activities and other predominant activities in the Orinoquia, the differentiation at the subregional level was necessary, according to the landscape, as criteria to prioritize the areas of Biocarbon ERP interventions, which responded both to the physiographic conditions, the potentialities and limitations (environmental, social and economic) and the unsustainability problems identified. First, there is a mountain[17] area that has a mosaic of agricultural activities and natural forests, some of them with protected areas, but affected by agricultural expansion and illegal logging.

A foothills area[18], where most of the human settlements in the region are located, as well as livestock, agro-industrial (oil palm), commercial and financial activities; here the drivers of emissions are related to agricultural expansion (see section 3.1.1). This is the region that has transformed its ecosystems the most, which tends to increase its vulnerability to climate change, resulting in a possible increase in the frequency and intensity of future extreme weather events.

In the area contiguous to the foothills, there is an area known as floodplains of Arauca and Casanare[19], characterized by low fertility soils, where extensive or low-intensity livestock activities are mainly carried out. In addition to the number of heads of bovine cattle, there is an emissions problem related to the increasing development of rice activity (mainly in the municipality of Paz de Ariporo); this may be generating socio-environmental conflicts due to the transformation of

[16] During that same Identification Mission (2015), other perspectives or approaches were registered based on which the jurisdictional area of the Program was defined, integrating the four departments as the most convenient taking into account: the basin approach, approach of environmental offers, of prioritization of productive identification or reconversion of uses, focus on restoration of landscape connectivity, focus on reducing emissions and focus on ensuring the complementarity of IPFS and Visión Amazonia programs to avoid double counting.

[17] The mountain zone, also called the Andean corridor (DNP, 2020) includes the eastern slope of the eastern mountain range over the departments of Casanare and Meta, it has high mountain ecosystems, hillside forests and humanized landscapes, most of the waters of the Orinoquia basin.

[18] Also called the lower high-plain subregion (DNP, 2020), it is contiguous to the Andean corridor and includes the departments of Arauca, Casanare and Meta.

[19] The humid savannah zone occupies almost the entirety of the departments of Arauca and Casanare; It is also known as the savannahs of the Arauca-Casanare amphi-biome because it remains flooded most of the year

ecosystems from wetlands to rice paddies, the intensive use of agrochemicals and/or the displacement of productive activities considered traditional.

Adjacent to the flooded savannahs and towards the southeast of the region, is the high-plain zone[20], characterized by natural savannahs[21], where hydrocarbon, livestock and technical agriculture activities are carried out; and that implies the development of oil palm, rice, corn, soybean crops, and commercial forestry plantations, subjected to pluviometric extremes (strongly marked dry season); The natural covers, which should be considered as strategic areas for their conservation, correspond mainly to gallery forests and moriche palm crops, within a matrix of native savannah.

Finally, the problem of GHG emissions in the south of the Meta region is associated with the high rates of annual deforestation related to grassland processes and the expansion of the agricultural frontier over protected forest areas and Orinoquia Amazonia transition zones in the municipality of Mapiripan, the Serranía de la Macarena is also located here, one of several protected areas that converge in the AMEM[22]; which, among others, contains a highly intervened national reserve, where illegal hoarding processes take place, this area is one of the main active nuclei of regional and national deforestation.

To address all these causes and agents of emissions with jurisdictional scope, after the pre-technical assistance phase carried out by the World Bank (2016), in the two missions of 2017 and under additional criteria of: updated data on levels and sources of deforestation and the political context of the four departments, three clusters were defined with prioritized areas for deforestation control objectives, sectoral reduction of emissions and agroforestry goals. Consequently, prioritized high-impact landscapes in the ER were associated with ecological landscapes: i) Plains - Savannahs of Sarare de Arauca (Arauquita-Puerto Rondón) and Paz de Ariporo; ii) High-plain - Villavicencio/Acacías; iii) Orinoquia Amazonia – Mapiripan Transition Zone; iv) High Mountain zone – La Macarena/La Uribe; and v) High-plain area – Puerto Gaitán/ La Primavera/ Santa Rosalía or Puerto Carreño[23].

Considering the central axis of the Biocarbon ERP is the GHG ERs generated by the AFOLU sector, direct and indirect causes, and critical factors that will be managed under the categories of land use and management and land use changes were determined. On a timeline from two moments: a historical one, until the year 2010, which will address actions for conversion and management of generated emissions, which will counteract inappropriate practices which have been carried out by

[20] The high-plain is extended through the departments of Meta (Puerto López, Puerto Gaitán and Mapiripán), and Vichada (La Primavera, Puerto Carreño and Santa Rosalía).

[21] The regional natural savannahs are characterized by the abundance of grasses or grasses mixed with shrubs and trees. In Guayanés shield there are stunned low forests, despite the complex climatic conditions of the high-plain (high temperatures, nutrient, and water deficits), specialized species endemic to the region emerge. The high savannahs or high-plain (Peinobiome Ecosystems) contain the highest percentage of biodiversity species at the Ecosystem level, even when compared to Forest and Flood Savannah or Amphibiome ecosystems. (El Gran Libro de la Orinoquia, IAvH 2019, p.251)

[22] AMEM Área de manejo especial La Macarena is made up of PNN, Sierra de la Macarena, Tinigua, Picachos and Sumapaz, as well as preservation, recovery and production zones. Over the AMEM, 15 municipalities of Meta have jurisdiction (MOTRO, 2020) p. 163

[23] These prioritized areas had to consider the following additional criteria: presence of PNN, PDETs priorities, Transitory Veredales Zones (Peace Agreement), Modern POT, Cadastre, and reduction of Emissions. Ayuda de Memoria V y VI Misión Banco Mundial. Pre-Evaluación y Evaluación, Julio, septiembre y noviembre, de 2017.

years and allow progress towards the goals of the Paris Agreement; and a projected one, which will consider emissions since 2010 and future planning actions, adoption of policies, good practices and incentives to maintain the level of emissions below the determined limits[24].

According to the above, the Orinocense territory, represented 15,9% of the total national GHG emissions to 2018, and at the regional level the Agriculture, Forestry, and Other Land Use (AFOLU) sector contributed 78,7% of all GHG emissions from the four departments, this denotes an important potential to achieve the country's ER goals and to potentiate a series of identified environmental, economic and social co-benefits (see Table 14).

Although the jurisdictional coverage of the Biocarbon ERP covers the four departments of Orinoquia (Arauca, Casanare, Meta, and Vichada), it should be clarified that the area could vary (e.g. possible areas excluded from accounting) depending on the agreements that are generated with mitigation initiatives that are in the implementation phase on the platform of the National Emission Reduction Registry (RENARE), so that they can participate under the figure of executing partner. If it is not possible to reach a joint participation agreement with these initiatives, the exclusion of ERP areas will be carried out in accordance with the provisions of Resolution 1447 of 2018.

**BOOSTERS IN AFOLU EMISSIONS AND REMOTIONS**

The main sources of emissions in the AFOLU sector in the region are:

- Deforestation of natural forests, particularly, the change of this natural cover to grassland and, to a lesser extent, to OWV (cover that does not meet the criteria of the definition of forest) and wetlands.
- The enteric fermentation of bovine cattle, which depends directly on the inventory of cattle and their age groups.
- The emissions associated with the unsustainable consumption of firewood by the rural population, mainly for cooking food.
- Direct and indirect emissions from grazing animals through managed soils.
- Emissions (not $CO_2$) from biomass burning.

The main sources of remotion of GHG emissions in Orinoquia are:

- GHG removals from surfaces that incorporate OWV, which has been progressively reduced.
- The implementation of commercial forest plantations.
- Expansion of the area planted with permanent crops such as oil palm.

Among the direct causes of emissions, the causes which most stand out are the expansion of the agricultural frontier, extensive cattle raising, grazing land expansion, agro-industrial crops and, with a lower current impact, crops for illicit use; referring to the expansion of the agricultural frontier and the establishment of agro-industrial crops, these have traditionally not incorporated sustainable low-carbon models (see Section 3.1.1).

[24] Ídem

### 2.1.3 VISION, INTERVENTION LOGIC, AND EXPECTED RESULTS FROM THE BIOCARBON ERP

#### i. Vision

The purpose of the Biocarbon ERP is to implement, in a minimum period of six years (2024 to 2029), actions that allow the region to comply with a reduction in potential emissions of 50.861.179 $tCO_2$ eq[25]; promoting GHG ER activities associated with the main sources of emissions, such as emissions resulting from deforestation of the natural forest, GHG emissions from cattle farming and emissions resulting from rice cultivation in the Colombian Orinoquia.

To reach this vision, the Biocarbon ERP will strengthen activities that avoid the loss of surface and increase the removal of GHG through natural restoration and regeneration processes of the forest and promote the implementation of low-carbon sustainable productive development models, which, based on the incorporation of different landscape management tools, favor an increase in carbon content by increasing and maintaining woody vegetation in commercial forest plantations (including rubber), oil palm, cocoa and marañon crops.

#### ii. Logic intervention

The intervention logic proposed by the Biocarbon ERP is a combination of measures and actions whose main objective is to reduce GHG emissions from the AFOLU sector in the region.

Through the flow of information from the national MRV system, data are provided as inputs for the National GHG Inventory System (SINGEI), which for the AFOLU sector also collects agricultural information from multiple sources. Using this information and from other sources (see section 3.1.1 and Annex I.docx) the causes and agents of the transformation and their relationship with the main sources of GHG emissions were identified and analyzed.

The direct causes of emissions in the Orinoquia are related, mainly, to the expansion of the agricultural frontier due to bovine cattle, grazing land expansion, industrial crops and crops for illicit use; In the same way, the expansion of transport infrastructure and the extraction of wood are identified as direct causes of emissions.

These direct causes of emissions are associated with AFOLU emission agents in the region related with the expansion of the agricultural frontier (in production systems that do not incorporate environmentally sustainable practices), which are: large-scale cattle ranchers, medium- and small-scale cattle producers, grazer for land-grabbing purposes, industrial agricultural producers, and coca producers. On the other hand, the direct cause of expansion of the transport infrastructure is associated with the emission agent that builds the transport infrastructure and, referring to timber extraction, the extractors of wood for self-consumption purposes are identified as associated

[25] The GHG emission reduction potential established and presented in this document is technical and obeys the GHG reduction ambition of the Orinoquia region, which includes compliance with the NDC goal. For this reason, it cannot be understood under any circumstances as the volume of GHG emissions reduction that the country will commit to the ISFL in the period of implementation of the Biocarbon ERP. This volume of GHG reductions must be agreed upon within the framework of the negotiations for the preparation of the ERPA that the country will carry out with the donors and the World Bank.

emission agents as well as large-scale commercial loggers. The greatest contribution to GHG emissions in the Orinoquia can be attributed to the agent called "large-scale grazing rancher" which adds emissions from deforestation as a result of grazing, the unsustainable growth of the cattle herd, as well as uncontrolled burning and inefficient nitrogen fertilization processes for the establishment and renewal of grassland; practices that are not part of a production system low in GHG emissions (see Annex I.docx).

Associated with the direct causes, there are also underlying causes identified in the region, mainly linked to economic and technological, political and institutional, cultural, demographic, and biophysical factors.

The direct causes are responsible for the main sources of AFOLU emissions, which for the Orinoquia were identified as: deforestation and/or forest degradation, Cattle Enteric Fermentation, nitrogen fertilization of crops and grasslands, and direct emissions from rice cultivation; in this way, a relationship is generated between the direct causes of emissions and the AFOLU subcategories of the regional GHG inventory. The expansion of the agricultural frontier by livestock is related to the subcategories contained within category 3A-Livestock, at the same time, it is related to category 3C-Aggregate sources and non-$CO_2$ emissions from land. On the other hand, the expansion of the agricultural frontier due to grazing, industrial crops, and crops for illicit use is related to category 3B-Land and 3C category. The last two direct causes of emissions, expansion of transportation infrastructure and timber extraction, are directly related to category 3B- Land (see section 3.1.1-Table 5).

Based on the diagnosis and the development of solutions to the problem posed (GHG emissions for the AFOLU sector), the construction process of the Biocarbon ERP intervention portfolio (measures and actions) was defined (see Figure 9). The construction of this portfolio was developed through a multi-stakeholder process that has been carried out in different stages (see section 3.1.2); this process resulted in the establishment of the following objectives: 1) promote sustainable agricultural and livestock systems with a low-carbon production approach; 2) improve the efficiency of production systems in terms of land use and other resources; 3) increase GHG removals in the AFOLU sector from the integration of the forestry component into agricultural systems and restoration processes; 4) reduce deforestation rates in the region (with emphasis on the nuclei where the phenomenon is concentrated) and promote a culture of sustainable management of the natural forest and; 5) generate the enabling conditions required for the effective implementation of direct interventions.

Once the objectives of change for the interventions were defined, the measures and actions of Biocarbon ERP were organized into five thematic groups that related to one or more of the objectives developed, the thematic groups are: 1) agricultural chains; 2) forestry and restoration; 3) cattle farming; 4) deforestation; and 5) planning and governance. In order to prioritize interventions, the Biocarbon ERP includes 41 measures (Table 8), section 3.1.2), 27 of which correspond to direct measures, that is, they can calculate the GHG mitigation potential. These direct measures are classified into the following four large groups, seeking a comprehensive implementation of sustainable and low-carbon land uses, while complying with the relevant WB EAS:

1. **Agricultural chains:** Measures focused on increasing GHG removals based on good practices and approaches applied to permanent crops (oil palm, cocoa, marañon) and the reduction

of emissions in transient (mainly rice) and permanent crops. The measures proposed in this group of interventions are related to the following main causes identified: emissions from the expansion of the agricultural frontier by industrial crops, the removal of permanent crops in previously transformed areas and sustainable management practices for degraded soils and grasslands.

2. **Forestry and restoration:** Measures focused on increasing GHG removals from commercial forest plantations and increasing restoration areas of degraded natural ecosystems, mainly forests. This group also contemplates measures focused on reducing or improving the efficiency of the use of fuel wood (firewood) by the rural population. The measures proposed in this group of interventions are related to the following main causes identified: emissions from timber extraction, the removal of forest plantations in previously transformed areas, and natural regeneration and restoration of the forest.
3. **Cattle farming:** Measures focused on increasing the productivity of cattle farming in the region through sustainable low-carbon production models, including, among others, different pastoral and silvopastoral arrangements and the release of areas that allow the restoration and conservation of the natural forest. The measures proposed in this group of interventions are related to the following main causes identified: emissions from the expansion of the agricultural frontier by livestock and grasslands, removals of natural regeneration and restoration of the forest, silvopastoral systems, and sustainable management practices of soils and degraded grasslands.
4. **Deforestation:** Measures focused on the control of deforestation and sustainable management of forests on a regional scale, based on the promotion of actions that strengthen the sustainable forest economy in the region, conservation, and sustainable management of forests and control of the activities that generate deforestation in the Orinoquia. The measures proposed in this group are related to all the direct causes of AFOLU emissions (expansion of the agricultural frontier, expansion of transportation, and extraction of wood infrastructure) and to the cause of natural regeneration removals and forest restoration.

On the other hand, the fourteen (14) measures classified as indirect correspond to interventions that support the implementation of direct measures, in matters of territorial and property planning and ordering, regulatory adjustments, institutional and stakeholder strengthening, and water resource management, among others.

Additionally, the ERP measures must include the following principles in the specific actions for their implementation: 1) Promote sustainable productive reconversion, mainly in previously intervened areas that present degradation in soils and/or grasslands; 2) the protection of regional ecosystems, including savannahs, forests, and wetlands; 3) the release of degraded areas for the purpose of restoration or development of agroforestry systems; 4) the generation of economic and competitive advantages for producers who implement low-carbon production practices, 5) the inclusion of an adequate gender and social responsibility approach; 6) the strengthening of the technical and decision-making capacities of institutional and community actors at the local and regional level; 6) Develop or support the implementation of instruments and policies aimed at reducing GHG emissions in the AFOLU sector at the regional level.

### iii. Expected results and continuity of Biocarbon ERP

It is expected that during the implementation period of the Biocarbon Program, actions will be developed that allow the region to comply with a reduction in potential emissions of 50.861.179 $tCO_2$ eq; the mitigation measures identified are consistent with the mitigation goals prioritized by the country in the Nationally Determined Contribution (NDC)[26], the Integral Regional Climate Change Plan for the Orinoquia PRICCO and the carbon neutrality strategy of 2050 (E2050 Colombia)[27]. It is intended that the Biocarbon ERP measures strengthen these climate change mitigation instruments in the medium term, hoping that their continuity will allow the country and the region to meet the expected reductions by the year 2030.

### iv. Stakeholder engagement

Through a participatory consultation process[28], different stakeholders are involved in both the design and implementation of the Biocarbon ERP. Initially, interested parties were identified and analyzed, which resulted in a map of actors, composed of 11 groups in the 4 regional jurisdictional areas, as shown in Table *2*:

**Table 2. Identified stakeholder's groups[29]**

| Stakeholders' groups | Stakeholders description |
|---|---|
| **National government institutions** | Entities in charge of executing the program and others that participate as GHG reduction implementing partners defined by the Orinoquia Biocarbon ERP:<br>- MADR: executing entity that leads measures in the agricultural sector in the prioritized production chains (rice, cocoa, oil palm, marañon, forest plantations and livestock).<br>- MADS: co-executing entity that leads the measures to reduce emissions from deforestation.<br>- IDEAM: co-executing entity, which leads the monitoring, reporting, and verification system of REDD+ activities.<br>- UPRA: co-executing entity, which leads the monitoring, reporting, and verification system of the activities of the agricultural sector<br>- National Natural Colombian Parks: implementing entity, responsible for the administration and management of the National Natural Parks System and the coordination of the National Protected Areas System. |
| **International Cooperation Entities** | International cooperation organizations that carry out initiatives that contribute to the development of the region and are aligned with the purpose and actions of the Orinoquia Biocarbon ERP. |

[26] MinAmbiente et al, 2020. ACTUALIZACIÓN DE LA CONTRIBUCIÓN DETERMINADA A NIVEL NACIONAL (NDC) REPÚBLICA DE COLOMBIA. https://www.minambiente.gov.co/wp-content/uploads/2022/05/NDC_Libro_final_digital-1.pdf.
[27] https://www.minambiente.gov.co/cambio-climatico-y-gestion-del-riesgo/estrategia-2050/.
[28] The consultation process is described in detail in the Stakeholder Participation Plan, a dynamic tool and guide for the socialization and collective construction in two ways of the actions for the definition and future implementation of the Biocarbon ERP.
[29] The identification of other parties must be updated, endorsed and/or specified once progress is made in the implementation of the Biocarbon ERP Orinoquia

| Stakeholders' groups | Stakeholders description |
|---|---|
| **Corporaciones Autónomas Regionales y de Desarrollo Sostenible** | CORPORINOQUIA and CORMACARENA, entities in the Orinoquia Biocarbon ERP area that act as the highest environmental authority in their jurisdiction, executing environmental policies, plans, programs, and projects, through the construction of social fabric, to contribute to the sustainable development of the territory. |
| **Territorial entities** | Territorial institutions like regional governments and mayors |
| **Financial and business support entitites** | Entities that support the development of the agricultural sector in the region through business strengthening and credit lines for the development of initiatives. For example, FINAGRO, Banco Agrario, Chambers of commerce, among others. |
| **Universities, research centers and technical assistance** | Institutions responsible for research and technology transfer for territorial development. For example, Agrosavia, Alexander von Humboldt Institute, Unillanos Antonio Nariño University, among others. |
| **Ethnic groups** | Indigenous population and ethnic groups in the influence area of Orinoquia Biocarbon ERP. For example, U'wa, Saliba, Sikuani, Cuiba, Piapoco, among others. |
| **Base and productors organizations (women, families, community)** | Civil Society Organizations that are aimed to contribute to the consolidation of territorial development in an integral and sustainable way. For example, AGAPILL, Agropecuaria el Remanso, RESNATUR, ASCATIDAR, ASOTAMA, ORIC, among others. |
| **NGO** | NGOs that carry out actions in favor of the environmental recovery of the region and activities related to sustainable agricultural development techniques. For example, Orinoquia Fundation, Natura Fundation, Omacha Fundation, Cataruben Fundation, among others. |
| **GHG Mitigation Initiatives** | Programs and/or projects initiatives that have been implementing actions to mitigate GHG emissions in the region, mostly registered in the RENARE. For example, MAVALLE Forest Project in rubber plantations, El Tigre REDD+, CO2CERO Meta_09 Forest Project, La Primavera Organization Forest Project, among others. |
| **Private sector** | Parties whose activities and/or functions are related to the Orinoquia territories, which carry out activities not directly controlled by the State and which influence decision-making in the prioritized production chains (livestock, rice, marañon, oil palm, cocoa and forestry). For example, Fedepalma, Cenipalma, Comité de Ganaderos, Fedecacao, among other associations (e.g. APP, see section 3.1.2). |

According to the expected impact of the Biocarbon ERP, two categories of interested parties are considered: a. parties benefited and/or directly affected; and b. other interested parties.

a. Parties benefited and/or affected: this category includes eligible beneficiaries of Orinoquia Biocarbon ERP and/or that will likely be affected (positively or negatively) by the implementation of actions and/or GHG reduction measures of Biocarbon ERP and/ or the Benefit Sharing Plan. They are considered in this category due to actual impacts or potential risks to their physical environment, health, safety, cultural practices, welfare, or livelihoods. They may include individuals or groups, as well as local communities. For example, families, community base organizations, indigenous or ethnic peasant organizations, among others.

b. Other interested parties refers to any individual, group or organization that has an interest in the Biocarbon ERP for the following reasons: location, characteristics, impacts, or public interest. For example, regulatory entities, local administrations, allies, international cooperation, academics, women's organizations, civil society organizations, initiatives and programs in the region, among others.

The categories are not exclusive, that is, a stakeholder can also be a beneficiary and/or directly affected and can be part of both groups but their differentiation allows the proper environmental and social management of the Orinoquia Biocarbon ERP. In both categories, special attention is paid to the vulnerable or less favored population (women, marginalized producers, youth, ethnic groups, among others), understood as the people who are most likely to be affected by the impacts of Biocarbon ERP or who could be more limited than others in their ability to take advantage of its benefits. Similarly, these individuals or groups are more likely to be excluded from the participation and consultation process or not be able to fully participate and may therefore require specific measures or assistance to do so. Age considerations will be considered here, including minors and the elderly even in circumstances where they may be separated from their family, community or other individuals on whom they depend on[30].

The main parties affected (positively or negatively) by the Biocarbon ERP are the families and community base organizations, most of which are local, regional and national farmer or indigenous organizations (organizations that include those dedicated to and / or involved in the construction of peace in the territories). Their involvement must always be developed through a participative, representative and transparent communication channel. With the farmer communities, the particularities of each territory are evaluated, and sometimes this participatory process can be carried out through productive associations or community organizations such as the community action boards or the veredal centers. For indigenous population and Afro-Colombian Communities, the interaction with the traditional and political authorities of each of the reservations and/or community councils must be considered, including second and third level organizations due to their fundamental role within the indigenous governance. and in decision-making in accordance with national regulations.

An important perspective in the stakeholder participation process is the relationship and the involvement of women. Related to this, the PPPI (see section 3.2) contains the general guidelines to include a gender-based approach to ensure that their needs are met and promote their inclusion, participation, and empowerment.

For their part, the other interested parties, which may include any individual, group or organization that has an interest in the actions carried out by the PRE, are grouped together: national and territorial government entities, NGOs and cooperation entities, social organizations, initiatives and programs in the region, unions, research centers and academia. These parties are involved through

[30] World Bank. EAS 10. Participación de las partes interesadas y divulgación de la información. Junio de 2018.

participatory spaces for socialization and construction that allow the complementation of the Biocarbon ERP.

**v. Social and environmental safeguards management of the PRE**

The purpose of the Environmental and Social Management – (GA&S) of the Biocarbon ERP is to implement the environmental and social mitigation measures necessary to anticipate, avoid, minimize, or mitigate the risks and impacts which originate from the defined actions. In this regard, the possible social and environmental risks associated with the design and implementation of the Biocarbon ERP with a pay-for-results approach, are identified, and relevant GA&S tools and instruments are developed in compliance with the requirements and guidelines of the World Bank, established in the Environmental and Social Standards –ESS (English acronym). For the World Bank, the most important objective of its policy is to contribute to "putting an end to extreme poverty and promoting shared prosperity", for this, the ESS replace operational policies and establish a systemic management model and tools for planning and design of the different initiatives, which promotes the protection of people and the natural environment against possible effects originating from their implementation, through observance of the standards.

The ESS provide guidance to address social and environmental risks, and they also provide the appropriate management practices associated with the planning and implementation of the projects supported by the World Bank. The ESS are the following:

*ESS 1 Assessment and Management of Environmental and Social Risks and Impacts*
*ESS 2 Labor and Working Conditions*
*ESS 3 Resource Efficiency and Pollution Prevention and Management ESS 4 Community Health and Safety*
*ESS 5 Land Acquisition, Restrictions on Land Use and Involuntary Resettlement ESS 6 Biodiversity Conservation and Sustainable Management of Living Natural Resources*
*ESS 7 Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities*
*ESS 8 Cultural Heritage*
*ESS 9 Financial Intermediaries*
*ESS 10 Stakeholder Engagement and Information Disclosure*

The previous ESS are made operational through the design and implementation of the GA&S instruments, which in the case of the Biocarbon ERP are the following:

a. Environmental and Social Management Framework (MGAS), an instrument that provides and defines concrete measures in compliance with all the ESS to minimize, anticipate, reduce, and mitigate potential environmental and social risks that may arise during the execution of the Biocarbon ERP.

b. Stakeholder Participation Plan (PPPI), designed to comply with ESS 10 and as a tool to manage relationships and ensure the active and fluid participation of interested parties during the preparation and execution of the Biocarbon ERP.

c. Planning Framework for Indigenous Peoples (MPPI), in harmony with and to guarantee ESS 7, defines a participatory base approach to develop the actions of the Biocarbon Program in the territory with the presence of indigenous peoples and other ethnic communities, respecting their culture, territoriality and autonomy.

d. Manpower Management Plan (PGMO) in compliance with ESA 2, an instrument that aims to promote labor relations among all the personnel that implement the actions of the Biocarbon ERP. Includes a PQRSD mechanism for workers.

e. Framework of Procedures for Involuntary Restrictions (MP) in harmony with ESA 5, an instrument that incorporates the necessary measures to safeguard the rights and interests of those who might be potentially affected. In the case of the Biocarbon ERP, this instrument created preventively, since it is not anticipated that the program will affect access to resources or livelihoods.

f. Petitions, Complaints, Claims and Suggestions and/or Denunciations (PQRSD) Mechanism, in harmony with ESS 10, an instrument that allows transparency in information in a timely manner.

Additionally, the Environmental and Social Management of the Biocarbon ERP responds to the 15 elements of the national interpretation of the Cancun safeguards[31], which were included and harmonized in the Biocarbon ERP design and in the different instruments described above.

The Biocarbon ERP also includes a transparent, coherent, and robust system for the follow-up, monitoring, and reporting of GA&S information called the Information System for the Environmental and Social Management of the Emissions Reduction Program (SIGASPRE). This system is based on two key principles: i. transparent, coherent, updated, easily accessible and flexible information that allows continuous improvement; ii. Dissemination of information related to the way in which national safeguards and WB ESS are being addressed and respected in the GA&S in the Biocarbon ERP.

[31] According to the United Nations Framework Commission on Climate Change, the Cancun Safeguards are proposed as the rules for REDD+, which should guide countries and ensure that the actions to be carried out in the territory are carried out correctly, increasing benefits, reducing social and environmental risks, ensuring respect for the rights of communities (COP16.Cancún 2010). Taking into account that each country is different, the Safeguards must be reviewed and interpreted by each one taking into account its own context, its legislation, the groups of stakeholders involved, and the way in which REDD+ activities are going to be implemented in the territory of so that they can be adequately addressed and respected, in Colombia, the seven Cancun REDD+ safeguards have been translated into 15 elements that must be applied to all REDD+ Policies, Actions, and Measures that are implemented at the national, regional, and local levels. https://www.minambiente.gov.co/wp-content/uploads/2022/03/Interpretacion-Nacional-Salvaguardas-Sociales-y-Ambientales.pdf

### 2.1.4 SUMMARY OF THE FINANCIAL PLAN OF THE ORINOQUIA BIOCARBON PROGRAM

The Biocarbon ERP has a cost that adds up in 7 years[32], a present value of 135 million dollars. Financial resources have been identified with a present value of around 91.1 million dollars (see Section 3.1.3). The present value of the identified resources minus the present value of the estimated costs of the measures represents a present value gap of $44.1 million, using a discount rate of 4 percent per year, which reflects the long-term growth of the Colombian economy.

**Table 3. Financial Plan Summary and financial gap of Biocarbon ERP**

| | |
|---|---|
| **Costs of planned actions and interventions, including institutional, intervention, incentive and transaction costs.** | USD [135.152.000] (Present value discounted at 4% per year) |
| **Estimated total funding identified/guaranteed for planned actions and interventions.** | USD [91.140.000] (Present value discounted at 4% per year) |
| **Financial Gap** | USD [-44.012.000] (Present value discounted at 4% per year) |

The financial gap will be covered with resources from result-based payments from BioCarbon Fund, as well as fromthe General System of Royalties (SGR); the Fondo de Vida (Fonsurec), which administers the Colombian carbon tax revenue, as well as institutional cooperation grants and the Emissions Trading System. Additional details are provided on Section 3.1.3 “Arrangements for flow of funds.

## 2.2 ADMINISTRATIVE PROVISIONS OF THE ORINOQUIA BIOCARBON PROGRAM

### 2.2.1 ENTITY AUTHORIZED TO NEGOTIATE/SIGN AN ERPA

The National Government will delegate a Ministry, who on its behalf will be authorized to negotiate and sign a potential (ERPA).

The Orinoquia Biocarbon ERP, to comply with the guidelines set forth in Law 2294 of 2023, article 230 (Plan Nacional de Desarrollo 2022 - 2026), and Resolution 1447 of 2018 and by including the AFOLU sector in its activities in an integral way, must register on the RENARE platform under two figures: the first, a GHG Mitigation Agricultural Sector Program[33] and the second, a Program for the

[32] Six years of execution of the Program measures and one year of technical and administrative tasks are contemplated to manage the reports and payments related to the results of the program.

[33] Sector program for GHG mitigation. It is the type of initiative that includes activities to reduce emissions or GHG removals other than REDD+, which are carried out at the national, subnational and/or sectoral level. These initiatives are formulated by, or have a national public entity as a partner and demonstrate the contribution in a given sector to the fulfillment of national climate change goals established under the UNFCCC.

Reduction of Emissions from Deforestation and Avoided Degradation (REDD+)[34], which are part of the mandates of MADR and MADS, respectively.

For this reason, the Program in its design phase proposes that MADS and MADR be jointly designated as holders to negotiate and sign a potential ERPA, granted that there is prior approval through a signed act. in the Steering Committee, responding to the mandated functions of the institutions, the sectors involved in the Program and the provisions of Law 2294 of 2023, article 230, and Resolution 1447 of 2018 or that which modifies it.

| |
|---|
| **Entity Name:**<br>MADR<br><br>**Type and description of the entity:**<br>Ministerial Entity that is responsible for formulating, coordinating, and evaluating inclusive agricultural public policies that promote competitive, equitable, and sustainable development of the agricultural, livestock, fishing, and forestry sectors with criteria of efficiency, transparency, innovation, decentralization, agreement, and legality to improve conditions of life of the rural population with a differential approach.<br><br>**Web site:** https://www.minagricultura.gov.co/paginas/default.aspx.<br><br>**Main contact:**<br>**Position:** Vice Ministry of Agricultural Affairs/Innovation,<br>Technological Development and Sanitary Protection Directorate<br>**Address:** Avenida Jiménez N°. 7A - 17 Bogotá, Bogotá D.C.<br>**Phone:** +57-1-2543300 (5663)<br>**Email:** desarrollo.tecnologico@minagricultura.gov.co |
| **Entity Name:**<br>Environment and Sustainable Development Ministry<br><br>**Type and description of the entity:**<br>Ministerial Entity in charge of defining the national environmental policy and promoting the recovery, conservation, protection, ordering, management, use and exploitation of renewable natural resources, in order to ensure sustainable development and guarantee the right of all citizens to enjoy and inherit a healthy environment.<br><br>**Web site:** https://www.minambiente.gov.co/<br><br>**Main contact:**<br>**Position:** Vice Ministry of Environmental and Territory Planning / Climate Change and Risk Management Directorate<br>**Address:** Calle 37 Nº 8-40, Bogotá DC<br>**Phone:** + 57 (1) 332 3400 Ext. 1100<br>**Email:** viceordenamiento@minambiente.gov.co |

[34] The REDD+ Program: It is a type of GHG mitigation program that implements REDD+ activities and covers a national-level geographic area or a subnational-level area with biomes or large extensions of natural forests. The program is part of a public entity of the national order and its owner is the MADS, individually or in association with other government entities. These initiatives demonstrate their mitigation results within the framework of compliance with the goals indicated in the Comprehensive Strategy to Control Deforestation and Forest Management, as well as the national climate change goals established under the UNFCCC.

In this way, the rights of use of the reduced emissions (ER) by the Biocarbon ERP will be determined jointly, by the MADS and the MADR. In the event that the reductions are for national use, MADS and MADR will specify the mode of distribution of benefits in accordance with the Benefit Distribution Plan designed for the ERP (see section 3.6); On the other hand, in the case of an international transfer of ER titles, this will be subject to the national authorization cycle and the decision of the authority designated for this process[35].

### 2.2.2 RESPONSIBLE FOR THE MANAGEMENT/EXECUTION OF THE ORINOQUIA BIOCARBON PROGRAM

The management and execution of the Biocarbon ERP will be led by MADR

A. **Entity Name:** Agriculture and Rural Development Ministry/ Agricultural Affairs Vice Ministry / Innovation, Technological Development and Sanitary Protection Directorate

   **Type and description of the entity:** the Innovation, Technological Development and Sanitary Protection Directorate is responsible of formulating all policies and objectives related to agriculture, livestock and commercial forestry. Supply chain policies, extension services and financial support policies are directed from the Ministry.

   **Organizational relationship between the entity and the ERP:** MADR will be the executing entity of the Biocarbon ERP. Directs the formulation of all policies and objectives related to agriculture, livestock and commercial forestry. It will be responsible for the administrative and operational management of the Program, as well as leading the execution of the measures related to the agricultural sector in the prioritized productive chains (rice, cocoa, oil palm, marañon, forest plantations and livestock). It will direct the inter-institutional arrangements aimed at strengthening the MRV of the Biocarbon ERP; the necessary management to implement agricultural activities that generate ER in the region; as well as to implement the Benefit distribution program (PDB) to be agreed for the Biocarbon ERP.

   The Program implementation Unit (UIPR) will be composed of a team of professionals responsible of promoting and ensuring the execution of the program in accordance with the Annual Operating Plans that are approved by the steering committee.

   **Web site:** https://www.minagricultura.gov.co/paginas/default.aspx.

   **Main Contact:**
   **Position:** Innovation, Technological Development and Health Protection Directorate
   **Address:** Avenida Jimenez N°. 7A - 17 Bogotá, Bogotá D.C.
   **Phone:** +57-1-2543300 (5663)
   **Email:** desarrollo.tecnologico@minagricultura.gov.co

[35] MADR and the MADS, on behalf of the national Government, will establish a Steering Committee for the ERP, which will be delegated for decision-making regarding the negotiation and signing of a potential ERPA and will maintain the same structure as the Steering Committee of the phase 2 for technical assistance from the Orinoquia Biocarbon Program. An inter-institutional agreement is expected to materialize the proper management of the ERP between both parties.

On the other hand, the (IDEAM) and (UPRA), will be co-executing entities of Biocarbon ERP and responsible for technical issues that are under its missionary and institutional competence.

**B. Entity Name:** Environment and Sustainable Development Ministry / Environmental and Territory Planning Vice Ministry / Climate Change and Risk Management Directorate

**Type and description of the entity:** Ministerial Entity from the Climate Change and Risk Management Department which develops the technical and operational bases necessary to advance in the management of climate change in the different sectors and territories of the country, in association with public and private actors at the local, national and international level. Among its main functions is to supply the technical elements required for the elaboration of public policies, plans, projects and climate change programs, with a low-carbon approach that will strengthen the development of the country.

**Organizational relationship between entity and PRE:** It will be the co-executing entity of the Orinoquia Biocarbon ERP and will be responsible to lead the technical execution of measures related to the reduction of GHG emissions due to deforestation and forest degradation, the conservation and increase of carbon reserves and sustainable forest management (REDD+).

**Web site:** https://www.minambiente.gov.co/

**Main Contact:**
**Position:** Climate Change and Risk Management Directorate
**Address:** Calle 37 Nº 8-40, Bogotá DC
**Phone:** +57 6013323400
**Email:** cclimatico@minambiente.gov.co

**C. Entity Name:** Hydrology, Meteorology and Environmental Studies Institute – IDEAM.

**Organizational relationship between entity and PRE:** Co-executing entity of the Orinoquia Biocarbon (ERP) responsible for the National GHG Inventory (INGEI) the National Forest Inventory (IFN), the National Forest Information System (SNIF) and the Forest and Carbon Monitoring System (SMByC). It also carries out modelling and analysis of the drivers of deforestation and other emissions, as well as analysis of land use change. IDEAM will be responsible for monitoring and reporting the reduction of GHG emissions due to deforestation and forest degradation, the conservation and increases of carbon stocks, and sustainable forest management (REDD+).

**Web site:** www.ideam.gov.co

**Main Contact:**
**Position:** Environmental Studies Sub-directorate
**Address:** Cl. 25d #96B - 70, Bogotá
**Phone:** +57-320-8212384
**Email:** estudios@ideam.gov.co

**D. Entity Name:** Rural Agricultural Planning Unit – UPRA

**Organizational relationship between entity and ERP:** Co-executing entity of the Orinoquia Biocarbon ERP which, due to its nature as a technical-scientific entity in the agricultural sector, advance efforts to strengthen the system, not only of the Orinoquia Biocarbon ERP, but also at the national level, due to the importance for the agricultural sector Strengthen all the methods that allow the respective monitoring, reporting and verification to be carried out. UPRA will be responsible for monitoring and reporting the reduction of GHG emissions from the agricultural sector in the prioritized production chains (rice, cocoa, oil palm, marañon, forest plantations and livestock).

**Web site:** www.upra.gov.co

**Main Contact:**
**Position:** General Management - Office of Information and Communication Technologies
**Address:** Cl. 28 #13-22, Bogotá
**Phone:** +57-1-5529820
**Email:** atencionalusuario@upra.gov.co

### 2.2.3 ORGANIZATIONS WICH PARTICIPATE IN THE ORINOQUIA BIOCARBON PROGRAM

The Orinoquia Biocarbon ERP will have the participation of multiple public and private entities. Table *4*. Associated organizations involved in Table 4 describes the national and regional public organizations that will have a leading role in its implementation.

**Table 4. Associated organizations involved in ERP**

| | | |
|---|---|---|
| **DNP** | Decentralization and Territorial Development Subdepartment<br><br>Phone: +57-1-3815000<br><br>Email: @dnp.gov.co | An advisory entity of the Orinoquia Biocarbon ERP that will form part of the Steering Committee and will support the planning and development of Program activities associated with its mandate function. |
| **APC** | International Cooperation Demand Management Directorate<br><br>Phone: +57-1-6012424 | An advisory entity of the Orinoquia Biocarbon ERP that will form part of the Steering Committee and will support the planning and development of Program activities associated with its mandate function. |

| | | |
|---|---|---|
| | Email: | |
| Corporation for the Sustainable Development of the Special Management Area La Macarena- **CORMACARENA** | Switch Phone: +(57) 608 - 6730420<br>Mobile Phone: 3212253023<br>Free attention line: 018000117177<br><br>Email: info@cormacarena.gov.co | Main environmental authority in Meta and technical secretary of Orinoquia Regional Climate Change Node (NORECCO).<br><br>It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through the GHG reduction measures and actions associated with its mandate. |
| CORPORINOQUIA | Casanare Phone: 3108186137<br><br>Arauca Phone: 310 8186131<br><br>Vichada Phone: 3132838233<br><br>Email: atencionusuarios@corporinoquia.gov.co | Main environmental authority and administrator of natural resources through the implementation of prevention, protection and conservation actions in Arauca, Casanare and Vichada.<br><br>It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through the GHG reduction measures and actions associated with its mandate. |
| National Natural Parks | Central level: atencion.usuario@parquesnacionales.gov.co/ PNN – Territorial Address Orinoquia: buzon.dtor@parquesnacionales.gov.co | Entity responsible of the administration and management of the National Natural Parks System and the coordination of the National Protected Areas System.<br><br>It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through which the GHG reduction measures and actions associated with its mandate. |

| | | |
|---|---|---|
| Rural Development Agency (ADR) | Productive Integration Vice Presidency and Projects Vice Presidency<br><br>Phone: +57 (601) 748 22 27<br><br>Email: correspondencia@adr.gov.co | The ADR's mission is the promotion, structuring, co-financing and execution of comprehensive agricultural and rural development plans and projects and generating capacities to improve the management of comprehensive rural development with a territorial approach to contribute to the transformation of the Colombian countryside.<br><br>It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through which the GHG reduction measures and actions associated with its mandate. |
| National Land Agency (ANT) | **Phone in Bogotá:** (+57) 6015185858, opción 0<br><br>Email: atencionalciudadano@ant.gov.co | Main land authority that consolidates and maintains the social ordering of rural property, to improve the living conditions of the population.<br><br>It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through which the GHG reduction measures and actions associated with its mandate. |
| Colombian Agricultural Institute (ICA) | Free Nacional Phone Line: (+57) 01 8000 185630<br><br>Email: contactenos@ica.gov.co | It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through the GHG reduction measures and actions associated with its mandate. |
| Alexander von Humboldt Institute | | It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through the GHG reduction measures and actions associated with its mandate. |

| | | |
|---|---|---|
| Colombian Corporation of Agricultural Research (Agrosavia) | | It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through the GHG reduction measures and actions associated with its mandate. |
| Others | Governors and mayors of the territory; Academy and research institutes; Ethnic groups; Producer organizations; NGOs; Private sector. | It may be an implementing entity of the Orinoquia Biocarbon ERP through the union of technical and/or administrative efforts for the structuring and execution of projects through the GHG reduction measures and actions associated with its mandate. |

### 2.2.4 DESCRIPTION OF THE COORDINATION BETWEEN THE ENTITIES PARTICIPATING IN THE BIOCARBON ERP

The coordination between participating entities in the Biocarbon ERP will be in accordance with the governance scheme in Figure 2.

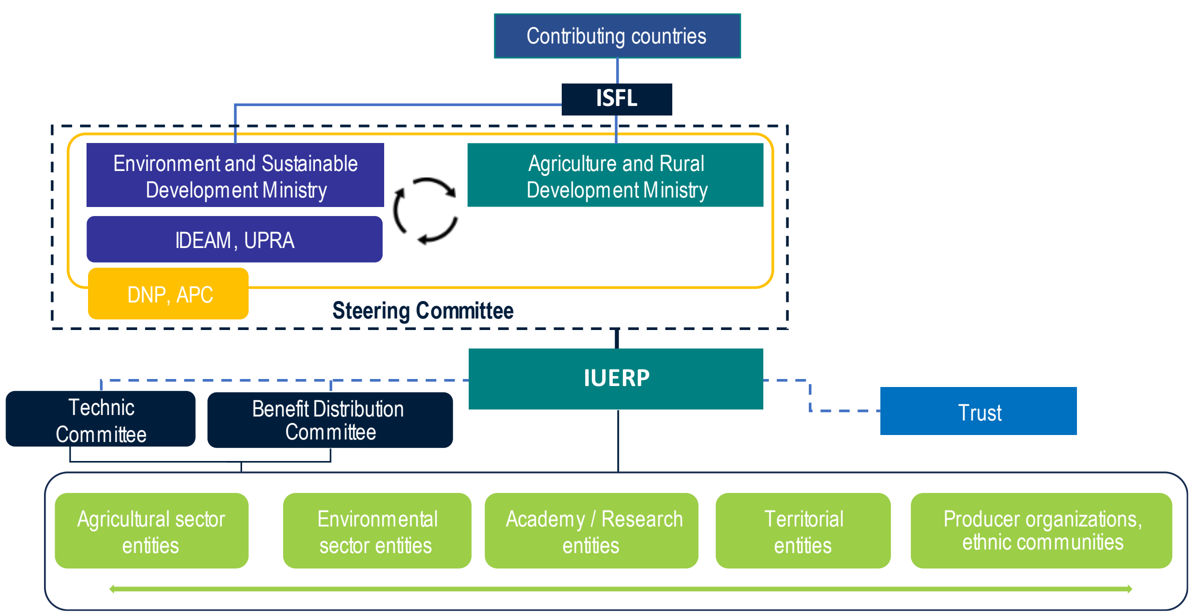


**Figure 2. Governance scheme of Biocarbon ERP Orinoquia**

The Orinoquia Biocarbon ERP **executor** will be the MADR. MADS , the IDEAM and UPRA will be co-executing entities of the Program and responsible for the technical issues that are under their mandate and institutional jurisdiction. The National Planning Department (DNP) and the Presidential Agency for International Cooperation (APC) will be **advisory entities** for the Program.

All the above entities will make up the steering committee, for which an Inter-administrative[36] agreement will be signed between them.

The **Orinoquia Biocarbon ERP Implementation Unit – UIPRE** - will be responsible for submitting the reports required by the decision-making and advisory entities, articulating actions with the executing and implementing entities of the program and monitoring the subscribed commitments, managing the formulation and execution of projects for the implementation of GHG reduction measures, among other issues.

The financial resources will be managed by a **technical and financial operator or a fiduciary,** under the terms and conditions acceptable to the Government of Colombia and the IBRD, which will include, among others, the obligation to act as fiduciary agent of MADR with respect to the provisions of the Agreement to be concluded between the Government of Colombia and the World Bank.

ERP **implementing entities**, which may be public or private law entities, at the national, regional or local level, will combine technical and administrative efforts to structure and execute projects to implement the GHG reduction measures and actions defined in the Biocarbon Orinoquia ERP, identifying the project modality, the intervention area, the applicable environmental and social management, the technical approach, the eligible participants or beneficiaries, the budget, the temporal scope, among other elements.

The implementing entities, under the leadership of the UIPRE and with the participation of the co-executing entities of the Program, will form technical committees to address relevant issues related to the effective implementation of the measures, monitoring compliance of agreements, environmental and social management, among other topics. The relationship of implementing entities with the Program will be formalized through the signing of inter-administrative agreements and/or contracts (between Agriculture and other public law entities) and association agreements or contracts (between Agriculture and other private law entities[37]).

The implementing entities may also be beneficiaries of the payments by results of the Program, under the guidelines, conditions and criteria established in the Benefdit Distribution Plan. In addition to signing the agreements or contracts, benefit distribution agreements will be signed and they will include the monetary or non-monetary benefit, for the reduced emissions, and the express authorization for the use or transaction of the ER. To verify compliance with the benefit distribution conditions and criteria, benefit distribution committees will be held.

The coordination between the participating entities of the Biocarbon ERP will take place to ensure the execution of the established components (Figure 3), namely: 1) Payments for the reduction of emissions distributed in accordance with the Benefit Distribution Plan; 2) Monitoring of biodiversity conservation in sustainable productive landscapes; 3) Program Management and Monitoring, Reporting and Verification System.

[36] Based on the legal framework established in the Political Constitution (art. 113 and 209, Law 80 of 1993, Law 1150 of 2007, Decree 1082 of 2015 and Law 489 of 1998 (art. 6 and 95).
[37] Based on the legal framework established in the Political Constitution (art. 113 and 209); Law 80 of 1993; Law 1150 of 2007; Decree 1082 of 2015; Law 489 of 1998, articles 6 and 95. Contracts with non-profit entities: Decree 092 of 2017.

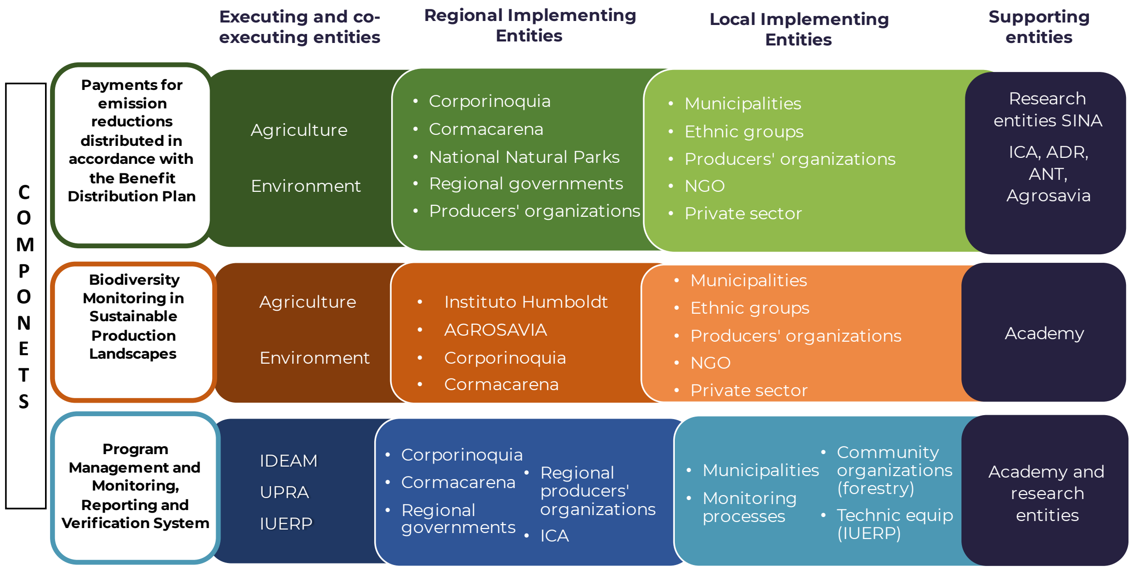


**Figure 3. Orinoquia Biocarbon ERP**

**(i) Component: payment for emission reductions distributed according to the Benefit Distribution Plan**

Emission reductions will be achieved through the implementation of projects that will aim to implement the measures related to deforestation emissions[38], led by MADS and measures in the agricultural sector[39] in prioritized production chains (rice, cocoa, oil palm, marañon, forest plantations and livestock), led by MADR.

For the implementation of GHG reduction measures, the projects will comply with the following stages: a) Targeting areas for intervention at the project level; b) Identification and prioritization of project profiles that meet the conditions, requirements and criteria for participation in the Orinoquia Biocarbon ERP; c) Development of projects and management of co-financing; d) Execution and monitoring of projects.

To identify, formulate and execute projects the support of the implementing entities will be provided, such as the Corporation for the Sustainable Development of the Special Management Area La Macarena-CORMACARENA, CORPORINOQUIA, National Natural Parks (PNN), ADR, National Land Agency (ANT), Colombian Agricultural Institute (ICA), Colombian Corporation for Agricultural Research (Agrosavia, Alexander von Humboldt Institute, governors and mayors of the territory, academia, ethnic groups, producer organizations, NGOs, private sector, among other.

[38] These projects will be formulated, managed and executed following the guidelines established for REDD+ initiatives, that is, GHG mitigation projects that implement REDD+ activities and cover a specific geographic area with biomes or large extensions of natural forests. These projects will demonstrate their mitigation results within the framework of compliance with the goals indicated in the Comprehensive Strategy for Control of Deforestation and Forest Management, in the national climate change goals established under the UNFCCC and in the portfolio of GHG measures of the Biocarbon ERP.

[39] These projects will be formulated, managed and executed following the guidelines established for Low Carbon Development initiatives (PDBC), that is, projects that include activities to reduce emissions or GHG removals other than REDD+, and that demonstrate the contribution in a certain sector. compliance with national climate change goals established under the UNFCCC and in the portfolio of GHG measures of the Biocarbon ERP.

The fulfillment of the GHG reduction goals resulting from the effective formulation, execution and monitoring of the projects will allow access to payments by results from the ISFL Biocarbon Fund, therefore, the component will also guide the procedures for the distribution of monetary and non-monetary benefits, verifying compliance with the conditions and criteria for participation by eligible beneficiaries and highlighting the participation of community base organizations, producer organizations related to silviculture and/or agricultural activities for income generation and women.

**(ii) Component: monitoring of biodiversity conservation in sustainable productive landscapes.**

This component will implement farm-based pilots to identify accurate and robust biodiversity indicators to be able to identify positive externalities originating from the application of low-carbon practices in the livestock, rice, and forestry value chains. The biodiversity evaluation and monitoring process will be carried out on the farms prioritized by the Orinoquia Biocarbon ERP, based on a joint technical analysis led by the Humboldt Institute and Agrosavia, with the active participation of the community and the integration of the CAR (CORPOMACARENA and CORPORINOQUIA) and the different NGOs present in the territory and that develop community projects.

Two approaches will be addressed to monitor biodiversity as part of productive activities: (a) a description of the sub-regional context, in order to recognize the status and trends of biodiversity using secondary information (GBIF database) and remote sensing data , and also a description of the main human drivers of change at this scale for the two selected subregions (the foothills of the Andes (Orotoy River Basin – Tua River Basin) and the flooded savannahs of Arauca and Casanare (Casanare and Ariporo river basins)). b) reference scheme and farm-based monitoring on (i) farms where producers start to implement low-carbohydrate and biodiversity-friendly practices, and (ii) farms where producers have applied low-carbon and biodiversity-friendly practices for a long time and (iii) farms where producers, traditionally, have not applied low-carbon and biodiversity-friendly policies and iv) Natural spaces with minimal human intervention as a control. These approaches will be carried out in three value chains: livestock, rice and forestry.

This approach will allow the identification of the best low carbon practices for each supply channel that have a positive impact on biodiversity. Furthermore, it will determine how these site-based practices contribute to the state of biodiversity at a sub-regional scale.

**(iii) Component: Program Management and monitoring, reporting and verification system**

The monitoring of emission reductions for the accounting of the Orinoquia Biocarbon ERP, will be carried out consistently and in compliance with Resolution 1447 of 2018[40], of MADS, which regulated the National MRV of Mitigation Actions, as well as the RENARE and the National Accounting System for GHG reductions and removals (SCRR-GEI).

The MRV will be implemented by the IDEAM and the UPRA, a technical-scientific institution in the agricultural sector that has made progress in strengthening the system, not only in the Biocarbon ERP, but also at the national level, due to the importance for the agricultural sector of strengthening all methods for monitoring, reporting, and verification.

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[40] https://www.minambiente.gov.co/wp-content/uploads/2022/01/15.-Resolucion-1447-de-2018.pdf

At the regional level, the MRV will be supported by environmental authorities, governments and producer organizations, who provide information to the national GHG inventories, and this information has been used as input to design the Biocarbon ERP. Likewise, the Colombian Agricultural Institute (ICA) will be involved in the process, this is an entity that provides information on the forestry, commercial and livestock sectors. At the local level, municipal entities (mayorships), the UIPRE and producer organizations will provide information on the implementation of GHG measures to feed the data related to activities and emission factors, this data will be used to compile reports related to emissions reductions from the program. In the same way, the academic sector and research centers will provide support.

On the other hand, the component also involves actions to manage the administrative and financial aspects, as well as the monitoring of the Orinoquia Biocarbon ERP, facilitating the integration of the technical and operational activities described in the other components. There will be a technical and financial operator who will form the UIPRE.

# SECTION 3: ORINOQUIA BIOCARBON ERP DESIGN

## 3.1 ACTIONS AND INTERVENTION EXPECTED IN THE ERP AREA, INCLUDING FINANCING

### 3.1.1 EMISSIONS AND REMOVALS DRIVERS IN AFOLU[41] IN BIOCARBON ERP AREA

[41] Check Annex I.docx for more information

The Third Biennial Update Report (BUR) of Colombia to the United Nations Framework Convention on Climate Change (UNFCCC) (IDEAM et al. 2021), indicates that the Orinoquia (total area of the Arauca, Casanare, Meta and Vichada departments) contributed 15,9% of the country's total emissions and 25,5% of the total absorptions corresponding to the year 2018. Specifically, Meta contributed 67,7% of total emissions and 70,8% of net regional emissions, highly related to deforestation in the southern area of Orinoquia. 78,7% of the region's total emissions in 2018 corresponded to the AFOLU sector.

The analysis of the secondary data available and the results obtained from working with national, regional and local actors in the framework of the design of the Biocarbon ERP, allowed to characterize the dynamics associated with the causes and agents of GHG emissions and removals in the AFOLU sector at the regional level (Annex I.docx).

**Direct causes of regional AFOLU emissions**

Six main direct causes of AFOLU emissions in the Orinoquía were identified: 1) expansion of the agricultural-livestock frontier; 2) expansion of the agricultural frontier - grassland; 3) expansion of the agricultural frontier - industrial crops; 4) expansion of the agricultural frontier - crops for illicit use; 5) expansion of transportation infrastructure; and 6) extraction of wood.

The analysis of the regional GHG inventory indicates that these six causes are responsible for the main sources of AFOLU emissions in the Orinoquia, which are: 1) the change in land use from natural forest to grasslands (and to a lesser extent to crops), which basically corresponds to deforestation; 2) bovine cattle enteric fermentation, which depends directly on the cattle inventory and its age structure; 3) nitrogen fertilization, mainly for crops and improved grasslands; and 4) direct emissions from rice cultivation. Bovine farming, specially that which is carried out in production systems that do not incorporate environmentally sustainable practices, thus has a double role as the main source of regional GHG emissions; On the one hand, there are direct emissions due to the increase in the size of the cattle herd and the processes of nitrogen fertilization of the soils for the establishment and maintenance of the grasslands, and on the other, the indirect emissions originated in the change of the natural cover (mainly forest) to grasslands (see Annex I.docx). The relationship between the direct causes and the subcategories of the regional GHG inventory (updated to 2018) is presented in Table 5.

**Table 5. Relationship between direct regional emissions causes in AFOLU and GHG inventory subcategories.**

| Direct causes of AFOLU emissions | AFOLU subcategory from regional GHG inventory* |
|---|---|
| **Agricultural frontier Expansion – Livestock** | **Cattle Enteric Fermentation** |
| | **$N_2O$ Direct Emissions** |
| | **$N_2O$ Indirect Emissions** |
| | Bovine manure management |

| Direct causes of AFOLU emissions | AFOLU subcategory from regional GHG inventory* |
|---|---|
| | Range fires emissions |
| | Indirect cattle manure management |
| **Agricultural frontier Expansion - Grassland** | **Forest converted to grassland (Deforestation)** |
| | Forest fires emissions |
| **Agricultural frontier Expansion – Industrial Corps** | **Rice cultivation** |
| | **$N_2O$ Direct Emissions** |
| | **$N_2O$ Indirect Emissions** |
| | **Forest converted to cropland (Deforestation)** |
| | 3B2a… Cropland remaining cropland (emissions from renewal of permanent crops) |
| | Organic soil emissions and crop fires |
| | Crop fires emissions |
| **Agricultural frontier Expansion - illicit use crops** | **Forest converted to other forest lands** |
| | **OWV dynamic** |
| | $N_2O$ Direct Emissions |
| | $N_2O$ Indirect Emissions |
| | **Forest converted to cropland (Deforestation)** |
| **Transportation infrastructure expansion** | **Forest converted to grassland (Deforestation)** |
| | **Forest converted to other forest land** |
| | **Forest converted to cropland** |
| | **Forest converted to other land** |
| | Forest converted to settlements |
| **Wood extraction** | **Forest converted to other forest land** |
| | **Dynamic in OWV (OWV reduction)** |
| | **Forest remaining forest (degradation due to firewood consumption)** |
| | Dynamic in forest plantations |

Source: Own elaboration with information from the regional and departmental GHG inventory for the year 2018.

* The size and highlighting of the text indicate a greater importance of the subcategory within the regional GHG inventory.

- **Agricultural frontier expansion – Bovine Livestock:** Corresponds to the establishment and expansion of cattle production systems that mainly leads to the generation of methane emissions by enteric fermentation processes that are directly related to the size of the herd (number of animals), their age distribution and productive end. Burning for the renewal of grasslands and nitrogen fertilization for the growth of improved grasslands complement the GHG emissions of livestock systems. Finally, this cause includes some minor emissions (direct and indirect) related to cattle manuree management.

- **Agricultural frontier expansion – Grassland**: It refers to the change of natural cover (mainly forests) to grasslands that cause emissions from the change in land use and from the burning that is frequently used in the process. In general, the new deforested lots expand from areas already transformed, allocating their use to land grabbing or the establishment of new cattle grazing areas.
- **Agricultural frontier expansion – Industrial Crops:** Corresponds to the change of natural coverage (mainly forests) to various industrial monoculture with economic importance in the region such as: oil palm, rice, coffee, cocoa, rubber, fruit trees, among others. This land use change process is complemented by emissions from burning for the establishment and/or renewal of crops, nitrogen fertilization, direct emissions from rice cultivation and, by the renewal of permanent crops.
- **Agricultural frontier expansion – Illicit use crops**: It implies the change of the natural cover for the establishment of lots with coca crops, which generates direct emissions complemented by the nitrogen fertilization of the crop. When coca is established within the forest matrix, it indirectly generates a process of degradation of the natural forest towards other forest cover (non-forest), which adds emissions due to the decrease in carbon content. Illicit crops can have an indirect effect by stimulating the expansion of other agricultural activities. According to UNODC (2021), coca crops show a clear trend of reduction in the Orinoquia; however, they still stimulate important processes of natural cover conversion, mainly in the southern area of the Meta Department.
- **Transport infrastructure expansion:** This refers to the direct effect of the removal of vegetation cover for the construction of road access in rural areas (mainly terrestrial). However, the main effect in terms of GHG emissions is the one that occurs indirectly enabling the expansion of the other causes of emissions and by allowing access to new areas and their transformation.
- **Wood Extraction:** Corresponds to the processes of deforestation and/or forest degradation due to selective logging, especially illegal logging, for large-scale commercialization, complemented by emissions from forest degradation generated by small-scale firewood consumption (for self-consumption or local trade). The renewal of commercial forest plantations and the timber products derived from this activity generates some emissions that also are added.

**Special distribution of direct causes emissions**

Figure 4 shows the presence and spatial distribution of these direct causes of AFOLU emissions in the region. A high concentration of GHG emission drivers was identified in the foothill areas of the departments of Arauca, Casanare and Meta, especially due to the expansion of the agricultural frontier through cattle ranching, logging and industrial crops. Coca crops are in the southern part of the departments of Meta and Vichada, where, together with logging and extensive cattle ranching, they have generated significant deforestation, even affecting protected areas. In the high-plains and natural savannah areas, typical of the Orinoquia biome, a significant presence of the causes and their expansion towards the east was also identified. The axes of natural cover transformation (historical and current) are related to transportation infrastructure, both due to the expansion of land roads and the navigability of the region's main rivers.

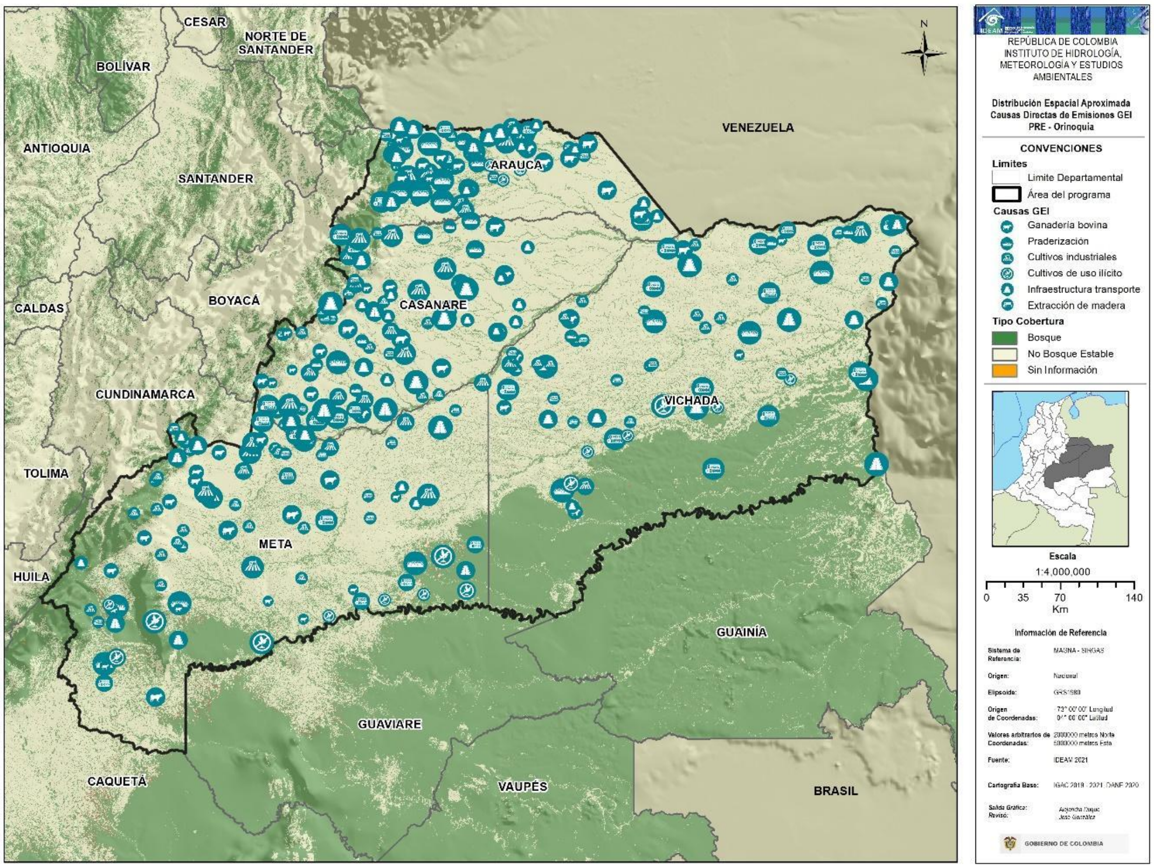


**Figure 4. Spatial distribution of the direct causes of AFOLU emissions in the Orinoquia region (own elaboration based on social mapping with regional stakeholders).**

The information available for livestock, deforestation and GHG emissions in the regional AFOLU sector, allowed identifying important trends in the behavior of key variables for the recent period (2015-2019). Of the 59 municipalities that make up the four departments of the region, six (6) concentrated 77% of the accumulated regional deforestation during the period (197,062 ha); five (5) belong to the Meta Department (La Macarena, Mapiripán, Uribe, Puerto Rico and Vistahermosa) and one to Vichada (Cumaribo). Significant increases in deforestation were observed in La Macarena, Mapiripán and Vistahermosa, areas recurrently reported as High Deforestation Nuclei (HDC) by IDEAM's, SMByC. In the same period, the livestock inventory increased by 90% and the number of properties with livestock increased by 89% for the six municipalities, compared to regional increases of 18% and 16%, respectively. For the year 2019, these municipalities concentrated 11% of the cattle heads and 12% of the properties with livestock activity in the Orinoquia region (ICA 2020), and considering the current socioeconomic conditions[43], this activity has potential to continue growing. This also indicates a spatial relationship between areas with higher deforestation and cattle herd growth and a high concentration of GHG emissions in the period analyzed. The sustained growth of the livestock herd in the region, with positive rates and a

[43] High demand for livestock products, availability of inputs and resources for the growth of the activity, availability of land with different tenure status, sectoral policies that favor expansion, cultural and demographic factors, among others.

greater acceleration as of 2017 (ICA 2020), suggests that in the future, greater direct emissions will be generated by enteric fermentation and indirect emissions by the increase in deforestation due to grassland, which will ultimately lead to an increase in GHG emissions from the regional AFOLU sector due to the loss of natural forest and the accelerated transformation of the Orinoquia's ecosystems.

**Underlying causes from regional AFOLU emissions**

The underlying causes analyzed are mainly associated with the legal status and land tenure, the presence and effectiveness of protected areas and indigenous reserves, the vision of the region as the "agricultural and livestock pantry of the country" (current and potential), the technological and productive development of large-scale agricultural activities, the livestock culture of the region, the presence of illegal armed actors that promote transformation activities, among others (see Annex I.docx).

**Regional AFOLU emissions agents**

The following were identified as the main agents of AFOLU emissions in the Orinoquia region[44]: 1) large-scale cattle rancher-logger; 2) medium and small-scale cattle rancher; 3) land-grabbing rancher; 4) industrial agricultural producer; 5) coca producer; 6) transport infrastructure builder; 7) timber extractor for self-consumption; and 8) large-scale commercial timber extractor. The relationship between the emissions agents identified and the direct causes is presented in the Table 6.

**Table 6. Relationship between agents and direct cause in GHG AFOLU emissions in Orinoquia**

| Associated direct cause | Main agents' denominations of AFOLU emissions in Orinoquía |
|---|---|
| **Agriculture frontiers expansion** | Large-scale cattle rancher. |
| | Small- and medium-scale livestock producer |
| | Land-grabbing cattle rancher. |
| | Industrial agricultural producer. |
| | Coca producer. |
| **Infrastructure expansion** | Transportation infrastructure builder. |
| **Wood extraction** | Self-consumption wood extractor. |
| | Large-scale commercial wood extractor. |

Source: Own elaboration

The greatest contribution to GHG emissions in the Orinoquia is concentrated in the agent known as "large-scale cattle ranching", which adds emissions from deforestation resulting from cattle grazing, the growth of the cattle herd, as well as uncontrolled burning and inefficient nitrogen fertilization processes for the establishment and renewal of grasslands; practices that are not part of a production system with low GHG emissions (see Annex I.docx).

[44] Corresponds to the classification of individual actors or groups of actors that (within each category) make the decision to implement productive or extractive activities, with the development of unsustainable practices that lead to an increase in GHG emissions.

**Chains of events of Regional AFOLU emissions**

AFOLU emissions in the Orinoquia region are directly related to the expansion of the agricultural frontier (extensive cattle ranching, grazing, industrial crops and coca crops), due to the impact that this expansion generates in terms of deforestation and its impact on other land covers such as natural savannahs. The processes of transformation of natural land cover promote the continued expansion of the frontier, mainly through cattle ranching, and the use of fire as a means of expanding the activity from previously transformed areas.

Deforestation and the increase of cattle herds in unsustainable systems make these two sources of emissions (change of natural forest to other uses and Cattle Enteric fermation) the main ones in the region, adding the highest emissions of $CO_2$ and $CH_4$, respectively. In addition, $N_2O$ emissions from nitrogen fertilization of improved grasslands, industrial crops (mainly rice) and coca crops remain in the region (Figure 5).

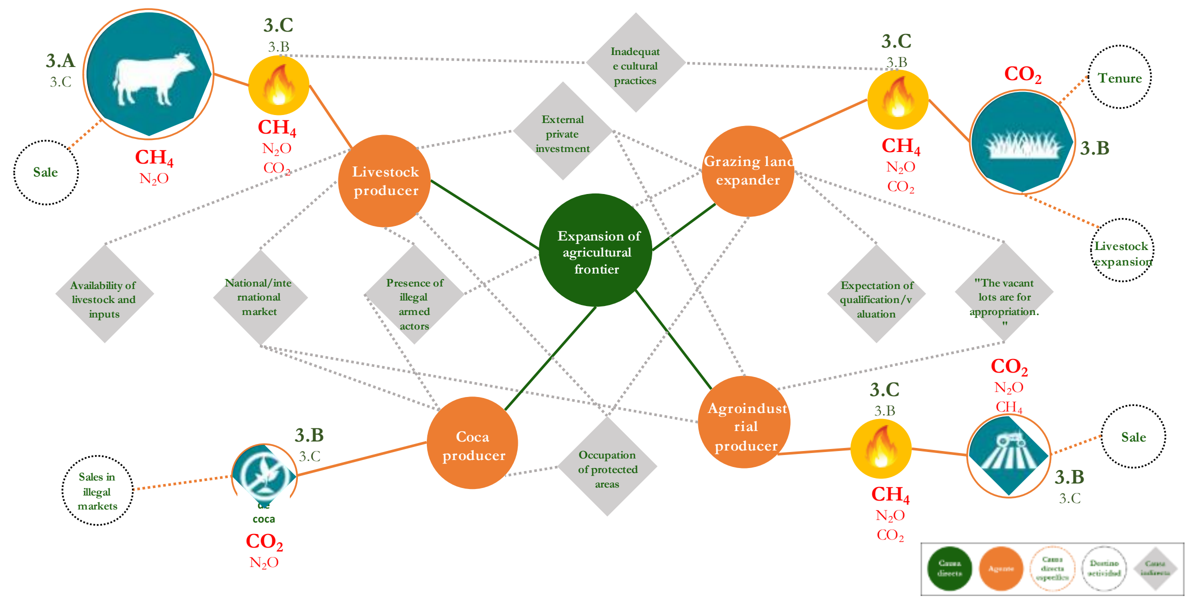


**Figure 5. Chain of events of regional AFOLU emissions due to expansion of the agricultural frontier (Own elaboration)[45]**

The expansion of transportation infrastructure includes a formal component related to the construction of roads for hydrocarbon exploration and exploitation, biofuel production and mining activities. There are also agents that build or improve informal roads (roads and cattle trails), even in protected areas, for connectivity purposes between isolated population centers or to have the possibility of moving livestock that enters and is marketed commercialized in the region. Other underlying causes that condition the decisions of the agents (formal and informal builders of transport infrastructure) are the availability of investment resources at different scales and

[45] In these chains of events, the number followed by a letter indicates the relevant AFOLU categories of the GHG inventory, and in red letters the main gases emitted in each sub-chain, according to their degree of importance.

objectives, planning and control problems in the expansion of this type of infrastructure, and the presence of illegal armed actors, among others.

Although the direct impact of this chain is centered on the change in land use for formal and informal road construction that generates minimal $CO_2$ emissions, the results indicate that the greatest impact of this expansion is indirect as it allows the expansion of the agricultural frontier and the consequent growth of the livestock herd and deforestation, which ultimately results in higher GHG emissions (Figure 6).

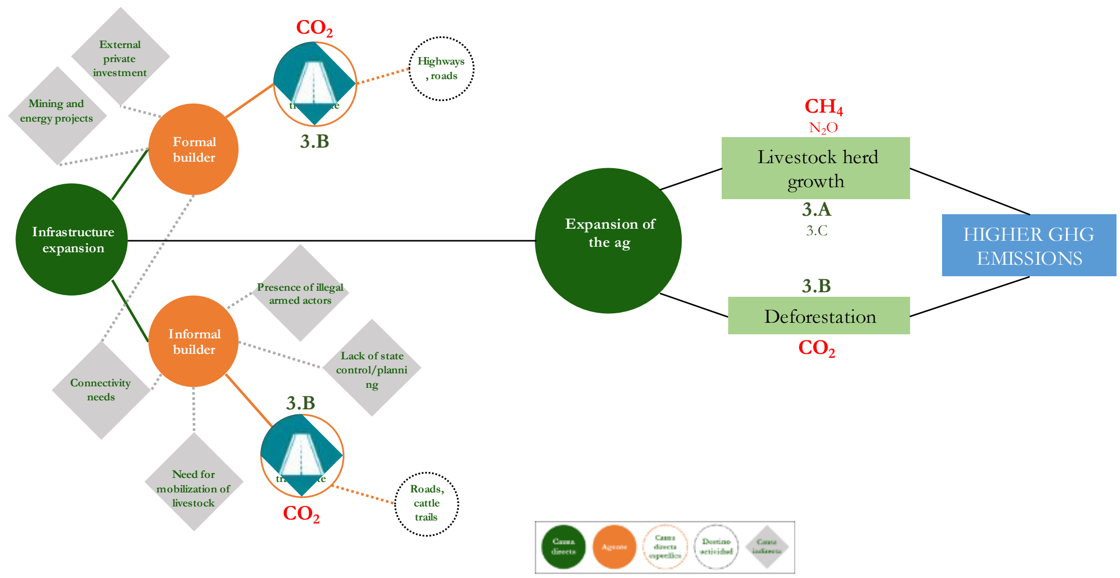


**Figure 6. Chain of events of regional AFOLU emissions due to the expansion of transportation infrastructure (Own elaboration).**

From the point of view of emissions accounting, wood extraction basically refers to forest degradation processes whose impact depends on the scale of extraction; that is, small-scale logging (for firewood consumption) has lower impacts than large-scale selective logging (for commercial purposes). Factors such as cultural roots in the local use of timber, easy access and low extraction costs, as well as the illegality of the activity facilitated by the presence of organized illegal armed actors, the lack of forest control and surveillance, and the demand for fine wood, all contribute to this chain of emissions events. The interrelationship between the indirect or underlying causes described above, the decisions of the agents (timber harvesters for self-consumption or sale) and the transformation of natural cover through direct causes (extraction processes at different scales), generate significant $CO_2$ emissions that are part of category 3B (Land) of the AFOLU component in the regional GHG inventory (Figure 7).

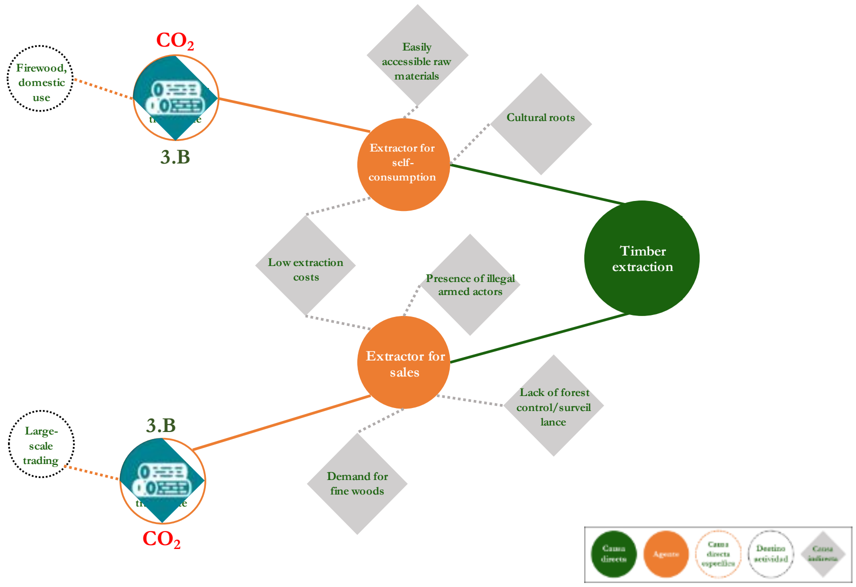


**Figure 7. Chain of events of regional AFOLU emissions from timber extraction (Own elaboration).**

**Direct Drivers of Regional AFOLU Removals**

The baseline information on emissions and removals for the period 2009-2018, obtained from a change analysis from SMByC and other sources, indicate that removals in the region are due to the permanence and gains in areas of coverages classified as OWV (not included in the country's definition of forest), commercial forest plantations, oil palm cultivation, other permanent crops, silvopastoral systems and regeneration processes.

On this basis, it was identified that the main direct causes of GHG removals in the Orinoquia correspond to: 1) natural regeneration and forest restoration; 2) forest plantations in previously transformed areas; 3) permanent crops in previously transformed areas; 4) silvopastoral systems; and 5) sustainable soil and degraded grasslands management practices (see Annex I.docx). Regarding the connection between the causes of removals and the GHG inventory, GHG removals in the region are concentrated in the subcategories[46] of OWV, commercial forestry plantations and oil palm cultivation, which are expected to have a future trend toward permanence or growth in the region areas (Table 7).

**Table 7. Relationship between direct causes of regional AFOLU removals and GHG inventory subcategories**

| Removals direct causes | AFOLU subcategories in GHG regionalinventoryy* |
|---|---|
| **Natural regeneration and forest restoration** | **Dynamic in OWV** |
| | **Land converted to forest (Regeneration)** |
| | Forest converted to other forest land |

[46] The structure of the GHG inventory for the AFOLU sector in the Orinoquia (relevant categories and subcategories) is detailed in section 4 of this document.

| Removals direct causes | AFOLU subcategories in GHG regionalinventoryy* |
|---|---|
| **Forest plantations in previously transformed areas** | **Dynamic in forest plantations** |
| | Harvested wood products |
| **Permanent crops in previously transformed areas** | **Dynamic in oil palm cultivation** |
| | **Dynamic in OWV** |
| **Silvopastoral systems** | **Dynamic in OWV** |
| **Sustainable soil and degraded grasslands management practices** | **Dynamic in OWV** |
| | Grassland converted to cropland (NE) |

Source: Own elaboration with information from the 2018 regional and departmental GHG inventory.

* The size and highlighting of the text indicate greater importance of the subcategory within the regional GHG inventory.

NE: Not estimated.

### 3.1.2 ACTIONS AND INTERVENTIONS FORESEEN IN THE FRAMEWORK OF THE IMPLEMENTATION OF THE ORINOQUIA BIOCARBON PROGRAM

Based on the diagnosis presented and the structuring of the solutions to the problem posed (GHG emissions for the AFOLU sector), the process of developing the interventions (measures and actions) of the Biocarbon ERP was defined (Figure 8).[47]

According to the baseline GHG inventory for the AFOLU sector in the region (section 4) and other sources of information (section 3.1.1 and Annex I.docx), the causes and agents of the transformation and their connection with the main sources of GHG emissions were identified and analyzed. With the problematic situation defined and analyzed, the main objectives of change required in the ERP framework were established: 1) promote sustainable agricultural and livestock systems with a low carbon production approach; 2) improve the efficiency of production systems in terms of land and other resource use; 3) increase GHG removals in the AFOLU sector from the integration of the forestry component in agricultural systems and restoration processes; 4) reduce deforestation rates in the region (with emphasis on the areas where the phenomenon is concentrated) and promote a culture of sustainable management of the natural forest; and 5) generate the enabling conditions required for the effective implementation of direct interventions.

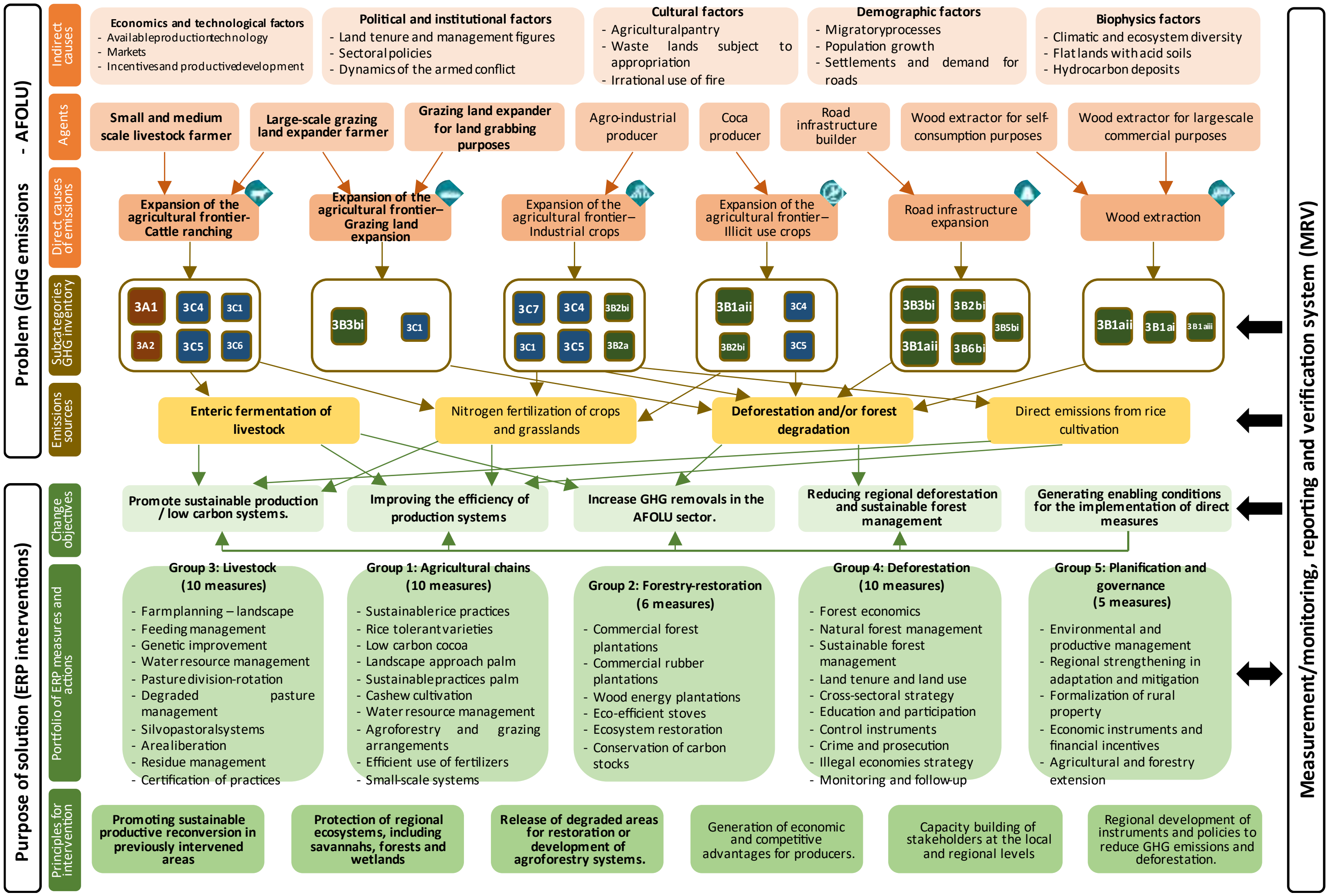


**Figure 8. Diagram of the relationship between AFOLU emissions drivers and proposed interventions of the Biocarbon ERP (own elaboration).**

Once the objectives of change for the interventions were defined, the process of constructing the measures and actions of the ERP was developed and organized into the five thematic groups described above (section 2.1.3), which are harmonized with one or more of these objectives: 1) agricultural chains; 2) forestry and restoration; 3) cattle ranching; 4) deforestation; and 5) planning and governance.

Finally, some principles or conditions were established that have been considered in the construction of the portfolio of measures and actions of the Biocarbon ERP and that will continue to be relevant during its implementation and monitoring:

- Sustainable productive reconversion should be promoted in previously intervened areas with degraded soils and/or grasslands.
- Protection of regional ecosystems, including savannahs, different types of forests and wetlands.
- As a result of the improvement in productive efficiency in terms of land use, the release of degraded areas for restoration or development of agroforestry systems.
- The generation of economic and competitive advantages for producers implementing low-carbon production practices.
- Strengthening the technical and decision-making capacities of local and regional stakeholders, with the interrelationship between institutions and communities.
- The development or support for the implementation, at the regional scale, of instruments and policies aimed at reducing GHG emissions in the AFOLU sector and deforestation.

**ERP portfolio of measures and actions construction**

The Biocarbon ERP has defined a set of measures and actions whose main objective is to reduce GHG emissions from the AFOLU sector in the region. The construction of this portfolio has been developed through a multi-stakeholder process that has progressed in different stages (Figure 9), which are described below.

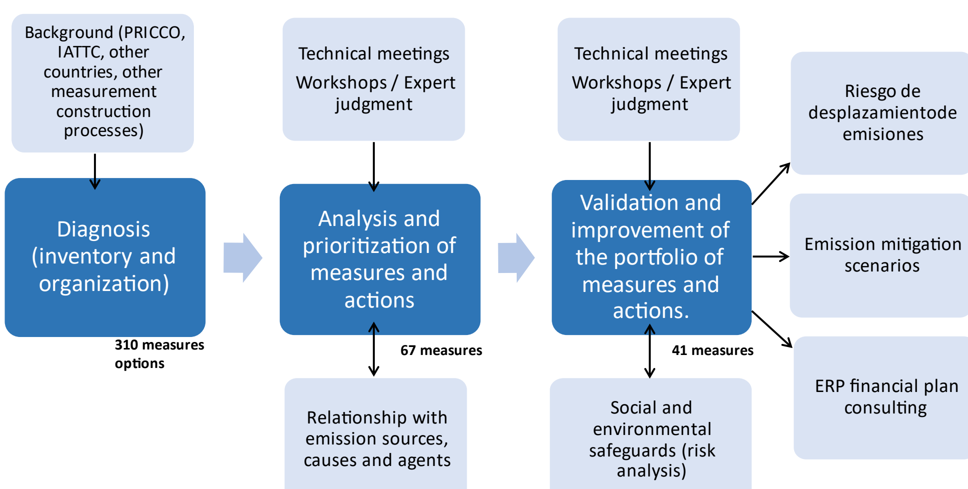


**Figure 9. Phases developed for the ERP portfolio of measures and actions construction (Own elaboration).**

A) Inventory and organization

This first phase was based on the review of territorial planning instruments of the four departments of the Orinoquia, as well as national and regional policies and instruments that included or compiled proposals for measures and actions focused on reducing emissions in the AFOLU sector in the region. This was done in order to preliminary identify the measures that were related to the project objectives and the prioritized production chains. To complement the international reference information, a review of the emission reduction programs of Indonesia, Bolivia and Costa Rica was consulted.

Among the sources of information consulted during this phase, the following were considered relevant:

- Colombia Nationally Determined Contribution (NDC). Update 2020 (Government of Colombia 2020)[47]
- Regional Comprehensive Climate Change Plan for the Orinoquia – PRICCO (CIAT & Cormacarena 2017).
- Departmental development plans in force (2020-2023)[48].
- Study on low carbon development opportunities for the Orinoquia. International Center for Tropical Agriculture (CIAT). Phase I Biocarbon Orinoquia (Tapasco et al. 2018).
- Guide to best low-carbon practices associated with sustainable oil palm production (Chaparro et al. 2020)[49].
- Initiatives registered in RENARE[50] for the Orinoquia.
- Comprehensive Strategy for the Control of Deforestation and Forest Management (Government of Colombia 2018)[51].
- National Policy for the Control of Deforestation and Sustainable Management of Forests. CONPES Document 4021 of 2020 (DNP 2020)[52].

In this phase, 310 options for measures were identified and organized in an inventory matrix with variables of description, proposed interventions, approach (mitigation, adaptation and/or control of deforestation), initial thematic classification and relationship with the prioritized chains.

B) Analysis and prioritization

[47] Available in https://www.minambiente.gov.co/cambio-climatico-y-gestion-del-riesgo/documentos-oficiales-contribuciones-nacionalmente-determinadas/

[48] Available in https://arauca.gov.co/plan-de-desarrollo-departamental-2020-2023/; https://www.casanare.gov.co/Dependencias/Planeacion/paginas/Plan-de-Desarrollo-2020-2023.aspx; https://regioncentralrape.gov.co/plan-de-desarrollo-meta/; http://www.vichada.gov.co/planes/plan-de-desarrollo-2020-2023-trabajo-para-todo-vichada

[49] Available in https://www.wwf.org.co/?365539/Aceite-de-palma-sostenible-y-bajo-en-carbono-una-guia-para-lograrlo

[50] Available in http://renare.siac.gov.co/GPY-web/#/gpy

[51] Available in https://www.minambiente.gov.co/direccion-de-bosques-biodiversidad-y-servicios-ecosistemicos/control-a-la-deforestacion-2/#:~:text=La%20Estrategia%20Integral%20de%20Control,rural%20integral%2C%20desarrollo%20de%20acciones

[52] Available in https://www.dnp.gov.co/programas/ambiente/medio-ambiente

This phase was based on the implementation of different spaces of technical coordination with key actors at the national and regional level, with the objective of refining, adjusting, prioritizing and classifying the measures and actions. Among the spaces developed, the following stand out:

- Working meetings with the technical teams of component 3 of the Biocarbon Project and coordination with the other components of the program.
- Virtual workshops with key national and regional stakeholders for the initial analysis of the measures and their relationship with potential environmental and social risks and impacts.
- Harmonization with the process of characterization of GHG emissions and removals drivers for the Orinoquia, developed according to the ERP framework.
- Thematic technical roundtables (virtual) by groups of measures for review and complementation.

Through this articulated work of hierarchization and prioritization, a first version of the matrix of the portfolio of measures and actions of the ERP was obtained (67 measures), classified in the five thematic groups described (agricultural chains, forestry and restoration, cattle ranching, deforestation, and planning and governance).

C) Validation and continuous improvement

Corresponds to the current phase of portfolio construction. It is based on the development of technical participatory processes for the review, adjustment and continuous improvement of the measures, actions and other specific contents of the portfolio matrix. Among the spaces developed, the following stand out:

- Working meetings with the technical teams of component 3 of the Biocarbon Project and coordination with the other components of the Project.
- Face-to-face workshops with key stakeholders in the Orinoquia region (four departments), developed in the ERP framework, for the review, prioritization and preliminary spatialization of the measures in the territory.
- Expert budgement by national and regional experts, in different spaces advanced in the ERP framework, for the validation of the information on the measures and their prioritization in the territory.
- Coordination with the process of analysis and spatialization of the GHG emissions and removals drivers for the Orinoquia, developed according to the ERP framework.
- Synergy with the processes of updating and adjusting the regional GHG inventory for the AFOLU sector, construction of emissions mitigation scenarios, environmental and social safeguards, emissions displacement risk analysis, ERP financial plan, non-carbon benefits, among others, developed according to the ERP framework.
- Review and adjustment of the information portfolio in accordance with the feedback processes to the draft versions of the ERP document.
- Face-to-face workshops with key stakeholders in the Orinoquia region (four departments) for the socialization of progress in the development of the ERP.

Table 8 lists the prioritized measures for the ERP area. The 41 total prioritized measures are contained in a portfolio with different thematic groups according to agricultural chains, mitigation activities in the environmental sector, and relevant planning and governance activities. According to the baseline of the regional GHG inventory for the AFOLU sector, the proposed measures are related to the subcategories that aggregate 94,56% of the estimated net emissions.

**Table 8. Measures prioritized in the Biocarbon ERP[53]**

| Thematic group | Chain | Measure | Code | Main subcategories of the related GHG inventory | Aggregate significance in the 2009-2018 net emissions baseline (%)*. |
|---|---|---|---|---|---|
| I. Agricultural chains | A. Rice | 1. Development of rice varieties tolerant to climatic extremes. | AR1 | Rice cultivation (4,73) | 4,73% |
| | | 2. Selection and implementation of sustainable low-carbon production practices and models to reduce GHG emissions in rice production. | AR2 | | |
| | B. Cocoa | 3. Implementation of low-carbon cocoa crop production strategies. | CA1 | Dynamic in OWV (13,36%) | 13,36% |
| | C. Oil Palm | 4. Planning and rehabilitation of oil palm plantations under a landscape approach. | PA1 | Land converted to forest (0,66%) | 1,76% |
| | | 5. Implementation and monitoring of best low-carbon practices associated with oil palm production. | PA2 | Dynamic in oil palm cultivation (1,10%) | |
| | D. Marañon | 6. Sustainable low-carbon agroecosystems development for marañon cultivation. | MA1 | NE | NE |
| | | 7. Planning and efficient management of water resources for the improvement of rubber, oil palm and cocoa crops. | MU1 | NA | NA |

[53] The file "Matriz_Portafolio_Medidas_Mitigación_PRE_2023-06-28." is included as complementary documentation, which includes the matrix that has the prioritization of the measures described. This matrix is being adjusted and is susceptible to changes according to the results of the consultancy that should identify the distribution of ERP benefits and the socialization workshops in the territory (four departments) on the progress of the ERP, which were held during the months of August and September 2022.

| | | | | | |
|---|---|---|---|---|---|
| | E. Multichain | 8. Research and establishment of agrosilvopastoral and agroforestry arrangements that contribute to improving the carbon balance in agricultural systems. | MU2 | NE | NE |
| | | 9. Promoting the efficient use of fertilizers and agrochemicals in agricultural production systems. | MU3 | Synthetic fertilizer (0,22%) Leaching/synthetic fertilizer runoff (0,06%) | 0,35% |

| | | | | | |
|---|---|---|---|---|---|
| | | | | Emissions from urea application to soil (0,04%) Volatilization of synthetic N fertilizer (0,03%) | |
| | | 10. Implementation of sustainable management practices aimed at reducing GHG emissions in small-scale agricultural systems that contribute to food and nutritional security. | MU4 | NE | NE |
| | | | | Emissions from organic soils and crop fires (0,09%) | 0,09% |
| **Subtotal aggregate significance in baseline net emissions 2009-2018 (Group I)** | | | | | **0,29%** |
| **II. Forestry and restoration** | F. Forest plantations | 11. Development and consolidation of the commercial forestry plantation production chain as a contribution to increasing GHG removals. | PL1 | Dynamic inforestry plantations (1,49%) | 1,49% |
| | G. Rubber | 12. Development and implementation of sustainable production practices with commercial rubber plantations. | CH1 | | |
| | H. Efficient cooking technology | 13. Establishment of wood energy plantations. | EN1 | | |
| | | 14. Implementation of eco-efficient stoves in rural households. | EN2 | Forest remaining Forest (2,12%) | 2,12% |

<table>
<tr><td rowspan="2"></td><td rowspan="2">I. Conservation and restoration</td><td>15. Implementation of restoration processes in degraded areas and ecosystems.</td><td>RE1</td><td>Land converted to forest (Regeneration) (0,66%)</td><td rowspan="2">11,41%</td></tr>
<tr><td>16. Implementation of conservation, protection and management processes for areas and ecosystems that contribute to increase carbon stocks.</td><td>RE2</td><td>Forest that is converted to other forest land (10,75%)</td></tr>
<tr><td colspan="5">Subtotal aggregate significance in baseline net emissions 2009-2018 (Group II)</td><td>15,02%</td></tr>
<tr><td rowspan="7">III. Cattle raising</td><td rowspan="7">J. Livestock</td><td>17. Management of certification processes for livestock practices related to the mitigation of GHG emissions.</td><td>GA1</td><td rowspan="7">Cattle Enteric fermentation (24,35%)<br><br>Dynamic in OWV (13,36%)<br><br>3B3a - Grassland remaining Grassland (0,56%)<br><br>Cattle manure management (0,25%)<br><br>Emissions from grassland fires (0,03%)<br><br>Indirect Cattle Manure Management(<0, 01%)</td><td rowspan="7">38,55%</td></tr>
<tr><td>18. Cattle feed management for GHG emissions mitigation.</td><td>GA2</td></tr>
<tr><td>19. Use of cattle breeds and their crossbreeds adapted to the environment and with better response to low-carbon feeding practices.</td><td>GA3</td></tr>
<tr><td>20. Management and administration of water resources in cattle ranches.</td><td>GA4</td></tr>
<tr><td>21. Rational grazing through paddock division and rotation.</td><td>GA5</td></tr>
<tr><td>22. Recovery and renewal of degraded introduced grasslands.</td><td>GA6</td></tr>
<tr><td>23. Establishment of intensive and non-intensive silvopastoral systems.</td><td>GA7</td></tr>
</table>

| | | | | | |
|---|---|---|---|---|---|
| | | 24. Release of areas from livestock use for restoration or reconversion to agroforestry systems. | GA8 | | |
| | | 25. Landscape and farm planning for the implementation of sustainable livestock systems. | GA9 | | |
| | | 26. Management of waste generated in livestock systems. | GA10 | | |
| **Subtotal aggregate significance in the 2009-2018 net emissions baseline (Group III)** | | | | | **38,55%** |
| **IV. Deforestation** | K. Reduction of deforestation | 27. Promotion of sustainable productive options based on natural capital to boost the forest economy. | DE1 | Forest converted to grassland (Deforestation) (33,05%)<br><br>Forest converted to wetlands (Deforestation) (0,77%)<br><br>Emissions from forest fires (0,68%)<br><br>Forest converted to cropland (Deforestation) (0,95%)<br><br>Forest converted to other land (Deforestation) (0,30%)<br><br>Forest converted to settlements (Deforestation) | 35,82% |
| | | 28. Implementation of conservation and sustainable forest management processes, including in specially protected areas affected by deforestation. | DE2 | | |
| | | 29. Development of extension, technical assistance and research mechanisms for the sustainable use of biodiversity associated with natural forests. | DE3 | | |
| | | 30. Development and implementation of comprehensive interventions for the stabilization of NADs, including land use planning, as well as the resolution of conflicts related to land use, occupation and tenure. | DE4 | | |
| | | 31. Generate technical capacity to develop cross-sectoral planning and management instruments to avoid deforestation. | DE5 | | |

| | | | | | |
|---|---|---|---|---|---|
| | | 32. Strengthening education, communication, knowledge and citizen participation for territorial governance and sustainable forest management. | DE6 | (0,07%) | |

| | | | | | |
|---|---|---|---|---|---|
| | | 33. Articulation of deforestation control instruments in NADs and strategic natural forest conservation areas. | DE7 | | |
| | | 34. Strengthening the administrative, technical and legal capacities of the authorities involved in the prevention, investigation, prosecution and control of environmental crimes. | DE8 | | |
| | | 35. Implementation of actions to control illegal economies that drive deforestation. | DE9 | | |
| | | 36. Generation of schemes for monitoring the effectiveness and follow-up (national, regional and local) of interventions to control deforestation and sustainable forest management. | DE10 | | |
| **Subtotal aggregate significance in the 2009-2018 net emissions baseline (Group IV)** | | | | | **35,82%** |
| V | L. Planning and governance | 37. Environmental and productive management of the rural territory at different scales (subregional, departmental, local). | PG1 | NA | NA |
| | | 38. Strengthening of planning processes and capacities to advance climate change adaptation and mitigation. | PG2 | | |
| | | 39. Strengthening of rural property formalization processes. | PG3 | | |
| | | 40. Integration of economic instruments/financial incentives to make GHG emission reductions feasible and increase the resilience of regional ecosystems. | PG4 | | |

| | | | | | |
|---|---|---|---|---|---|
| | | 41. Incorporation of agricultural and forestry extension strategies, environmental education and citizen participation aimed at low-carbon rural development. | PG5 | | |

| | |
|---|---|
| **TOTAL, AGGREGATE SIGNIFICANCE IN THE 2009-2018 NET EMISSIONS BASELINE** | **94,56%** |

NA: Not applicable.
NE: Not estimated to date.
* Aggregate information according to the data presented in section 4. Reference source not found (section 4).
** Gross emissions of this subcategory are related to group 4 of measures (deforestation).

**Interventions prior to and during the technical assistance phase of the Orinoquia Biocarbon Project**

A) Interventions related to group 1: Agricultural Chains

In order to characterize and validate low-carbon production systems for **rice cultivation** in prioritized landscapes of the Orinoquia and promote the conversion of traditional production models to sustainable low-carbon models, the Orinoquia Biocarbon Project through the consultancy with AGROSAVIA in the municipalities of Arauca (Arauca), Paz de Ariporo (Casanare), Villavicencio, Puerto Lopez and Puerto Gaitan (Meta) since June 2021 implemented activities of analysis of the predominant production models; analysis of changes in land use and land cover associated with rice cultivation; identification and selection of sustainable production models with practices that reduce carbon emissions (including measurement of emission factors and GHG capture associated with activity data); validation of the scalability of low-carbon sustainable production models (in coordination with supply networks aimed at the integral sustainability of the chain); preparation of prospective analyses and socialization of results.

The exercise finished in September 2022 with the delivery of the following products: characterization and analysis of the predominant production models; the analysis of changes in land use and land cover associated with rice cultivation; the identification and selection of sustainable low-carbon production models based on their comparative referencing; the extension plan to validate the scalability of the prioritized production models (450 producers, extensionists and public officials trained); the guidelines required for the adoption of the validated production models by producers; the guide aimed at policymakers to promote the scaling up of the validated production models; and the delivery of the prospective analysis for 2030 at the landscape scale in each of the prioritized municipalities, based on scenarios that integrate assumptions associated with the adoption of the validated production models.

On the other hand, the Biocarbon Project is developing the Orinoquía Spatial Data Infrastructure-IDE, through which the crop monitoring system will be available for consultation, and it will be possible to monitor the area of rice and oil palmcrops to determine changes in land cover. The crop monitoring system will harmonize the areas of coverage resulting from the low-carbon sustainable rice production model developed by the AGROSAVIA consultancy; likewise, the areas of coverage resulting from the oil palm production model will be harmonized and with the Orinoquia SDI it will be possible to access to the crop monitoring information layers and the cartographic reference information of the agriculture and environment sectors.

Consultancy is currently underway with the two leading entities in the Colombian oil palm sector, Fedepalma and Cenipalma, in order to strengthen the extension of good low-carbon practices in the oil **palm** chain in the Orinoquia and promote the development of sustainable business cases.

Among the specific activities to be developed by the consultancy are the establishment of baselines for the oil palm sector in the Orinoquia; the prioritization of good low-carbon practices according to their relevance in terms of GHG reduction and/or capture and validation of the methodologies required for MRV; the design and implementation of extension pilots in the foothills of Meta and Casanare for the validation of good low carbon practices and the methodologies required for their MRV; regional prospective analysis based on scenarios associated with the scaling up of good low carbon practices and the development of sustainable business cases. This consultancy is expected to be completed in the last quarter of 2023.

Among oilseeds, oil palm is the most efficient crop in terms of vegetable oil production per unit area. Colombia started its cultivation and production in the 1950s; however, in the last decade of 2000, the growth of planted areas has been mainly supported by the implementation of the biofuels policy. Between 2010 and 2020, the planted area increased from 379.611 cultivated hectares to 590.189, with a 55% growth, and the eastern zone (Orinoquia) went from 139.516 to 274.596 cultivated hectares with a 97% growth in the period. By 2020, the eastern oil palm zone represented 46% of the national total and its absolute growth that year was 17,408 hectares out of a national total of 21.802, which represents 80% of oil palm growth in the country by 2020.

Other initiatives aimed at the oil palm-growing sector in the region have been developed, such as the Biodiverse Palm Landscape project. This project includes the Landscape Management Tools HMP[54], which is a strategy that contributes to the conservation and sustenance of biodiversity in productive systems through the recovery and/or maintenance of the natural vegetation that interacts with the crops. Its implementation is fundamental for the consolidation of a sustainable oil palm sector that generates economic, environmental and social benefits, for production systems and for local and regional communities. Among the main benefits of HMPs are the provision of ecosystem services, adaptation to extreme climate events (floods and droughts), connectivity between ecosystems, habitat and species passage and the management of High Conservation Value areas, a requirement for the Roundtable for Sustainable Oil Palm - RSOP.

In order to achieve economic growth and sustainable development of the oil palm industry, it is important to reduce the ecological footprint through the adoption of new technologies and best practices aligned with the Sustainable Development Goals, in order to balance environmental, economic and social sustainability in the oil palm agroindustry, and to consolidate a product with special attributes at the national and international level of the challenges in terms of sustainability[55]; therefore, Fedepalma and Cenipalma have been promoting best practices to close gaps in aspects of legal compliance, reduction of economic, environmental and social risks[56].

[54] Paisaje Palmero Biodiverso. Herramientas del Manejo del Paisaje- HMP. Estrategia de conservación de biodiversidad en cultivos de palma de aceite.
[55] Hinestroza-Córdoba, A. & Obando-Mera, C. (2019). Índice de sostenibilidad y producción de aceite de palma sostenible en Colombia. Revista Palmas
[56] Fedepalma; Cenipalma (2020). Producción de aceite de palma sostenible de Colombia. Cultivo. Norma de empresa NE 001 FEDEPALMA**.**

In this way, the Sustainability Index IDS is presented, which is a measurement tool that allows establishing a baseline and monitoring the status of a farm, with respect to a series of best economic, environmental and social practices, aimed at ensuring the sustainability of oil palm cultivation[57]. Once the risks are identified, the Action Plan is developed, which allows closing gaps.

On the other hand, the Sustainability Strategy is being developed. For the development of this strategy among oil palm producers, it is essential to begin with the characterization of suppliers in which the baseline is established according to the information collected with the Technological Balance Index IBT and the IDS then proceed to identify the gaps and their causes and generate an action plan aimed at minimizing, mitigating and/or compensating the identified risks, and finally quantify the costs and benefits of implementing these practices[58].

Regarding the **marañon**, the Biocarbon Project with the Spatial Data Infrastructure of the Orinoquia-IDE will be able to access the monitoring system for the area of the crops to determine changes in coverage. The Orinoquia IDE will also provide reference cartographic information.

In different areas of the Colombian high-plains the price of land is low, due to its acid soils, with high aluminum saturation, limited in macro and micronutrients, which highlights the potential of marañon (*Anacardium occidentale*), being endemic to the region and having the appropriate eco-physiological conditions for its development, this according to previous research conducted by AGROSAVIA in search of the development of economically promising clones. Between the 1960s and 1970s, 450 hectares were planted and then in the years 2009 to 2011, 3 clones were selected that stand out for their yield characteristics and export quality, contributing to the production system that would allow farmers in the region to venture into safer and more profitable marañon business models.

Therefore, in the Biocarbon Project framework, AGROSAVIA, in association with WSC, is carrying out a consultancy project aimed at "Creating enabling conditions for the development of sustainable low-carbon agroecosystems for marañon cultivation in the Colombian high-plains".

Among the activities developed by the consultancy are:

- Establishment of a georeferenced baseline with updated and strategic information: this activity is characterized by its environmental, social and economic nature for marañon chain, thus carrying out the analysis for the identification of good agricultural practices associated with marañon cultivation that contributes to the sustainability of the production system, articulated with the environment of low GHG emissions in the soil and carbon sequestration in the air. Marañon plantations in the departments of Vichada and Meta will be geo-referenced, looking for information collected by the secretariats of agriculture, AGROSAVIA, the GIZ-Tonina Project and the WCS Wildlife Project, and based on the

[57] Hinestroza-Córdoba, A. & Obando-Mera, C. (2019). Índice de sostenibilidad y producción de aceite de palma sostenible en Colombia. Revista Palmas
[58] Hinestroza-Córdoba, A. & Obando-Mera, C. (2019). Índice de sostenibilidad y producción de aceite de palma sostenible en Colombia. Revista Palmas

information collected, there will be routes to verify existing crops in the region. According to the information collected, the marañon crop areas will be identified by satellite and, if satellite identification is not possible, a GPS localization will be used to identify the location, extent and delimitation of the productive area. According to this information, the practices and tasks applied in crop management will be identified, thus obtaining production costs, good agricultural practices that will be assessed and evaluated by the producers and different actors in the chain, and the farms that will be chosen as demonstration farms for the analysis of management practices and the estimation of GHG as a knowledge strategy.

- Development and implementation of a methodology and preparation of a field guide for the estimation of GHG emission and capture factors for marañon cultivation: the sustainable agriculture perspective considered as the most important is the implementation of soil conservation and regeneration practices, establishing multifunctional agroecosystems adapted to the climate, that is, replacing the conventional management that has been used for years in the soils of the Orinoquia, improving their structural stability and organic matter content. The initiative has a methodological approach to calculate GHG emission and sequestration factors in marañon crops to evaluate their application, adaptation and validation in the Orinoquia. The application of this methodology is the construction of a model for calculating greenhouse effect emissions in marañon crops with a documented minimum level of uncertainty (pilot field manual to determine emission factors in marañon farms).

- Design and implementation of an extension plan for the validation of good practices for marañon cultivation under production-conservation schemes in the Colombian high-plains: the knowledge management process in the principles of a coordinated and territorial and differential approach, sustainable land use and social management oriented to a differentiated market for the product and incorporating the value chains and the participation of the actors of the National Agricultural Innovation System- SNIA (national marañon chain and its agro-industry). In this way, it is expected that good practices will be appropriated for exploitation under the production-conservation scheme that will contribute to GHG mitigation and fixation and low-carbon practices.

  Within the framework of the extension plan formulated, an interaction is established to strengthen the capacities and competencies of 50 producers and 10 extensionists (a minimum of 25% must be women) who will identify and prioritize good low-carbon practices in marañon cultivation (method demonstrations, technical tour, strengthening workshops focused on production-conservation, administrative, technical, organizational, financial and marketing planning of the farm, efficient use of Information and Communications Technology – ICTs).

  In addition, the consultancy proposes the selection of at least 2 demonstration farms where the capacity-building workshops will be developed, reducing gender gaps through relationship guidelines and empathetic and equitable treatment, especially with indigenous communities and women.

A portfolio of good low-carbon practices will be formulated to help improve the sustainability and competitiveness of marañon cultivation. Three training modules will be delivered for agricultural extensionists and three guides for the development of sustainable low-carbon agroecosystems for marañon cultivation.

- Participatory validation of the proposal for enabling conditions for the development of sustainable low-carbon agroecosystems for marañon cultivation in the Colombian high-plain, including financial and non-financial incentives required by different types of producers for the scaling up of validated good practices: in this activity a preliminary diagnosis of financial and non-financial instruments will be carried out to generate a proposal for the consolidation and growth of the marañon chain in Vichada. The participatory construction of growth scenarios for marañon cultivation in the areas under study in Vichada and Meta will be carried out with the participation of stakeholders who have signed the chain's competitiveness agreement. The first consists of a dynamic model of the production system for the analysis of behavior over time in different cost-benefit production scenarios, thus providing information for decision-making. The second is a modeling tool scenario that specifies clearly and in detail the change in land use for planting new areas. This initiative will end in December 2023.

The Biocarbon Project contracted AGROSAVIA, in association with FEDECACAO, to "Formulate a strategy for the scaling up of low carbon agroforestry systems SAF for **cocoa cultivation** in productive areas of Arauca and Meta", which aims to improve the enabling conditions for the management of sustainable low carbon landscapes in this region. Scaling would result from the combination of renovation, rehabilitation and/or expansion of cocoa cultivation under the SAF validated in the framework of this initiative within the current productive area of Arauca and Meta.

This strategy aims to develop guidelines and training modules for the development of low-carbon cocoa SAF in the Orinoquia and characterize the financial and non-financial incentives required for their scaling up, in addition to assessing the potential for scaling up promising cocoa SAF in the productive area of Arauca and Meta, as well as their impact on GHG reduction. Within the scope of the consultancy is the construction of a low carbon development vision for the region, supported by the implementation of a GHG emissions reduction program with a payment-by-results approach, the strategy involves enormous challenges for the consideration of the significant but complex contribution of cocoa SAF.

Among the objectives of the consultancy are:

1. Provide the basis for the implementation of an information and monitoring system for cocoa production area in Arauca and Meta. To achieve this objective, the following activities will be carried out:
   1.1. Establishment of a geographically explicit baseline of cocoa cultivation in the productive nuclei of Arauca and Meta and selection of competitive cocoa SAF. This activity will deliver the following products: the baseline of up to 24 nuclei in the different municipalities of Meta and Arauca "baseline technical document"; a sustainability matrix "sustainability of cocoa agroforestry systems technical document"; the characterization of the predominant agroforestry systems " predominant cocoa agroforestry systems technical document"; the

validation of promising cocoa agroforestry systems "validated agroforestry systems technical document" and; the information and monitoring system of nuclei “cocoa agroforestry systems and mapping database technical document".

1.2. Generate a proposal for the integration of initiatives associated with traceability in the chain and the MRV reporting and verification mechanism associated with the ERP. This activity should deliver the integration proposal technical document.
1.3. Development of Methodology for the Estimation of GHG Emission/Capture Factors for the IPCC SAF category and practical application in promising cocoa SAFs. This activity shall deliver the GHG Emission/Capture factors for the SAF category.

2. Build guidelines and training modules for the development of low carbon cocoa SAF in the Orinoquia and characterize the financial and non-financial incentives required for their scaling up. To achieve this objective, the following activities will be carried out:
    2.1. Development of training modules on good practices for the scaling up of promising cocoa SAF with a gender approach, with their respective associated guides. This activity should provide good practice guides for scaling up cocoa agroforestry systems.
    2.2. Implementation of a Knowledge Management Exercise. This activity shall deliver the proposed knowledge management exercise, "the route of activities proposed and developed technical document".

3. Evaluate the potential for scaling up promising cocoa SAF in the productive nuclei of Arauca and Meta, as well as their impact on GHG reduction. To achieve this objective, the following activities will be carried out:
    3.1. Evaluation of the potential of promising cocoa SAF in the productive nuclei of Arauca and Meta. This activity shall deliver the evaluation of the scaling potential "the evaluation of the scaling of the cocoa agroforestry system technical document"; socialization and delivery of results "report compiling the activities developed and their conclusions".

Finally, through the Biocarbon Project with the Orinoquia IDE the water resource layers available in the Environmental Information System of Colombia - SIAC and in the Agustin Codazzi Geographic Institute - IGAC will be available, which could contribute to measures proposed in the Biocarbon ERP, such as the one related to the proposal for planning and efficient management of water resources for the improvement of rubber, oil palm and cocoa crops. Likewise, the Orinoquia IDE will present the layers of forest suitability and agricultural frontier of the UPRA, which could contribute to the measure aimed at researching and establishing agroforestry arrangements that contribute to improving the carbon balance in agricultural systems.

B) Interventions related to Group 2: Forestry and Restoration

The forestry sector has been viewed for years as one of the pillars of the country's future agricultural development; apart from having a growing international market, the domestic market has been in deficit for decades in its main items. By the year 2020, US$ 508 million was imported in paper products and their manufactures, US$ 206 million in wood products and US$ 130 million in cellulose fibers for paper and chipboard production. This interest in the sector has been accentuated by its potential for carbon sequestration[59].

Therefore, the Biocarbon Project is carrying out a consultancy aimed at "Identifying the best enabling conditions to promote the development of sustainable forest plantations for commercial purposes in productive areas of the Orinoquia", under the responsibility of the Temporary Union Forestal Orinoquia Colombia Brazil formed by the companies Genlyptus S.A.S., Ecoflora S.A.S. and the Sociedade de Investigacoes Florestais attached to the University of Vicosa-Brazil. The main objectives of this consultancy are: the establishment of a baseline of the productive area of the commercial forestry sector in the Orinoquia; the identification and evaluation of sustainable productive reconversion approaches for the current nuclei of the commercial forestry sector in the Orinoquia; the evaluation of the known policy instruments and the proposal of sustainable policy instruments for the commercial forestry sector in the Orinoquia; definition of main species (environmental supply / market); evaluation of profitability; evaluation of productivity; description of the cost structure of the business; characterization of limiting factors and public policy options in the commercial forestry sector. The time of consultancy is 12 months will be completed in the last quarter of 2023.

The consultancy has initially identified the forestry sector pros and cons in the country and according to this initial identification, there are more factors in opposition, among which are: soils with adaptation requirements; insecurity in land tenure; lack of access roads; low productivity (size of properties, lack of technical knowledge); impossibility of mobility from May to November (roads affected by winter); high requirements by the Regional Autonomous Corporations – CARs; divergence of statistical data and; low industrialization.

In addition, the consultancy presents a classification of eleven prioritized species, between introduced and native, which are perhaps the most promising for the region according to studies in Brazil, with similar conditions to those in the Colombian Orinoquia; species such as Acacia (*Acacia mangium*), Eucalyptus (*Eucalyptus pellita*), Eucalyptus (*Eucalyptus tereticornis*), Eucalyptus (*Eucalyptus urograndis*), Eucalyptus (*Eucalyptus urophylla*), Pine (*Pinus caribaea*), Eucalyptus (*Eucalyptus camaldulensis*), Pine (*Pinus oocarpa*), Eucalyptus (*Eucalyptus globulus*), Balso (*Ochroma pyramidale*) and Walnut (*Cordia alliodora*).

On the other hand, also from the Biocarbon Project with the Spatial Data Infrastructure of the Orinoquia – IDE it will be possible to consult the crop monitoring system to monitor the area of forest plantations to determine changes in coverage. In addition, it will be possible to consult the suitability of UPRA's forest plantations.

Regarding **conservation and restoration** processes, the Orinoquia IDE is coordinated with entities of the National Environmental System SINA to provide layers of information such as conservation, protection and forest areas.

[59] Misión de Crecimiento Verde del DNP (2015-2018); Política Nacional del Cambio Climático- Estrategia de Desarrollo Rural (pp. 169-170, 2017); Plan de Desarrollo 2018-2022 (DNP, 2018, pp. 369 y 916-921); Plan de desarrollo del sector forestal- Resolución 189 de 12 de junio de 2019.

In August 2022, the Biocarbon Project finalized a consultancy contract with Inerco Óptim Cunaguaro, whose purpose was to support the structuring of programs and projects of Payments for Environmental Services – PSA of the environmental authorities and territorial entities of the departments of Arauca, Casanare, Meta and Vichada. This consultancy was carried out through activities such as the design and implementation of a strategy for capacity building and training of PSA trainers; the development of four departmental PSA programs formulated with the environmental authorities and territorial entities of the Orinoquia (including PSA suitability maps for each of the 4 departments); one (1) project per department, for a total of four (4) projects, formulated up to the pre-feasibility phase; one (1) project per department, for a total of four (4), formulated up to the feasibility phase; four (4) project profiles per department, for a total of sixteen (16) formulated with the same considerations as above.

According to a technical study conducted in 2015 by MADR and UPRA, the country has 24 million hectares with forest suitability, of which 39% has high suitability, 25% medium suitability and 46% low suitability. On the other hand, the forestry sector in Colombia has a participation of 0,6% of the Gross National Domestic Product (GDP) and 2,9% in the Gross Agricultural Domestic Product (GAIP), if we consider the huge area with forest suitability, the country is wasting this economic potential, which could contribute significantly to the national GDP, in addition to freeing the country's balance of payments from dependence on non-renewable resources such as fossil fuels (oil and coal). From another perspective, deforestation has a high global impact and therefore appears as a priority in the agendas of the world summits on climate change, due to its ecological and environmental importance, since trees, whether for commercial use or restoration, are of great strategic importance for human life on the planet[60].

The systems, technologies or programs related to the production of plant material, must be integrated to the regulations associated with such proposals, in this case, the resolution 000329 of 2021 "By which the plant traceability system is regulated and other provisions are issued", dictates guidelines where it qualifies the plant traceability as a fundamental element that must be regulated by the countries, in Colombia it is integrated into the good agricultural practices that includes small, medium and large producers; these traceability systems must integrate the identification of producers, suppliers of inputs, as well as raw materials, encompassing improvements for the production of species and better understand elements related to production[61]. The Innovation, Technological Development and Sanitary Protection Directorate of MADS recommends regulating seed production, transformation, processing (washing, brushing, treatments, packaging, conservation), collecting information associated with all the links in the chain related to large, medium and small producers.

Regarding the regulations governing the registration of nurseries and/or basic orchards dedicated to the production and marketing of propagating plant material for planting in the country, Resolution 0780006 of November 25, 2020, defines that the ICA is responsible for adopting the

[60] Martínez, Ó.; Flórez, A.; Castro, L.; Fonseca, M.; Garcés, E.; Gutiérrez, É.; Murillo, J.; Montaña, A... Toro, Á. (2018). Plantaciones forestales con fines comerciales para la obtención de madera y su cadena productiva: lineamientos de política. Bogotá: UPRA.
[61] Ministerio de Agricultura y Desarrollo Rural. Resolución 000329 de 2021. “Por la cual se reglamenta el sistema de trazabilidad vegetal y se dictan otras disposiciones”.

necessary measures to make effective the technical control in the production and commercialization of seeds for sowing, as well as its development in policies aimed at protecting the health, production and agricultural productivity of the country and minimizing the food and environmental risks associated with it. Likewise, the standard defines the requirements for the registration of nurseries/orchards and marketing of propagating plant material and/or live plants, phytosanitary conditions, inspection visits, infrastructure requirements, obligations of the registrant, plant material movement requirements, product information (labeling)[62].

C) Interventions related to Group 3: Cattle raising

In the technical assistance phase framework of the Biocarbon Project, different initiatives are being developed for the livestock sector. Through the consultancy provided by the consortium made up by CIAT, CIPAV, FEDEGAN and TNC, since December 2021 a strategy has been implemented to support the sustainable transformation of low-carbon livestock agroecosystems in prioritized landscapes of the Orinoquia. This strategy includes the validation of the direct measures for livestock enunciated in the ERP, based on their application in each of the prioritized landscapes in the municipalities of Arauca (Arauca), Paz de Ariporo (Casanare), Puerto Lopez (Meta), Macarena (Meta) and Primavera (Vichada).

This initiative is being implemented through activities such as the analysis of the predominant livestock production systems; analysis of changes in land use and land cover associated with livestock production; comparative benchmarking of promising livestock production systems; validation of the scalability of promising production systems; preparation of prospective analyses and socialization of results.

The initiative, led by the consultancy, will deliver as products the characterization of the predominant livestock agroecosystems based on the analysis of the predominant livestock production systems and changes in land use and land cover associated with livestock; the selection of promising livestock production systems for each of the prioritized landscapes based on their comparative referencing; the validation of the scalability of the promising livestock production systems with support for the adaptation of a network of 25 demonstration farms, 500 participating farms and 1.500 producers, extensionists and public trained officials; prospective analysis for livestock production in the landscapes prioritized by the Project based on scenarios without intervention and scenarios that involve assumptions associated with the adoption of the validated production systems; guides for producers for the adoption of low-carbon livestock production systems for each of the prioritized landscapes: Floodable savannahs, high-plains and Serranía de La Macarena and a document with recommendations addressed to policy makers for the scaling up of production systems, the management of the transformation of livestock agroecosystems and the low carbon development of prioritized landscapes of the Orinoquia in addition to the design of financial and non-financial incentives to implement the above measures.

[62] Ministerio de Agricultura y Desarrollo Rural. Resolución 0780006 del 25 de noviembre de 2020. “Por medio de la cual se establecen los requisitos para el registro de viveros y/o huertos básicos dedicados a la producción y comercialización de material vegetal de propagación para la siembra en el país”.

On the other hand, the private sector strategy is being pursued through: Advocacy in multi-stakeholder spaces for the development of Public-Private Partnerships (PPPs) that affect supply networks for the adoption of sustainable and low-carbon systems of different local companies for having replicable developments and scaling low-carbon systems. The most developed companies in this aspect are Lácteos La Catira (100 producers) in Cumaral Meta, and Gomarlac SAS with 600 producers in the municipalities of Mesetas, San Juan de Arama and Uribe in Meta. Similarly, the PPPs that have companies for scalable development are: a. Meta Cocoa Cluster; b. Meta Meat Cluster; c. Meta and Cundinamarca Plain Foothill Dairy Basin; d. Arauca Dairy Basin; e. Marañon Cluster in Vichada; f. Sustainable livestock farming with short marketing circuits in the department of Vichada.

Of the projects formulated and supported from the private sector strategy, 14 productive alliances are being developed in the execution phase with formulation towards low-carbon systems; likewise, the project formulated in 2020 and called "Support to small and medium producers through assets", left the installed capacity in 700 producers from 16 associations and 16 municipalities with 700 ha in SSP, 350 ha of forage banks and equipment for the renewal of prairies.

Regarding the projects technically supported by the private sector strategy, the following stand out: GGGI (Global Green Growth Institute) is formulating a project with the support of the private sector strategy of the Orinoquia Biocarbon Project aimed at generating environmental awareness, water resource management, sustainable soil use, biodiversity conservation, promotion of silvopastoral systems and support for the generation of a departmental strategy for sustainable livestock farming. Similarly, through the Science, Innovation and Technology Fund of the Science and Technology Ministry, support was provided for the development and presentation of the project called "Productive innovation for competitiveness, climate change mitigation and rural development, based on sustainable livestock farming in the Orinoquia region" - SIGP: 95143, presented on 30/09/2022 to call 31 of the FCTeI-SGR, participation mechanism 1, for a value of 4,500 million pesos.

On the other hand, in the framework of the Biocarbon Project, the Orinoquia Spatial Data Infrastructure (IDE) is being developed, which will provide access to consult the crop monitoring system, monitor the area of clean grasslands and cover changes. The coverage areas of the model generated by the APCA for livestock will be harmonized and the geographic information layer will be available in the Orinoquia IDE.

Other initiatives aimed at the livestock sector are being carried out in the territory; in relation to the management of cattle feed to mitigate GHG emissions, the Sustainable Colombian Livestock Program made progress in defining intensive and non-intensive silvopastoral systems, techniques in mixed forage banks and intensive silvopastoral systems, management and monitoring systems, carbon capture capacity of sustainable systems in the Orinoquia foothills, in addition to the rural extension models proposed by FEDEGAN[63]. Likewise, AGROSAVIA develops evaluations of tree species, grazing systems, management of locally adapted breeds, grasslands introduction technologies, soil management in different landscapes of the Orinoquia, as well as the development

[63] Proyecto Ganadería Colombiana Sostenible: [Ganadería Colombiana Sostenible | Fedegán]

of forage materials such as JJT18 sorghum for livestock supplementation, responding to the definition of activities for mitigation and adaptation to climate change.

As for biotypes adapted to the environment, some breeds, due to their adaptation and high fertility rates, could contribute to the reduction of GHG emissions intensity (Kg of meat/$CO_2$ eq, Kg of milk/$CO_2$ eq) for this and as part of another initiative in the region, AGROSAVIA is working on the genomic evolution of the Sanmartinero Creole breed that is adapted to the foothills and high-plains of the Orinoquia region, as one of the seven locally adapted breeds with great possibilities of facing climate change due to its adaptation to the ecosystems of the landscapes in Colombia. In San Carlos de Guaroa (Meta), Rancho Acajure, and Hacienda Laureles in Villavicencio, are carrying out genetic improvement plans with the Nelore and Brahman breeds, following improvement plans aimed at adaptation and validated by genomic techniques and records. Horizonte Verde Fundation, in the framework of the Zulu Project, evaluated and estimated the intensity of emissions that exist through bovine systems that have a genetic component that is highly adapted to the landscape, and where fertility and high birth rates show very favorable results for these breeds or animal biotypes[64].

Another initiative located in the region is the one carried out by Ecopetrol in alliance with IDEAM, which is currently working on a project to upgrade fifteen hydrological-meteorological stations in the hydrographic subzones of the Cusiana and Cravo Sur rivers in the department of Casanare; the project is expected to last until 2030 and could contribute to the management and management of water resources in cattle ranches[65]. Additionally, the Cataruben Foundation, together with the CO2BIO project, is working on a project for the wetlands of the Orinoquia low plains, which seeks to prevent deforestation and degradation of gallery forests to contribute to the management of clean water in ecosystems[66], these actions go as far as the payment of $CO_2$ capture in gallery forests and natural savannahs in flooded savannah and high-plains landscapes.

Alliance Bioversity and CIAT have conducted research work to mitigate GHG emissions in the municipality of Villavicencio (Meta), these investigations were conducted in tropical forages with species of *Brachiarias humidícola* and hybrid (*Cayman* type), also with mixtures of these varieties with *Canavalia* and *Leucaena*[67]. This research could contribute to the definition of the species to be used (grasses and forages, shrubs, trees) in rational grazing; with an adequate grazing management, methane emissions generated by cattle can be reduced, due to a higher yield and productivity that reduces the fattening period of the animals.

AGROSAVIA through the study "Validation, adjustment of technology in the recovery of degraded

[64] Complementary information on the importance of creole breeds in the Orinoquia can be found in: 1) https://razasbovinasdecolombia.weebly.com/sanmartinero.html; 2) https://razasbovinasdecolombia.weebly.com/casanarentildeo.html; 3) https://www.contextoganadero.com/ganaderia-sostenible/por-que-es-importante-tener-razas-criollas-en-el-hato-colombiano; 4) https://www.fedegan.org.co/noticias/raza-sanmartinero-se-destaca-por-su-carne-y-leche-de-alta-calidad
[65] Ecopetrol Iniciative: Compensaciones ambientales e inversión forzosa del 1%
[66] Cataruben Foundation: Proyectos - Fundación Cataruben
[67] Alliance Bioversity – CIAT: Investigación en forrajes tropicales para mitigar las emisiones de GEI y combatir el cambio climático

grasslands in farms in the Meta foothills and the Colombian high-plains"[68] presents technologies to recover the productivity of grasslands, mentioning the process of grasslands degradation in the Orinoquia due to overgrazing, loss of soil fertility, insect attacks or little or no rotation of paddocks; treatments such as tillage systems, fertilization, planting of forage legumes, rice- grasslands rotation and grazing are also described. For this study, soil fertility evaluations and technology transfer areas were carried out. The study presents conclusions on the physicochemical properties of soils, the effect on grasslands and the benefits on animal production.

In addition to the progress of the Sustainable Colombian Livestock Project in foothills of the plain region, in September 2021 FEDEGAN signed an alliance with Ecopetrol to implement silvopastoral systems in 2,000 livestock farms in Arauca, Meta, Casanare, Vichada and Cundinamarca (400 farms per department)[69]. In the Meta department, the initiative begins with 40 farms in the municipalities of San Martín, Acacías, Guamal and Castilla, and in the Casanare department in the municipalities of Tauramena, Yopal and Villanueva. With this compensation from Ecopetrol, the aim is to capture 7,000 tons of carbon in the first three months of implementation of the initiative.

Regarding other initiatives present in the territory, in relation to the release of areas of livestock use for their restoration or reconversion to agroforestry systems, CORPORINOQUIA has initiated the public call for Livestock Productive Reconversion[70] to be carried out in the municipalities of Tauramena and Monterrey (Casanare), this initiative seeks to advance development and improve the quality and standard of living of the rural population, as well as promote the development of other economic sectors with ideas that respect and protect ecosystems.

UPRA is building the Reconversion of the Meat Chain Master Plan[71], which includes a chapter on the environmental management of the beef chain. During the month of October 2022, a workshop on reconversion plans for the dairy and meat chain will be held in the municipality of Villavicencio (Meta); this workshop conducted by UPRA will be supported by the Biocarbon Project.

The sustainable livestock project of the Amanecer Foundation (a subsidiary of Ecopetrol) in Meta and Casanare has supported the productive reconversion of more than ten thousand hectares, mainly through the management of grasslands.

GANSO (Sustainable Livestock), supports sustainable development through a commercial guarantee for producers associated with good sustainable practices of the supply network of Almacenes Éxito; GANSO is a technical assistance and financing support center that helps farms modify their inefficient livestock production towards diversified and sustainable production systems that mix the intensification of livestock production with forestry plantations and agricultural crops, together with the restoration and conservation of ecosystems. Strengthening of small milk producers in the municipality of Uribe, Meta; a project of the Governor's Office of Meta is helping 250 families of producers to move towards sustainable systems. Strengthening dual-purpose livestock farming by

[68] AGROSAVIA: Validación, ajuste de tecnología en la recuperación de pasturas degradadas en fincas del Pidemonte del Meta y la altillanura colombiana.
[69] FEDEGAN- Ecopetrol Aliance: Fedegán y Ecopetrol capturarán 7000 toneladas de carbono en cinco departamentos
[70] CORPORINOQUIA: Proyecto de Reconversión Productiva Ganadera (corporinoquia.gov.co)
[71] UPRA: Plan de Ordenamiento Productivo para la Cadena Cárnica en Colombia.

improving nutrition, with small producers of ASOGPROLEC, a project of National Natural Parks PNN and completed in 2019, which strengthened 84 families of La Macarena in the sustainable use of soil; in addition PNN also developed the project "Promoting the conservation of National Natural Parks: Sierra de La Macarena, Tinigua, Sumapaz, Cordillera de Los Picachos and their buffer zones, within the framework of the Sustainable Systems Strategy for the Conservation of PNN, through the implementation of environmentally sustainable productive systems for the management and reduction of pressures generated by extensive cattle ranching activities, as an incentive to the conclusion of participatory ecological restoration agreements", with 259 producers and their families benefited in six municipalities in southern Meta.

Finally, the Farmer to Farmer project of the Universidad de Los Llanos adopted 100 ha of SSP for 100 producers in the department of Vichada; likewise, the project "Strengthening the productivity of small livestock producers in the department of Meta" developed in the municipality of Mapiripán benefited 375 producers through good livestock practices, among several projects formulated by public entities in favor of small producers. There are other cooperation projects of greater impact in the region, such as: GEF-Corazón de la Amazonía; resilient dairy landscapes project executed by WWF and Horizonte verde; design of sustainable productive landscapes project; Escuela de Selva project: Trainer of local leaders as environmental promoters developed by the Universidad de la Amazonía and INBIANAM; "Pacto de crecimiento Verde del Meta" (Meta Green Growth Pact) project developed by The Nature Conservancy (TNC).

D) Interventions related to group 4: Deforestation

As part of the technical assistance phase of the Biocarbon Project, a consultancy is being developed to formulate community forestry projects, both in active deforestation areas and in high forest density areas in the four departments, with an analysis of stakeholders, potential beneficiaries, supply of timber and non-timber products from the natural forest, business plan and community monitoring. The objective is to implement sustainable economies for forest conservation in the four departments of the Orinoquia. A characterization of forest stakeholders has been carried out, which will contribute to the development of the first steps for structuring community forestry projects. For example, in the department of Vichada, 163 stakeholders have been identified, of which 50% are companies associated with production chains and forestry projects, 33% are individual producers and 7% are associations, among other types.

This consultancy will be able to contribute to the measure proposed in the Biocarbon ERP aimed at implementing conservation and sustainable management processes for natural forests, including in areas of special protection affected by deforestation (line of action 2 CONPES 4021 of 2020). Similarly, the Biocarbon Project will address this issue through consulting for the preparation of the Bita River Forest Management Plan.

On the other hand, there are some cooperation projects in the region that realized technical analyses on forest resources and forest governance, such as Probosques of GIZ, the Global Green Growth Institute (GGGI) and Action Fund. Likewise, goals and indicators that contribute to the restoration efforts of departmental and municipal governments and Regional Autonomous Corporations have been identified, especially in Vichada and Meta, and partially in Arauca, emphasizing the goals of the National Restoration Plan.

In the analysis of current planning instruments, goals and projects related to the substitution of illicit crops have been identified in departmental and municipal planning instruments, as in the case of cacao planting in Cumaribo in areas with the presence of illegal activity.

Amazonía Vision financed the Siare and Iteviare Forest Management Plans[72], which are the basis for the sustainable use of forests and the identification of restoration areas; these plans are still in the process of being approved by the environmental authority. CORMACARENA developed the Forest Management Plan for Alto Guaviare, in the municipalities of La Macarena and Lejanías; the study area is in three Integrated Management Districts: North Macarena, South Macarena, and Ariari Guayabero. Additionally, in the hydrographic subzone the exclusion area of the Sierra de La Macarena National Natural Park is also located. All the environmental regulations are part of La Macarena Special Management Area – AMEM (Decree 1989 of 1989). Finally, the watershed is part of the Amazon biome, which is subject to compliance with Ruling 4360 of 2018 of the Supreme Court of Justice. Within the hydrographic subzone, a consultancy was also advanced by CORMACARENA, where the Forestry Management and Use Plan was developed in the municipality of La Macarena, an area of the members of ASOPEPRO (Macarena Small Producers Association - 58 families), which becomes a tool for management and sustainable use, mainly of non-timber forest products.

The Southern Meta Alliance, led by CORMACARENA and the regional government of Meta, was formed with institutional allies from the national, regional, departmental and municipal levels, with the objective of environmental, social and economic recovery through conservation, reforestation, restoration and reconversion actions. The strategy is focused on achieving the reforestation of 10 million trees; establishing six mega forest garden centers (including Green Meta Corporation program); payments for environmental services; conservation incentives; reconversion - agroforestry systems and sustainable cattle ranching; and ecotourism supporting attractions of special interest in the region. The Biocarbon Project participates in these spaces between different stakeholders.

As another of the initiatives advanced in the territory and related to line of action 2 of CONPES 4021 of 2020, the USAID[73] Wasteland and forests Project generated a "model of sustainable forest management based on communities with a focus on value and multiple use" that has been socialized in different events in Meta and Arauca departments, such as the forestry tables.

Regarding the measure on the development of extension, technical assistance and research mechanisms for the sustainable use of biodiversity associated with natural forests (action line 3 CONPES 4021 of 2020), the Biocarbon Project has strengthened the Departmental Forestry Tables-MFD to integrate the concepts of sustainable forest management, forest economy, community forestry, and commercial forestry strengthening exercises. Likewise, the Project will work on the articulation of forest management plans and the development of timber and non-timber production chains as part of the community forestry project consultancy to be established by the Project.

[72] Planes de Ordenación Forestal, un salvavidas para detener la deforestación en la Amazonía – Visión Amazonía
[73] AMB - Páramos y Bosques | Colombia | U.S. Agency for International Development

On the other hand, according to the review of the Departmental Agricultural Extension Plans – PDEA, it has been possible to conduct a diagnosis to identify the inclusion of sustainable environmental development criteria in the productive sectors. The case of the PDEA of the department of Vichada can be cited, where under the category of environmental management, it is proposed to implement production models that aim at economic and ecological sustainability on a landscape scale. This is for the marañon and cocoa production lines, among others.

The development and implementation measure of integral interventions for the stabilization of the NADs, including land use planning, as well as the resolution of conflicts related to the use, occupation and tenure of land ownership (line of action 4 of CONPES 4021 of 2020) proposed in the ERP, is in the framework of the National Multipurpose Land Registry Policy[74], which aims to update the cadastre in the country, and through it generate the inventory of movable and immovable property, to know the current occupants and holders of the land, calculate the number of properties to be formalized and the property tax in both urban and rural areas. The National Government's strategy is expected to update 60% of the national territory and 50% in the Orinoquia. The Biocarbon Project finances the Development Program with a Territorial Approach PDET in the municipality of Arauquita, an area that is part of the Sarare-Arauca high deforestation nucleus. Also, the Biocarbon Project has made progress in the document "Property Regularization Strategy", built jointly with UPRA, in order to join efforts for the formalization of land from the governors' offices, which will allow prioritizing some areas of the Orinoquia.

It has been identified as part of departmental and municipal development plans to generate, adjust and/or support land-use planning instruments. In this sense, the Project is making the recommendation to emphasize the control of deforestation and in the case of municipalities with High Deforestation Nuclei – NAD, the importance of compliance with Ruling 4360 of 2018 is highlighted. Such is the case of the department of Vichada, where the Biocarbon Project highlighted the importance of including the issue of deforestation control in Subprogram 13 of strategic line 2 of the Departmental Development Plan. This is following the indicators related to the preparation of the document for the formulation of the Departmental Management Plan and support for the review and adjustment of the Municipal Land Management Plans.

The Biocarbon Project suggests that the autonomous corporations, the municipalities and departments include the measures of PRICCO, related to the control of deforestation and the Nationally Determined Contribution- NDC, among others. Likewise, the development of consultancies from Biocarbon for the development of the Orinoquia Comprehensive Strategic Plan for Deforestation Control- PEICDO and the Bita River Forest Management Plan, will provide specific support elements for the development or adjustment of land management plans and their approach to control deforestation.

The Amazonía Vision program is implementing a formalization process with the National Land Agency- ANT, in La Macarena and Puerto Concordia (Meta), which is oriented towards the

[74] Política del Catastro Multipropósito

formalization of private lands, adjudication of vacant lots and rights of use in Second Law[75] areas. Similarly, Our Prosperous Land, a USAID project, works to improve the processes of formalization and land tenure, in the specific case of the Orinoquia, through "barrio predial" methodologies[76].

The zero deforestation agreements, led by the private sector strategy, look to improve livestock practices to make sustainable use of resources and avoid deforestation. These developments at the pilot level with a focus on replicability and scalability would support the Biocarbon ERP in the generation of technical capacities to develop sectoral planning and management instruments to avoid deforestation (line of action 5 CONPES 4021 of 2020). Likewise, as mentioned above, the Biocarbon Project will develop the PEICDO, which can generate inputs for comprehensive climate change management plans.

As part of other initiatives that can contribute to this measure, the Amazonia Vision program developed forest fire and vegetation cover prevention campaigns through technical assistance to the communities in the NADs. Actions for the management and control of forest fires were identified as a contribution to the fulfillment of the NDC, for example, in the Departmental Development Plan of Vichada and in the Development Plans of the municipalities of Puerto Carreño and Cumaribo.

The Biocarbon Project is making recommendations for departmental and municipal governments to specifically incorporate strategies that emphasize deforestation, climate change and sustainable forest management in areas affected by deforestation, which could contribute to the measure proposed in the Biocarbon ERP to strengthen education, communication, knowledge and citizen participation for territorial governance and sustainable forest management (lines of action 6 and 7 CONPES 4021 of 2020).

Similarly, valuable information has been collected to be consolidated as input for the National System of Environmental and Social Safeguards to indicate the actors that participated in the forest governance spaces supported and strengthened by the project. Equally, the MFD in the Orinoquia region have been strengthened and the creation of two new ones has been promoted as a strategy for forest governance from the regions, which would allow them to be the driving force behind actions to control deforestation and sustainable forest management. Along the same lines, the Meta forestry table has been supported, with the participation and coordination of the cooperating partners: GGGI, GIZ's Pro-forest and USAID's wasteland and forest.

Dialogues have taken place with the military forces in various forest governance spaces such as the MFD and in the participatory construction of the Biocarbon ERP, regarding the measures taken and to be supported to control deforestation. Similarly, the PEICDO consultancy aims to develop synergies with the actors of the public forces, parks, corporations, governments and municipalities in areas of high deforestation, from a preventive approach. All this could contribute to the measure of coordination of command-and-control instruments in the NAD and strategic areas of natural forest conservation (line of action 8 CONPES 4021 of 2020).

[75] Formalización Visión Amazonía
[76] RED - Nuestra Tierra Próspera | U.S. Agency for International Development

With the design of the Technical Assistance Plan – PAT to be developed under the consultancy for the elaboration of the PEICDO by the Biocarbon Project, the incorporation of capacity building elements on issues related to the control of deforestation and regulations for environmental authorities and departmental governments will be taken into account and discussed, to contribute to the strengthening of administrative, technical and legal capacities of the authorities involved in the prevention, investigation, prosecution and control of environmental crimes (line of action 9 CONPES 4021 of 2020).

Among the actions that could contribute to the implementation of actions to control illegal economies that drive deforestation (line of action 10 CONPES 4021 of 2020), the Project is making progress in the development of support for the formulation of the Agreement for Legal Timber in Meta, which is aligned and articulated with the actions of forest governance in the framework of the Inter-sectoral Pact for Legal Timber, version 2.0. This process is being accompanied with training for government entities and corporations and must be validated and adjusted in the forestry sector coordination spaces. Similarly, with the coordination between GGGI and the Biocarbon Project, there is a plan to work on the development of the third phase of the Covima Web application, directly on the Single National Online Permit System - SUNL and the Online Forestry Operations Book – LOFL, in order to allow online and offline consultation of permits and forestry referrals, respectively. This third phase of the Covima project requires the exposure of data by the SUNL and LOFL systems as a mandatory condition to ensure interoperability between the systems.

With the elaboration of the PEICDO by the consultancy carried out by the Biocarbon Project, an analysis of the causes of deforestation will be developed in a participatory manner and strategies will be designed to address these problems in each of the departments. This will generate diagnostic and action inputs to consolidate public policies that contribute to the reduction of deforestation. Similarly, the structuring of community forestry projects includes the design of participatory monitoring schemes in accordance with IDEAM's Forest and Carbon Monitoring System. Two community participatory monitoring schemes per department will be consolidated to contribute to the generation of follow-up schemes (national, regional and local) for territorial interventions associated with deforestation control (line of action 12 CONPES 4021 of 2020).

Related to the promotion of productive options based on natural capital that motivate the forest economy (line of action 1 CONPES 4021 of 2020), cooperation projects or initiatives have been identified in activities related to reducing deforestation, forest conservation, deforestation control and forest economy that are aligned with the Biocarbon project. For example, the USAID Natural Wealth project, finished in 2022, aimed to reduce threats to priority ecosystems and species in strategic landscapes in the Caribbean and Orinoquia regions in Colombia through three main strategies: contributing to the increase of areas under legal protection, encouraging key actors in the public and private sectors, and supporting policies and planning instruments[77].

On the other hand, the inclusion of productive reconversion projects in areas with high deforestation and strengthening of green businesses in the action plans of regional, departmental and municipal planning instruments was identified, and in some cases, their level of compliance was

[77] Riqueza Natural de USAID: un programa que avanza en dos ecosistemas estratégicos en Colombia | CIAT Blog

known. To cite an example in Vichada, one of the goals of the Puerto Carreño Development Plan is: agricultural strengthening for economic development, which has as a product the co-financing of productive projects for sustainable agricultural development, having as an indicator the number of sustainable projects supported or co-financed (improvement of associativity in sustainable productive systems with a focus on green business or other financial and economic instruments that help the conservation of biodiversity and ecosystem services).

In addition, GGGI carried out a forestry diagnosis of Meta[78] to plan the natural forest resources in the department. Furthermore, GGGI is currently supporting the construction of the Forestry Development Plan in Meta to strengthen the forestry roundtable with GIZ and cooperating projects. Finally, ONF Andina is conducting the "Analysis of the Economic Potential of the Natural Forest in the Colombian Amazon", including the Amazon biome located in Meta.

E) Interventions related to group 5: Planning and Governance

Among the actions that have been developed from the Biocarbon Project and that could contribute to the environmental and productive planning of the rural territory at different scales (subregional, departmental, local) proposed in the Biocarbon ERP, there is the support provided to municipalities such as Orocué, Paz de Ariporo (Casanare), Acacías, Mapiripán, Puerto López, Villavicencio, La Macarena, Puerto Gaitán (Meta), Puerto Carreño, Santa Rosalba (Meta), Puerto Carreño, Santa Rosalba (Meta) and Santa Rosalba (Meta); Acacías, Mapiripán, Puerto López, Villavicencio, La Macarena, Puerto Gaitán (Meta); Puerto Carreño, Santa Rosalía, La Primavera and Cumaribo (Vichada) in the structuring of the Metropolitan Systems of Protected Areas – SIMAP. Besides, the Project team that supports NORECCO was involved in making an adjustment to the zoning of the Development Program with a Territorial Approach - PDET version 6.0 (Environmental Zoning Plan La Macarena - Guaviare, version 6.1). The modification was for an area in the municipality of Mapiripán, which went from being zoned as "productive use with reconversion" to "protection with sustainable use".

Regarding the measure proposed in the Biocarbon ERP to strengthen planning processes and capacities to advance in the adaptation and mitigation of climate change and some of the current initiatives that could contribute to this, the Biocarbon Project generated the NORECCO positioning and communication strategy, to comply with goals 1.2.2 and 3.1 of the NORECCO Action Plan 2021-2023, in order to comunicate information in the territory of PRICCO. Besides, the "Training strategy on climate change, set of the inclusion in land-use planning and low-carbon sustainable development, for NORECCO members, territorial entities and key stakeholders in the Orinoquia" was designed and is being implemented.

On the other hand, the Biocarbon Project contracted the consultancy that will develop the "Consolidation and integration of climate change criteria in the environmental determinants (of the natural environment and climate change management) in jurisdictions of CORPORINOQUIA (departments of Arauca, Casanare and Vichada) and CORMACARENA (Meta), and in a model of the

[78] Instituto Global para el Crecimiento Verde- GGGI. (2019). Evaluación de potencial de crecimiento verde. Departamento del Meta. Evaluación de Potencial de Crecimiento Verde

main departmental and municipal ecological structure of Vichada, as inputs for planning and land management in the Orinoquia", which will help improve spatial information for environmental zoning, ecological transition areas, analysis and incorporation of climate change in the 59 municipal records of the Orinoquia.

The project also worked on the formulation of two landscape charts with a low-carbon approach, with the purpose of including climate change analysis in this zoning figure and declaring the area as a landscape for preservation and conservation of a productive activity and rural development. Moreover, a GHG analysis and the structuring of adaptation and mitigation projects for low-carbon economic development are realized. The case studies are "family cocoa landscape" in Arauca and "floodable savannah landscape" in Paz de Ariporo (Casanare).

The Biocarbon Project, through the NORECCO support team, has contributed to the consolidation and administrative organization (conformation, action plan and its implementation) and support in the development of NORECCO meetings, which is made up of the technical secretariat, the steering committee, the technical committee and the Departmental Climate Change Committees – MDCC In addition, support has been given to the structuring of the departmental systems where the MDCCs are included. Of these, by ordinance, the MDCC of Meta (Ordinance 1129 of September 30, 2021) and Casanare (Ordinance 017 of July 29, 2022) are already in place.

By the Ordinances, some spaces were developed such as: the Meta Departmental Environmental System with MDCC, the Protected Areas Departmental System (Ordinance 1129 of 30.09.2021); the Casanare Departmental Environmental System with MDCC, Protected Areas Departmental System, Departmental Forestry Board, Technical Committee on Payments for Environmental Services, Territorial Environmental Health Council and the Interinstitutional Technical Committee on Environmental Education (Ordinance 017 of 29.07.2022). In Arauca, the adjustment of Ordinance 013E of 2019 of the Departmental Environmental System of Arauca was influenced, which would be formed by the MDCC, the Protected Areas Departmental System, the Departmental Forestry Board, the Technical Committee on Payments for Environmental Services and the Agroclimatic Technical Board. Finally, in Vichada, support was provided for the structuring of the Departmental Environmental System, with the MDCC, the Departmental Forestry Board and the Technical Committee for Payments for Environmental Services, and the Agricultural System with the Sectional Council for Agricultural Development - CONSEA; the Agricultural Science, Technology and Innovation Board - MECTIA; the Agroclimatic Technical Board - MTA, the Sustainable Livestock Board - MGS and the Technical Board for Local Public Procurement.

In the same way, the Biocarbon Project with NORECCO, supports the regional governments (with the support of the corporations and municipalities, according to the measures) in the formulation of the implementation plan of the Climate Action Law 2169 of 2021. In this, each entity elaborated for each of the measures established in the NDC, two products, one called monitoring plan, and another called an indicators technical sheet. As a starting milestone, it was established that the measures must be included in the Departmental Development Plans and Municipal Development Plans. In support of the NORECCO technical secretariat, the first monitoring of the implementation of PRICCO measures from 2018 to 2021 was implemented. Additionally, a guide is being prepared on how to include environmental determinants (with special emphasis on climate change) in land use planning, with Decree 1232 of 2020 as the axis.

Among the initiatives that could contribute to the Biocarbon ERP measure aimed at strengthening rural property formalization processes is the social management of property in prioritized areas (outside the NADs), a strategy that Project Biocarbon will develop with the National Land Agency (ANT) to formalize land in areas within the agricultural frontier that have not been deforested.

The Biocarbon Project and NORECCO are supporting the inclusion of climate change in the land-use planning of the municipalities of Puerto Gaitán, Mapiripán, La Macarena and Villavicencio (Meta). In addition, the company has been advocating for its inclusion in the Departmental Ordinance Plan POD and in the Departmental Plan for Disaster Risk Management PDGR of Meta. As an additional action, a climate change action plan is being built for Paz de Ariporo, a municipality that does not have climate change in its current Land Management Plan, and for Puerto López in support of a goal established in the current Municipal Development Plan.

The Biocarbon Project is also working on a consultancy to incorporate environmental attributes into the cadastre. This will allow valuing the attributes and ecosystem services of a property in the property and cadastral appraisals, and thus promote conservation properties in the Orinoquia. Contributing to the measure proposed in the Biocarbon ERP as an articulation of instruments and financial incentives to make the reduction of GHG emissions viable and increase the resilience of regional ecosystems.

Finally, in the territory, there are other projects such as MASCAPAZ[79], with the SINCHI institute, that are implementing formalization processes with the municipalities of Puerto Rico and Puerto Lleras (Meta).

F) Cross-cutting interventions of the strategy with the private sector

ISFL (in English) (Sustainable Forest Landscapes Initiative) commits to integrate the private sector in its projects, aiming to enhance investments towards sustainable land use, as well as to propose innovative approaches for sustainable development and coordinate activities towards sustainable development objectives, including emission reductions. ISFL defines four main forms of private sector integration: **1) cooperative engagements:** global support and cooperation activities for private sector investments and actions related to sustainability are developed in ISFL target areas, supporting sustainable land use and using existing knowledge; **2) industry engagements:** support for private sector commitments and actions from companies or industries, including the creation and implementation of corporate sustainability and zero deforestation policies and supplier standards; **3) agreements with the private sector:** the WBG (World Bank Group) can partner with global or local companies through the WBG's Global Finance Corporation (IFC), and leverage investments already made by the private sector in ISFL target areas; and **4) integration of the private sector by incorporating it into the design of its programs,** leveraging its implementation capacity in the designed program such as land use planning, regulations, good practices associated with

[79] Macarena Sostenible con Más Capacidad para la Paz, MASCAPAZ

emissions reductions, closing knowledge gaps, among others (ISFL Program Narratives 2017).

For the private sector strategy of the Orinoquia Biocarbon Program, different dimensions have been proposed in its development that aim to build, socialize, develop, and adopt products generated by the different strategies of the Program, directed to the development of the ERP. These dimensions contribute to the development of indicators and contemplate an integrated sector and towards the adoption of good sustainable low-carbon practices, as indicated in the general objective of the private sector strategy: ***"Promote the participation and investment of the private sector in the sustainable development of agricultural value chains with a low carbon vision in the Colombian Orinoquia".***

The dimensions that have been developed and are in the process of consolidation are as follows:

1. **Multi-stakeholders platforms:** These spaces are generally made up of producer groups (associations, companies, collectives, chain committees, federations, marketers, processors, on the other hand, the institutional framework integrated towards the development of the chain such as regional and local governmental bodies, research entities, educational institutions of all kinds, NGOs). The private sector strategy has several functions in the multi-stakeholder spaces where it has had a direct impact to integrate initiatives (not replicate), socialize initiatives derived from each entity, make actions visible, transfer knowledge to other actors in the chain, training sessions, development of pilots, innovation aimed at low-carbon development; this depends on the target chain, dynamics, development and degree of impact in the region for the development of policies and impact on productive projects that implement sustainable low-carbon practices in the region. In conjunction with Component 2 of the Biocarbon Program, these spaces are prioritized according to their technical capacities, regional or national policy advocacy, and impact on the development of the chain, among others. These multi-stakeholder platforms are strategic for the adoption of sustainable practices identified in the products and methodologically, as foreseen, they can integrate low-carbon practices to influence groups of producers, research, education, marketers, and processors; in other words, the direct and indirect links in the chains prioritized for intervention.

In this context, the following multi-stakeholder platforms have been prioritized as having the greatest impact: sustainable livestock roundtables in the Orinoquia, dairy chain in Meta, marañon committee in Vichada, CONSEA Meta and Vichada, cocoa chain in Meta, environmental table on oil palm; these roundtables have their own dynamics and are in different phases, so technical support is provided to those that require it and that are strategic for the adoption of low-carbon practices. Given these circumstances, the participation and influence in each multi-stakeholder space are evidenced in different actions such as technical support (integrated into component 2), support for project development and formulation, strategies for the adoption of sustainable systems, socialization of activities formulated by Biocarbon Orinoquia, as well as the integration of processes and detection of bottlenecks towards low carbon development.

Table 9 summarizes the progress made by the multi-stakeholder platforms in favor of the consolidation of the ERP.

**Table 9. Synthesis of progress made by multi-stakeholder platforms in favor of ERP consolidation.**

| Multi-stakeholders Space | Biocarbon Key Activities | Strategic achievements | Producers reached |
|---|---|---|---|
| Sustainable Livestock Roundtables Orinoquia | Professional support, advocacy in action and operational plans in favor of low carbon, training for producers, integration in project formulation, formulation of strategies for the development of scalable pilots, strategies for technology transfer and training of trainers, identification of PPP formulation opportunities that leverage low carbon development ERP. | Public-Private Alliance "Clúster Cárnico del Meta" adopts low-carbon principles and is interested in signing agreements for their adoption with the Orinoquia BioCarbon program.<br><br>-Public-Private Alliance "Sustainable development of the dairy foothill Meta-Cundinamarca basin".<br><br>-Public-private partnership for the sustainable development of breeding cattle in the department of Vichada.<br><br>-Public-Private Alliance for the sustainable development of the Arauca dairy basin. | *45 first pilot producers, scalable according to the growth of the cluster.<br><br>*Estimated 1500 producers in characterization.<br><br>*In characterization.<br><br>In characterization. |

| | | | |
|---|---|---|---|
| | Pilot reconversion of the dairy value chain of La Catira SAS, as the first development of reconversion with a chain vision in favor of low-carbon systems. | *First zero deforestation agreement, signed by regional anchor company.<br>*First zero deforestation agreement moving towards implementation, with important lessons learned towards the national framework of zero deforestation agreements.<br>*<br>*Development of demonstration farms by the private sector with a focus on strengthening the supply network.<br>*Formulation and development of projects for the adoption of sustainable practices.<br>*Green markets Cormacarena. | *70 Properties characterized and implemented in MRV GIS systems for zero deforestation agreements.<br><br>*In the process of consolidating a pilot supply network that can be scaled to other regional companies in the sector.<br><br>*Training strategy for rural youth, suppliers, agro-tourists and technicians in the supply network.<br><br>*Generation of sustainable and low-carbon products. |

| Multiactor Space | Key Activities BioCarbon | Strategic achievements | Producers reached |
|---|---|---|---|
| | | *Formation of the AGAPILL Association, led by women producers.<br>*Inter-institutional integration for capacity building of the producers' network.<br>*Release of strategic areas for restoration.<br>*Development of a sustainable livestock farming school, a training center for rural youth, technicians and producers for the development of sustainable systems in the region.<br>*Strategy under development for the development of responsible consumption niches through agrotourism. | *Diversification of production in a livestock matrix.<br><br>Network with verified land use, zero deforestation, incorporation of low-carbon sustainable practices.<br><br>*Supplier network aligned with the ERP. |

| | | | |
|---|---|---|---|
| Cacao del Meta Chain. | Participation in the identification of bottlenecks for the contribution to the development of Tdrs Cacao. | Support for the development of the Cacao del Meta Zona Ariari Public-Private Partnership.<br>-Ordinance for the development of cocoa in the department of Meta. | First phase: 350 producers. |
| Marañon Competitiveness Committee. | Support and national recognition of the marañon chain.<br>Strategies for the development of sustainable and low-carbon practices. | In progress: Marañon Clusterof Vichada. | To be determined in project formulation. |
| Orinoquia/Meta transitional crops technical roundtable. | Formation and methodological design of the platform that integrates production, competitiveness, projects and low-carbon sustainable development | In conformation phase. | Low-carbon supply network pilot to be determined. |

These multi-stakeholder platforms with the private sector strategy, propose and advance sustainable development pilots in the different chains, through Public-Private Partnerships (PPPs), which integrate supply networks and producers with their farms with a vision of landscape construction cell through a strategy of supply networks, which develop agreements and the adoption of sustainable low-carbon practices defined by the ERP as mitigation actions and with productive direction through products of components 1 and 2, leveraging financial and non-financial incentive strategies, with technical developments aimed at sustainable production chains, thus generating lessons learned to generate replicability and scaling in the territory.

Multi-stakeholder platforms are relevant for the private sector strategy because they make it possible to:

a. Identify chain development characteristics at the regional level, as well as bottlenecks, lessons learned, experiences and other projects under development, recognize relevant actors to influence chain development and regional and local policies, as well as to be able to propose and organize development pilots through leading companies using PPPs as a scalability strategy towards chain actors, thus supporting the development of the production chain to low-carbon sustainable systems.
b. Socialize and adopt the products of the different development strategies of components 1, 2 and 3 with greater impact and more rapidly in the region.
c. Make the pilot developments proposed with companies and/or PPPs scalable.

d. Identify production networks through anchor companies, marketers and transformers (supply networks) that can participate directly in the ERP and be differentiated in markets under different development methodologies.
e. Design and recognize a landscape that can be operated from the supply networks.

2. **Zero deforestation agreements:** There is a methodology of MADS that look for joint efforts to contribute to achieving the goal of zero net deforestation of natural forests in the country by 2030 and the restoration of areas disturbed by unsustainable production systems according to the National Plan for Ecological Restoration, Rehabilitation and Recovery of Degraded Areas; through sustainable models in the value and supply chain of beef and its derivatives, and cattle for meat products in Colombia, or dairy products as appropriate. However, it is important to point out that the dairy chain in the Orinoquia is mainly represented by dual-purpose producers.

These zero deforestation agreements, in the country, are in the development phase; however, their development through the private sector strategy for the Biocarbon program can:

a. Strengthen learning through implementation pilots; even though the zero deforestation agreements are in construction phases, it is intended that the progress made from Biocarbon and the accepted and signed supply networks will provide valuable information for the governance, monitoring and communications components of the agreements.
b. Generate an initial diagnosis of the supply network (spatial and landscape distribution of the network), compliance with land use planning regulations, deforestation threats and land cover for land use planning.
c. Understand the dynamics of supply networks in the different chains and landscapes.
d. Configure methodological routes for the sustainable development of value chains.

These developments at the pilot level, with a focus on replicability and scalability, would support the ERP in the following mitigation measures defined for group 4 (deforestation): 1) generation of technical capacities to develop sectoral planning and management instruments to avoid deforestation (line 5 Conpes 4121 of 2020); 2) strengthening of education, communication, knowledge and citizen participation for territorial governance and sustainable forest management; and 3) generation of monitoring and follow-up schemes (national, regional and local) to territorial interventions associated with deforestation control.

For the development of the private sector strategy, the adoption of zero deforestation agreements in chains already signed (livestock, oil palm and cocoa) has been proposed for both supply pilots and PPPs. This is a first step in diagnosing supply networks, as well as a differentiating element for products in sustainable value chains.

3. **Relationship between the ERP and the private sector:** The private sector is the fundamental actor to change towards sustainable production systems; it is the one that should implement the mitigation measures defined in the ERP; however, it must be surrounded by the public institutional offer to leverage these adoptions, well-defined financial and non-financial incentives that are attainable for the majority of producers, and a technical

direction that leads these sustainable systems to strong value chain developments, framed by their productive efficiency, greater profitability in the productive exercise and outstanding in the adoption of sustainable and low-carbon practices that manage to reduce GHG emissions in the AFOLU sector on a regional scale.

According to the conceptualization of the ERP construction, measures and actions to implement to reduce emissions and generate co-benefits, requires special attention in different aspects such as the technical, the operational and communicative, including the joint operation for the MRV to provide the information for decision-making and the adoption of voluntary agreements for the implementation of sustainable low-carbon practices. It will be very important to recognize the voluntary carbon markets and the development of mechanisms that will make the ERP competitive for its scalability, and thus achieve the emission reduction objectives at a regional scale.

**Environmental and social risks and their mitigation measures and actions.**

The actions and interventions contemplated to ensure governance, regulation and/or policies to control deforestation and forest degradation and promote sustainable forest development and productive low-carbon sectoral development, are planned and prioritized hierarchically under the approach of minimizing the potential environmental and social risks of implementing the proposed measures to reduce GHG emissions, according to the results of consultations on mitigation and/or compensation actions and considering measures to address cumulative environmental impacts, as well as the opportunities offered by the implementation of the ERP.

Overall, the ERP measures improve sustainable regional environmental performance, greater access to opportunities and fair benefits for forestry and productive low-carbon agricultural and livestock development; however, due to factors such as institutional weakness, limited presence of the State at different levels and competencies, legal gaps for access and tenure of land rights, non-compliance with management and planning instruments, among others, the implementation of climate change mitigation measures entails a high potential for environmental and social risks.

A first significant risk is the unregulated expansion or consolidation of the agricultural frontier, without due legalization, planning and sustainable management of the environmental and social externalities and impacts of its activities, which would increase the trend of forest degradation, reinforcing or maintaining the historical trend of land grabbing and non-compliance of social rights in these areas, where there is the potential to prolong existing socio-environmental conflicts. Another important risk is the potential displacement of unregulated agro-industrial production activities in the areas farthest from urban centers, in a scenario in which no robust political-institutional control tools, instruments and mechanisms are generated, accompanied by incentives comparable to the opportunity costs of the current sectoral economic benefits, which favor the conversion of low-carbon production activities to livestock and agricultural production of monocultures such as oil palm. Finally, in a scenario of incentives for payment by results, there is also the risk of an increase in inequality, escalation and intensification of socio-territorial conflicts due to violent disputes, increased land grabbing and irregular land appropriation in isolated areas or areas without state presence.

Consequently, the following policies, risk and impact mitigation measures and management actions, each with a defined timeframe, are priorities for risk reduction and adequate implementation of emission reduction measures: (i) strengthening of the integrated system of public governance and territorial control of deforestation and sustainable management of the use and exploitation of natural resources - Short term (years 1 to 3); (ii) strategy to consolidate the regularization and formalization of land tenure[80], through institutional support for land titling, as well as the combined articulation and implementation of technical-legal tools and instruments and local, departmental and regional environmental and territorial planning - Short term (years 1 to 3); iii) implementation of national policy and regional, departmental and local PES strategies (incentives for conservation and resources for restoration) of degraded areas and ecosystems and/or at high risk of degradation or deterioration applied by the public and private sectors - Short and medium term or years 1 to 6; iv) development of a system of financial and non-financial incentives to promote, for example, socio-community organization for technological modernization, market development, and sectoral productive reconversion, favoring access to the most at-risk population, including small and medium regional producers, victims of violence and armed conflict, farmer communities, Afro-descendant ethnic groups and settled indigenous communities - Medium and long term or years 4 to 10; and v) knowledge generation, rural extension, capacity building and technical assistance for productive modernization, education and environmental culture for low carbon and climate resilient development - Medium and long term (years 4 to 10). The planning and operational definition of the implementation of these timelines will inform the proportionality of the costs to be prioritized, according to the final Benefit Sharing Plan (BDP), and with criteria of hierarchy of mitigation of residual impacts and social justice.

### 3.1.3 FINANCING PLAN FOR THE IMPLEMENTATION OF THE ACTIONS AND INTERVENTIONS IN THE PRE-BIOCARBON PLAN[81]

The Biocarbon ERP has a cost that adds up to a present value of US$135 million over 7 years[82]. Financial resources with a present value of around 91.1 million dollars have been identified. These financing resources have been identified especially in the national budgets, in those of the Regional Autonomous Corporations CAR, and in the departmental and municipal budgets, as well as a contribution from the private sector coming from the parafiscal funds administered by the production guilds. A list of the sources contemplated for each measure is presented in Annex II.docx. The fiscal resources were identified through the review of previous years' budgets for the different levels of government involved, however, it is worth mentioning that the current National

[80] The strategy to consolidate the regularization and formalization of land tenure in the Orinoquia will include the development, strengthening and implementation of actions aimed at the technical-legal regularization of land tenure in the region. This is a region that has been prioritized for these purposes in national planning in recent years and is part of the first point of the Final Peace Agreement in relation to comprehensive rural reform. In such planning and management processes, the scope, timing and resources for these three types of land interventions will be defined.
[81] See Annex II.docx for more information.
[82] Six years are foreseen for the execution of the Program measures and one year of technical and administrative work to manage the reports and payments related to the Program's results.

Government has proposed a National Development Plan that has a special emphasis on the issues of sustainability, low carbon production, containment of deforestation and climate action, and although the budgets have not yet been approved, it does provide investment lines and strategic territorial projects for the Orinoquia region, which are quite compatible with the objectives of the Biocarbon ERP.

Possible resources that would enter to the program as payment by results have also been incorporated as a source of financing. According to the Benefit Sharing Plan, part of these resources will be received only after the second year, once measured, reported and verified, so they could serve as resources for the Program, although it is estimated that these resources (or at least part of them) will only be available for execution during the last three years of the Biocarbon ERP.

The present value of the identified resources minus the present value of the estimated costs of the measures represents a gap in present value of US$44.1 million, using a discount rate of 4 percent per year, which reflects the long-term growth of the Colombian economy. Figure 10. Behavior of ERP revenue and cost flows shows the behavior of ERP revenue and cost flows as well as the gap over time.

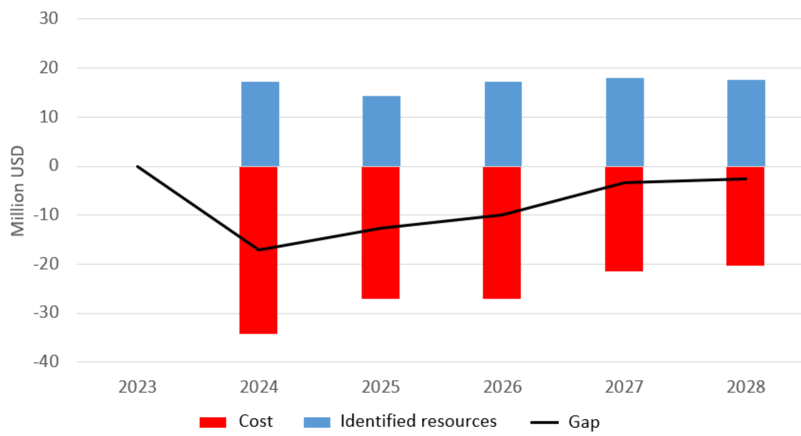


**Figure 10. Behavior of ERP revenue and cost flows**

**Source: Econometría Consultores**

To cover the financing gap, Colombia has different project financing mechanisms, among which several options have been foreseen, including in addition to the payments by results from the Biocarbon Fund, investment projects in the new Development Plan, resources from the General Royalties System (SGR), the recently created Fund for Life (Fonsurec), which manages the carbon tax funds, as well as the possibility of managing institutional cooperation donations.

The sensitivity analysis shows that the net present value of the gap can vary between US$41.5 and US$58 million depending on factors such as the availability of financing resources, or changes in unit costs, or changes in the discount rate considered. If unit costs rise across the board between 10% and 30%, the gap would vary between $47.9 million and $56.9 million. If financing were reduced between 10% and 30%, the gap would range from 48,6 to 58. And if a 2% discount rate is used instead of 4%, the gap increases from 4,.5 to 47,2% and if it is raised to 6%, the gap drops to USD 41.5 million.

The main financial risk arises at the national and departmental levels due to the concentration of financing at these two levels of government. The national government would cover the costs of most of the general enabling activities and the departments are mandated by law to set up funds to provide rural extension services. To reduce this risk, in case of insufficient funds from the national or departmental budgets, it is proposed to use as an option the carbon tax revenues, the General Royalties System, as well as to advance in the efforts to implement the Emissions Trading System, whose revenues could also be used to finance these state responsibilities. Table *10* shows the gap for each of the Biocarbon ERP measures. The trajectory of the gap can be found in Annex II.docx .

The following table presents for each measure, its main sources of funding, the amount expected to be funded by program revenues as payment by results, and the size of the gap where it persists.

**Table 10. Seven-year financing plan for the implementation of the planned actions and interventions of the Biocarbon Program.**

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| AR1 | Development of rice varieties tolerant to climate extremes. | 775 | 480 | 36 | Parafiscal Funds | 258 | General System of Royalties and/or International Grants |
| AR2 | Selection and implementation of sustainable low-carbon production practices and models to reduce GHG emissions in rice production. | 3.418 | 2.666 | 93 | Parafiscal Funds; Departmental Budgets | 659 | General System of Royalties and/or International Grants |
| CA1 | Implementation of low-carbon cocoa crop production strategies. | 2.924 | 2.427 | 170 | Departmental and Municipal Budgets | 327 | General System of Royalties and/or International Grants |
| PA1 | Planning and rehabilitation of oil palm cultivation under a landscape approach | 413 | 190 | 65 | Regional and Departmental Budgets | 159 | General System of Royalties and/or International Grants |

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| PA2 | Implementation and monitoring of low-carbon best practices associated with oil palm production | 967 | 445 | 151 | Departmental Budgets | 371 | General System of Royalties and/or International Grants |
| MA1 | Development of sustainable low-carbon agroecosystems for marañon cultivation | 2.447 | 1.199 | 181 | Departmental Budgets | 1.067 | General System of International Royalties and/or Donations |
| MU1 | Efficient water resource planning and management for rubber, oil palm and cocoa crop enhancement | 4.463 | 3.437 | 95 | Regional and National Budgets | 931 | General System of International Royalties and/or Donations |
| MU2 | Research and establishment of agrosilvopastoral and agroforestry arrangements that contribute to improving the carbon balance in agricultural systems. | 629 | 585 | 4 | National Budget | 40 | General System of Royalties and/or International Grants |
| MU3 | Promoting the efficient use of fertilizers and agrochemicals in agricultural production systems. | 1.198 | 192 | 94 | Departmental Budgets | 913 | General System of Royalties and/or International Grants |
| MU4 | Implementation of sustainable management practices aimed at reducing GHG emissions in small-scale agricultural systems that contribute to food and nutritional security. | 1.784 | 1.659 | 12 | Regional, Departmental and National Budgets | 113 | General System of Royalties and/or International Grants |
| PL1 | Development and consolidation of the commercial forest plantation production chain as a contribution to increased GHG removals. | 8.867 | 7.715 | 153 | National Budget | 1.000 | General System of Royalties and/or International Grants |

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| CH1 | Development and implementation of sustainable production practices with commercial rubber plantations. | 1.143 | 983 | 15 | National Budget | 145 | General System of Royalties and/or International Donations |
| ES1 | Establishment of wood energy plantations. | 1.140 | 1.140 | - | Municipal and National Budgets | - | - |
| ES2 | Implementation of eco-efficient stoves in rural households. | 14.535 | 14.535 | - | National Budget | - | - |
| RE1 | Implementation of restoration processes in degraded areas and ecosystems. | 11.150 | 2.119 | 1.212 | Regional, Departmental, Municipal and National Budgets | 7.820 | Fund for Life (Fonsurec) and/or International Donations |
| RE2 | Implementation of conservation, protection and management processes for areas and ecosystems that contribute to increasing carbon stocks. | 2.362 | 2.055 | 41 | Regional, Departmental, Municipal and National Budgets | 266 | Fund for Life (Fonsurec) and/or International Donations |
| GA1 | Management of certification processes for livestock practices related to GHG emissions mitigation. | 2.327 | 535 | 323 | Parafiscal Funds; Departmental and National Budgets | 1.469 | General System of Royalties and/or International Grants - - General System of Royalties and/or International Grants |
| GA2 | Cattle feed management for GHG emissions mitigation | 2.871 | 2.355 | 93 | Departmental and National Budgets | 424 | General System of Royalties and/or International Donations |

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| GA3 | Use of environmentally adapted cattle breeds and crossbreeds that are more responsive to low-carbon feeding practices. | 1.310 | 943 | 66 | National Budget | 301 | General System of Royalties and/or International Donations |
| GA4 | Water management and management of water resources in livestock farms. | 979 | 607 | 67 | Regional and Departmental Budgets | 305 | General System of Royalties and/or International Grants |
| GA5 | Rational grazing through division and rotation of paddocks. | 4.658 | 140 | 814 | Parafiscal Funds | 3.705 | General System of Royalties and/or International Grants |
| GA6 | Recovery and renewal of degraded introduced grasslands. | 2.854 | 599 | 406 | National Budget | 1.849 | General System of Royalties and/or International Grants |
| GA7 | Establishment of intensive and non-intensive silvopastoral systems. | 5.804 | 3.134 | 481 | Departmental Budgets | 2.189 | General System of International Royalties and/or Donations |
| GA8 | Release of areas from livestock use for restoration or reconversion to agroforestry systems. | 4.334 | 3.554 | 140 | Municipal and National Budgets | 640 | General System of International Royalties and/or Donations |
| GA9 | Landscape and farm planning for the implementation of sustainable livestock systems. | 867 | 711 | 28 | Departmental and National Budgets | 128 | General System of International Royalties and/or Donations |
| GA10 | Management of waste generated in livestock systems. | 416 | 246 | 31 | Parafiscal Funds; Regional Budgets | 140 | General System of Royalties and/or International Donations |

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| DE1 | Promotion of sustainable production options based on natural capital to boost the forest economy. | 1.725 | 1.173 | 272 | Regional, Municipal and National Budgets | 280 | Fund for Life (Fonsurec) and/or International Donations |
| DE2 | Implementation of conservation and sustainable forest management processes, including in specially protected areas affected by deforestation. | 2.390 | 1.625 | 377 | Regional, Departmental and National Budgets | 388 | Fund for Life (Fonsurec) and/or International Grants |
| DE3 | Development of extension, technical assistance and research mechanisms for the sustainable use of biodiversity associated with natural forests. | 510 | 347 | 80 | National Budgets | 83 | Fondo para la Vida (Fonsurec) and/or International Donations |
| DE4 | Development and implementation of comprehensive interventions for the stabilization of NADs, including land-use planning, as well as the resolution of conflicts related to land use, occupation, and tenure. | 1.255 | 854 | 198 | Regional, Departmental, and Municipal Budgets | 204 | Fund for Life (Fonsurec) and/or International Donations |
| DE5 | Generating technical capacities to develop cross-sectoral planning and management instruments to avoid deforestation. | 174 | 118 | 27 | Regional and Municipal Budgets | 28 | Fund for Life (Fonsurec) and/or International Donations |
| DE6 | Strengthening education, communication, knowledge and citizen participation for territorial governance and sustainable forest management. | 89 | 61 | 14 | Regional Budgets | 15 | Fund for Life (Fonsurec) and/or International Donations |

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| DE7 | Articulation of deforestation control instruments in NADs and strategic natural forest conservation areas. | 2.009 | 1.366 | 317 | Regional Budgets | 326 | Fund for Life (Fonsurec) and/or International Donations |
| DE8 | Strengthening the administrative, technical and legal capacities of the authorities involved in the prevention, investigation, prosecution and control of environmental crimes. | 2.009 | 1.366 | 317 | Regional Budgets | 326 | Fund for Life (Fonsurec) and/or International Donations |
| DE9 | Implementation of actions to control illegal economies that drive deforestation. | 2.009 | 1.366 | 317 | Regional and Departmental Budgets | 326 | Fund for Life (Fonsurec) and/or International Donations |
| DE10 | Generation of schemes for monitoring the effectiveness and follow-up (national, regional and local) of interventions to control deforestation and sustainable forest management. | 2.009 | 1.366 | 317 | Regional, Municipal and National Budgets | 326 | Fund for Life (Fonsurec) and/or International Donations |
| PG1 | Environmental and productive management of rural territory at different scales (subregional, departmental, local). | 4.189 | 1.424 | 722 | Regional, Departmental and National Budgets | 2.042 | Fund for Life (Fonsurec) and/or International Donations |
| PG2 | Strengthening of planning processes and capacities to advance climate change adaptation and mitigation. | 1.552 | 528 | 268 | Regional, Departmental, Municipal and National Budgets | 757 | Fund for Life (Fonsurec) and/or International Donations |
| PG3 | Strengthening of rural property formalization processes. | 1.010 | 344 | 174 | Municipal and National Budgets | 493 | Fund for Life (Fonsurec) and/or International Donations |

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| PG4 | Articulation of economic instruments/financial incentives to make GHG emission reductions viable and increase the resilience of regional ecosystems. | 1.158 | 394 | 200 | Departmental and National Budgets | 564 | Fund for Life (Fonsurec) and/or International Donations |
| PG5 | Articulation of agricultural and forestry extension, environmental education and citizen participation strategies aimed at low-carbon rural development. | 1.243 | 423 | 214 | Regional, Departmental and National Budgets | 606 | Fund for Life (Fonsurec) and/or International Donations |
| IN1 | Additional incentives for restoration | 893 | - | 477 | - | 416 | Fund for Life (Fonsurec) and/or International Donations |
| IN2 | Additional incentives for reduction of deforestation | 3.569 | - | 1.908 | - | 1.661 | Fund for Life (Fonsurec) and/or International Donations |
| | | | - | | - | | - |
| ET1 | Contribution to indigenous community projects | 11.570 | - | 5.785 | - | 5.785 | General Royalties System and/or Fund for Life (Fonsurec) and/or International Donations |
| | TOTAL BEFORE ADMINISTRATION AND MRV | **124.002** | **67.404** | **16.755** | - | **39.843** | - |

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| AD1 | UIPRE Administration | 5.346 | 1.060 | 3.287 | International Donations | 1.000 | General Royalties System and/or Fund for Life (Fonsurec) and/or International Grants - General Royalties System and/or Fund for Life (Fonsurec) and/or International Grants |
| AD2 | Integrated ERP information system | 1.467 | - | 436 | | 1.031 | - |
| AD3 | Other operating costs | 2.036 | - | 1.095 | | 941 | General System of Royalties and/or Fund for Life (Fonsurec) and/or International Donations - General System of Royalties and/or Fund for Life (Fonsurec) and/or International Donations |
| MRV | Monitoring, Reporting and Verification | 2.301 | 192 | 911 | International Donations | 1.197 | General Royalties System and/or Fund for Life (Fonsurec) and/or International Grants - General Royalties System and/or Fund for Life (Fonsurec) and/or International Grants |

| Code | Measures | Financing required (Thousands of USD) | Financing identified (Thousands of USD) | Expected pay-for-performance financing | Other identified sources of financing | Gap (thousands of USD) | Proposed financing/measures to close the gap |
|---|---|---|---|---|---|---|---|
| | TOTAL PRESENT VALUE DISCOUNTED AT 4%. | **135.152** | **68.656** | **22.484** | | **44.012** | |

Source: Annex II - ERP Financial Plan

### 3.1.4 LAWS, STATUTES AND OTHER REGULATORY FRAMEWORKS THAT ARE APPLICABLE TO BIOCARBON ERP

The Biocarbon ERP will have to be developed and implemented in accordance with the normative, legal and regulatory principles that govern the Republic of Colombia. The country has incorporated regulations associated with the protection of the environment and natural resources, land ownership, its use and exploitation, sustainable development, protection and guarantee of the rights of ethnic and farmer communities and citizens in general that coexist in the territory.

The Political Constitution (PC) of Colombia of 1991 constitutes the essential agreement of the Colombian society, it is a fundamental pillar or supreme norm directed to the people to governing the laws of the country. It is immersed in the express recognition of a structure of principles, which are directly related to the protection of the environment (Art. 58 C.P.). This implies that the defense of a healthy environment is a fundamental objective in the structure of the Social State of Law. The PC implicitly recognizes the Right to the Environment as a fundamental right. In principle, it is not expressly explicit as a fundamental right in the framework of the Political Constitution, however, jurisprudential development has recognized it as such, by offering a collective right treatment; likewise, as an advance with respect to the concept of property contained in the Constitution of 1886, it was established that property has an immersed ecological function (Art. 58 C.P.).

The constitutional and legal framework, and its normative and regulatory context are quite broad. As a result of the legal diagnosis for the ERP, a set of international agreements and conventions were also identified, as well as a collection of legal precepts that are transversally related to the design of the ERP. The most relevant of these are listed below[83]:

<u>International agreements and conventions subscribed and incorporated to our legislation:</u>

- Law 164 of 1994. United Nations Framework Convention on Climate Change - UNFCCC.
- Law 629 of 2000. Kyoto Protocol.
- Law 1844 of 2017. Paris Agreement.

[83] The entire regulatory framework can be consulted on the website of the Single Regulatory Information System: https://www.suin-juriscol.gov.co/legislacion/normatividad.html.

● Law 21 of 1991. Convention 169 of 1989 of the International Labor Organization (ILO).
● Law 461 of 1998. United Nations Convention to Combat Desertification (UNCCD).
Law 165 of 1994. Convention on Biological Diversity (CBD).
Law 47 of 1989. International Tropical Timber Agreement.
● Law 2273 of 2023. Approving the Escazú Agreement.

Legal norms prior to the entry of PC of Colombia:

● Law 2 of 1959. On forest economy of the nation and conservation of renewable natural resources.
● Decree 2811 of 1974. National Code of Renewable Natural Resources and Environmental Protection.
● Law 67 of 1983, by means of which development quotas are created and parafiscal funds are created for the cultivation of rice and cocoa

Legal norms developed as of the entry of PC of Colombia:

● Law 21 of 1991. Convention number 169 on indigenous and tribal peoples in independent countries. This legal instrument incorporates prior consultation, enshrined in Article 79 of the Constitution. The same has been developed through Laws 99 of 1993 and 1437 of 2011, Decrees 1320 of 1998 and 2893 of 2011, as well as in Presidential Directives 10 of 2013 and 08 of 2020. Prior consultation has been the subject of extensive jurisprudential development, essentially contained in judgments T769 of 2009, 120 and 129 of 2011, 376 of 2012, T485 of 2015, C389 of 2016 and T704 of 2016, with judgment T063 of 2019 being of special importance, as it is related to projects similar to ERP Biocarbon. A legal norm that incorporates in a single legal reference, the legal, doctrinal and jurisprudential provisions alluding to prior consultation and free, prior and informed consent, is pending legislative development.
● Law 89 of 1993. Whereby the livestock and dairy development quota is established, and the National Livestock Fund is created.
● Law 99 of 1993. Creates the Ministry of the Environment (now MADS), organizes the National Environmental System (SINA) and enacts other provisions.
● Law 101 of 1993; General Law of Agricultural and Fishing Development. This law was amended by Law 811 of 2003.
● Law 139 of 1994. Creates the Forestry Incentive Certificate - CIF.
● Law 138 of 1994. Whereby the quota for the promotion of the oil palm agroindustry is established and the Palm Development Fund is created.
● Law 160 of 1994. Creates the National System of Agrarian Reform and Rural Peasant Development; establishes a subsidy for land acquisition, reforms the Colombian Institute of Agrarian Reform (INCORA).
● CONPES Document 2834 of 1996. Its purpose is to achieve a sustainable use of forests in order to conserve them, consolidate the incorporation of the forestry sector into the national economy and improve the quality of life.
● Law 388 of 1997 on land use planning.
● Law 599 of 2000. Colombian Penal Code; Title XI, of said penal statute, contains crimes against natural resources and the environment.

● Law 811 of 2003. Amended Law 101 of 1993 on agricultural and fishing development (adding 3 new chapters) and created chain organizations in the agricultural, fishing, forestry and aquaculture sector, the Agricultural Transformation Companies (SAT).
● CONPES 3242 of 2003. Strategy for the sale of environmental services.
● Law 914 of 2004, creates the National Bovine Cattle Information System, modified by Law 1659 of 2013.
● Decree 4765 of 2008 (modified by means of Decree 3761 of 2009). Modifies the structure of the Colombian Agricultural Institute (ICA).
● Law 1333 of 2009. Establishes the environmental sanctioning procedure and other provisions.
● Law 1454 of 2011. Whereby organic norms on territorial planning are issued. Therefore, in conjunction with Law 9 of 1989, Law 388 of 1997 and in development of the provisions of Article 288 of the CP, it establishes the bases for territorial zoning.
● Law 1437 of 2011. Code of Administrative Procedure and Contentious Administrative Proceedings.
● Law 1448 of 2011, whereby measures of attention, assistance and comprehensive reparation to the victims of the internal armed conflict are issued.
● Decree 3570 of 2011. Creates the new structure of MADS.
● Decree 4145 of 2011. Creates the Planning Unit for Rural Land, Land Adequacy and Agricultural Uses (UPRA).
● CONPES Document 3700 of 2011. Institutional strategy for the articulation of policies and actions on climate change in Colombia.
● Law 1561 of 2012, which establishes a special verbal process to grant property titles to the material possessor of urban and rural real estate of small economic entity, sanitize false tradition.
● Law 1659 of 2013. It created the National System of Animal Identification, Information and Traceability.
● Law 1731 of 2014, financing measures are dictated for the reactivation of the agricultural, fishing, aquaculture, forestry and agro-industrial sector.
● Decree 2041 of 2014, which aims to regulate Title VIII of Law 99 of 1993, on environmental licenses.
● Decree 2363 of 2015. Creates the National Land Agency (ANT).
● Decree 2364 of 2015. Creates the Rural Development Agency (ADR).
● Law 1753 of 2015. Whereby the National Development Plan (PND) 2014-2018 is issued. Chapter VI contemplated a green growth policy, prevention of forest deforestation, protection of wetlands, delimitation and protection of paramos, created the RENARE, subsequently regulated through Resolution 1447 of 2018 of MADS, among other provisions.
● Decree 1071 of 2015. Many of the above regulations, related to the agricultural sector were compiled in the Sole Regulatory Decree of the Agricultural, Livestock, Fisheries and Rural Development Administrative Sector as of the date of its issuance.
● Decree 1076 of 2015. Sole Regulatory Decree of the Environment and Sustainable Development Sector.
● Law 1776 of 2016. Develops the Zones of Rural, Economic and Social Development Interest (ZIDRES). Likewise, Article 4 of the ZIDRES Law provides that MADR will define the agricultural frontier considering the definitions of environmental reserve zones and other land use restrictions imposed by any government authority.
● CONPES 3859 of 2016. Policy for the adoption and implementation of a rural-urban multipurpose cadastre.

● Law 1801 of 2016. National code of coexistence and citizen security. (Police Code). Which contains an environmental title (Title IX) through which corrective and preventive police measures are adopted aimed at the conservation of the environment, water resources, fauna, flora, air, the National System of Protected Areas (SINAP).
● Law 1819 of 2016. Whereby a structural tax reform is adopted. The same contains the creation of the so-called carbon tax on fossil fuels.
● Decree 926 of 2017. Which regulates the mechanism of non-causation of the carbon tax.
● Decree 870 of 2017. Aims to establish guidelines for the development of PES.
● Decree 1655 of 2015. Whereby five new sections are added to Book 2, Part 2, Title 8, Chapter 9 of Decree 1076 of 2015, in order to establish the organization and operation of the National Forest Information System, the IFN and the Forest and Carbon Monitoring System that are part of the Environmental Information System for Colombia.
● Law 1876 of 2017. Creates the National Agricultural Innovation System, which aims at the creation and implementation of the National Agricultural Innovation System (SNIA).
● Law 1900 of 2018. Establishes gender equity criteria in the awarding of vacant land, rural housing, productive projects.
● Decree 1007 of 2018. Regulates the payment incentive for environmental services, in accordance with the provisions of Decree Law 870 of 2017.
● Resolution 261 of 2018 MADR. Defines the national agricultural frontier and adopts the methodology for general identification.
● Law 1930 of 2018, contains provisions for the comprehensive management of paramos in Colombia.
● Law 1931 of 2018 on climate change management. Establishes the National Climate Change System and the National Program of Tradable Emission Quotas.
● Resolution 1447 of 2018 MADS. Regulates the MRV system of mitigation actions at the national level.
● Resolution 831 of 2020, in order to modify the regulation of the monitoring, reporting and verification system for mitigation actions at the national level, established in Resolution No. 1447 of 2018.
● Resolution 0256 of 2018 MADS. Whereby the update of the Environmental Compensation Manual of the Biotic Component is adopted, and other determinations are made.
● CONPES 3918 of 2018. Strategy for the implementation of the Sustainable Development Goals (SDGs) in Colombia.
● CONPES 3926 of 2018. Land suitability policy.
● CONPES 3934 of 2018. Green Growth Policy 2018-2038.
● CONPES 4021 of 2020. National policy for the control of deforestation and sustainable forest management.
● Law 1955 of 2019. PND 2018-2022 Pact for Sustainability: Producing Conserving and Conserving Producing; Pact for Decentralization: Connecting Territories, Governments and Populations. Article 156 defines the sanctioning power in sanitary, phytosanitary, safety and forestry matters through the ICA.
● Law 2046 of 2020. Establishes mechanisms to promote the participation of small local agricultural producers and peasant, family and community agriculture in public food procurement markets.
● Law 2071 of 2020. Establishes financing for the reactivation of the agricultural, fishing, aquaculture, forestry and agro-industrial sectors.

● Decree 1824 of 2020. On clarification and legal validity of colonial or republican titles of indigenous reserves.
● Decree 1785 of 2021. Related to measures tending to dynamize sanitation processes within the areas of the National Natural Parks System.
● Decree 1879 of 2021. On registration of forest plantations.
● Law 2111 of 2021. Substitutes Colombian Penal Code, incorporates modifications to environmental crimes.
● Law 2169 of 2021. Promotes the low carbon development of the country through the establishment of minimum goals and measures on carbon neutrality and climate resilience.
● Law 2173 of 2021. Whereby ecological restoration is promoted through the planting of trees.
● Decree 172 of 2022. Whereby the Intersectoral Commission of the Presidential Cabinet for Climate Action is created.
● Decree 1106 of 2022. On organization and operation of the national women's system.
● Law 2294 of 2023. Approves the National Development Plan 2022 - 2026.

Also, there is a jurisprudential framework that has recognized environment and land rights, its use, the recognition and protection of the rights of ethnic, agrarian and rural communities, through the development of jurisprudence related to environmental rights, collective rights, ecological constitution, protection of water sources, forests, among others.

The country has also built a legal and institutional universe that is in line with international agreements and treaties related to environmental protection, the fight against climate change, the reduction of GHG emissions, and the guarantee of protection of the rights of ethnic and rural communities, which have been complemented with the national legal framework and are in harmony with the actions planned under the project. This has made it possible to formulate the National Climate Change Policy - PNCC (CONPES Decree 3700 of 2011), and to develop the respective regulatory and institutional framework for its adoption, implementation and development. At the same time, the Colombian Low Carbon, Adapted and Resilient Development Strategy (ECDBCAR) has been built, which constitutes a public policy that involves various sectors. The same had an initial regulatory development through Decree 298 of 2016; however, it was subsequently elevated to legal status through Law 1931 of 2018. This legal and regulatory framework has been strengthening instances associated with the Climate Change Policy, such as the National Climate Change System (SISCLIMA), as well as other Coordination instances.

Colombia also has legal tools that allow it to develop actions related to the carbon market, supported by the incorporation of the Paris Agreement into national legislation, through Law 1844 of 2017, and regulatory developments contained in Law 1819 of 2016, Decree 926 of 2017, Law 1931 of 2018 (On climate change management) etc. Currently, the country is moving forward, under the leadership of MADS, in the construction of the necessary regulatory framework to clearly and transparently address the necessary rules and definitions. Likewise, it is working on strengthening the MRV mechanisms and the RENARE, created through Article 175 of Law 1753 of 2015 and modified through the National Development Plan 2022 - 2026, sanctioned through Law 2294 of 2023, Article 230, through which The National Registry For Reduction Of Emissions And Removal Of GHG is modified.

Finally, it is important to point out that the country also has the regulatory mechanisms and contents that allow for the incorporation and implementation of the standards in force related to social and environmental safeguards, under the framework of the National System of Safeguards, a structure in charge of the MADS, which, based on the Cancun Safeguards, has formed a component of national interpretation of Safeguards[84].

Considering that the portfolio of measures proposed for the ERP (Section 3.1.2) is nested in policies, plans, mechanisms, agreements or commitments in force, and that they have a legal or regulatory basis within the provisions of the Colombian Political Constitution, it is considered legally viable to implement the proposed Biocarbon ERP for the region.

In this sense, it is specified that, about the implementation of the actions and measures contemplated in the ERP, they are in line with the existing legal framework in the Republic of Colombia, inasmuch as it does not appear that they are contrary to the existing legal framework. However, as detailed in section 3.7.1 of this document, there is a lack of legal and regulatory development that allows the country to enter in a clear and transparent manner, minimizing possible risks, in the transfer of ER titles, however, as mentioned in that section, the country is working on advancing in the respective regulatory development that allows the respective transfers.

### 3.1.5 DISPLACEMENT OF EMISSIONS RISK TO THE ERP AREA

The displacement risk analysis tries to develop a portfolio of measures that minimizes or mitigates as much as possible the risks of displacement of GHG emissions associated with its implementation. For the GHG emissions displacement risk analysis of the Biocarbon ERP, a methodology was implemented which combines statistical modeling processes, spatially explicit or referenced, with the judgment of national and local experts by department[85].

Based on the analysis of drivers (Section 3.1.1) and the preliminary portfolio of ERP measures[86], three groups of measures or interventions associated with the most important causes and sources of emissions in the AFOLU sector in the region were prioritized and validated with local experts. According to the Biocarbon ERP GHG inventory (Table 19), 95% of GHG emissions in the Orinoquia region come from: (i) deforestation (associated with the direct cause of expansion of the agricultural frontier by grazing land), represented mainly in the subcategory "Forest that becomes grassland (Deforestation)" with 32,25% significance in the GHG inventory baseline; ii) livestock (associated with the direct cause of expansion of the agricultural frontier by livestock), represented mainly in the subcategory "Cattle Enteric Fermentation" with 24,52% of significance, and iii) industrial rice cultivation (associated with the direct cause of expansion of the agricultural frontier by industrial crops), represented mainly in the subcategory "Rice cultivation" with 4,76% of significance.

[84] Ver mayor detalle en el siguiente enlace del Ministerio de Ambiente y Desarrollo Sostenible: https://archivo.minambiente.gov.co/index.php/redd/salvaguardas-para-redd-en-colombia

[85] For further details, it is recommended to consult the complementary documentary input with the results of the GHG emissions displacement risk analysis (Displacement Input).

[86] This corresponds to the version of the portfolio of measures that was worked on with experts during the regional workshops held during the first half of 2022.

Although the percentage contribution of rice is low in comparison, it corresponds to the highest contribution within the crop subcategories; this is in addition to its importance for the region in terms of agricultural land use and economic production.

Independent modeling processes were developed to establish the areas, inside and outside the ERP area, with the highest risk of emissions displacement for each group. Finally, this output contributed to the design of the current Biocarbon ERP portfolio of measures (Section 3.1.2) by minimizing or mitigating the potential displacement risks associated with the proposed measures.

For group IV Reduction of deforestation, the measures contemplated in the Biocarbon ERP are aimed at reducing deforestation through the generation of instruments for planning, management, conservation, management and control of forest use. In a scenario where the implementation of measures to control illegal activities associated with deforestation (land grabbing, extensive cattle ranching in non-permitted areas, illicit crops, illegal logging) would occur in a disjointed manner with other actions and initiatives underway in the region or in a partial manner allowing agents to move to areas where such articulation was not occurring (especially south of the ERP implementation area), there would be a potential risk of displacement of emissions both internally and externally. Under this scenario, a medium internal emissions displacement risk was identified in the south of the department of Meta (municipalities of Vistahermosa, La Macarena and Mesetas) and low in the central area of Arauca (municipality of Arauquita); as well as a medium external risk in the departments of Guaviare (San José del Guaviare) and Caquetá (San Vicente del Caguán), and low in the departments of Norte de Santander, Boyacá and Huila. The risk of displacement of emissions, especially in the south of the Orinoquia, shows that the expansion of the agricultural frontier acts as a driving force for deforestation, mainly caused by land grabbing and/or extensive cattle ranching, illicit crops and industrial crops. Therefore, the mitigation measures of the Biocarbon ERP will be developed in coordination with the regional implementation of the CONPES 4021 of 2020 National Policy for the Control of Deforestation and Sustainable Forest Management[87], and with initiatives led by the State that during the implementation of the Biocarbon ERP contemplate interventions related to deforestation in the south of the Orinoquia region and in the neighboring departments of the Amazon biome[88]. With this articulated intervention strategy, a desired scenario of reducing

[87] Available at https://colaboracion.dnp.gov.co/CDT/Conpes/Econ%C3%B3micos/4021.pdf. CONPES 4021 provides policy guidelines to counteract deforestation and promote sustainable forest management. By analyzing the causes that affect the processes of land use change and loss of natural forest, it identifies the actions that the national government should develop in coordination with the sectors, communities, and other stakeholders so that, based on the recognition of the particularities and needs of the territories, this problem can be controlled and at the same time promote the conservation and sustainable management of forests. This policy focuses actions planned under the Comprehensive Strategy for the Control of Deforestation and Forest Management (EICDGB), is articulated with Ruling STC 4360-2018 of the Supreme Court of Justice Amazon subject of rights and is aligned with the country's international commitments such as the Sustainable Development Goals (SDGs), the implementation of the Paris Agreement on climate change, and the goals of the Joint Declaration of Intent (JIU), among others. This policy will be implemented over a 10-year time horizon (2020-2030) and is a cross-sectoral, multidimensional and systemic strategy. To learn about the progress in its implementation, it is recommended to consult the web page provided by the DNP: https://sisconpes.dnp.gov.co/sisconpesweb/#estadisticas.)

[88] To achieve this, dialogue will be promoted with the two main initiatives that are expected to have a direct influence on the prioritized areas, namely: the Vision Amazonia REM Program and the 2015 - 2016 Payment by Results Project of the Vision Amazonia GCF with FAO. Other actors and initiatives may be taken into account as their actions in these territories are formalize

the risk of displacement of internal emissions from medium to low level in the southern area of the department of Meta would be achieved, preventing it from spreading to the departments of Caquetá and Guaviare.

Livestock measures III contemplated in the design of the Biocarbon ERP promote their efficiency, which prevents them from having an associated displacement risk; however, the promotion of conversion to other land uses such as forestry or agriculture, contemplated in some measures of the portfolio, could potentially displace livestock to new areas. In a scenario of uncontrolled expansion, where cattle ranching is displaced and expands even over savannah ecosystems, a high risk of internal displacement was preliminarily identified in the south of the department of Meta, a medium-low risk of internal displacement in the department of Casanare, and a high risk of external displacement to the municipality of San Vicente del Caguán (department of Caquetá). For this reason, the design of the current ERP portfolio of measures incorporates the implementation of sustainable livestock landscapes that seek to protect savannah ecosystems while containing uncontrolled livestock expansion, which in tandem with technological improvement reduces the levels of internal displacement risk to medium-low in southern Meta, and to low in the department of Casanare. For the case of San Vicente del Caguán, the Biocarbon ERP also contemplates the articulation with regional and local initiatives and authorities of the Amazon region, to support the formulation and/or give continuity to the implementation of complementary measures to minimize or mitigate the risk of external displacement.

For the measures in group I Agricultural Chains, the rice chain was prioritized for analysis due to the socioeconomic importance of the crop in the region, its expansion trend, the availability of spatial information and its weight in GHG emissions compared to other crops (including direct emissions grouped in the "Rice cultivation" subcategory of the GHG inventory, direct and indirect emissions from nitrogen fertilization processes and indirect emissions from possible changes in land use). The rice chain measures are oriented to the conversion of rice in suitable areas and in systems with low emissions, i.e., they do not directly promote the expansion of traditional rice cultivation. However, in a non-systematic implementation scenario, there could be high risks of internal displacement towards the east of the department of Casanare and the center of Meta, and external displacement in the municipality of Paratebueno (Cundinamarca). In these areas, close to the municipalities with the highest rice production in the region and which under this scenario could be initially prioritized for implementation, there would be a risk of displacement of emissions due to market effects, where cultivation areas are expanded in search of greater economic income in unsuitable areas[89], which could include forest lands.

With the current ERP measures, the adoption of low-carbon technologies and other strategies associated with crop management, such as the technology transfer model based on sustainability and social responsibility and implemented gradually and systematically, the level of risk would be reduced from high to low, by minimizing potential impacts on ecosystems typical of the Orinoquia such as flooded savannahs, gallery forests or moriche palm forests. The areas at risk identified in the displacement belt that are outside the control of the ERP Biocarbon will require a coordinated

[89] According to suitability data generated by UPRA (UPRA, 2015). Cartographic information available at: https://www.upra.gov.co/uso-y-adecuacion-de-tierras/evaluacion-de-tierras/zonificacion

work strategy (contemplated in the country's regulations and policies related to climate change, deforestation control, sustainable sectoral development, land use planning, etc.), with national and regional actors such as Fedearroz, producer associations, businessmen, research centers, agricultural secretariats, among others.

## 3.2 DESCRIPTION OF THE BIOCARBON - ERP CONSULTATION PROCESS

The Biocarbon Program has a PPPI[90], an instrument that promotes the development and implementation of a participatory, open, and inclusive consultation and the information process of the interested parties both in its construction and implementation phase, its objectives are:

***i)*** Promote a systemic approach to stakeholder engagement that will help to identify stakeholders and build and maintain a constructive relationship with them.

***ii)*** Enable stakeholders' opinions to be considered in the design of the Program and environmental and social performance.

***iii)*** Promote throughout the Orinoquia Biocarbon ERP cycle the inclusive and effective participation of affected parties in relation to issues that could have an impact on them and provide the necessary means for such participation.

***iv)*** Ensure that adequate information on the Program, the environmental and social benefits, risks and impacts associated with the Program is disclosed to interested parties in a format and manner that is accessible, timely, understandable and appropriate.

***v)*** Provide parties affected by the Orinoquia Biocarbon ERP with accessible and inclusive means to raise issues and grievances and manage a timely response to them.

In line with the World Bank's Environmental and Social Standards (ESS), and aiming to increase benefits for the sustainable development of the territory and the reduction of risks, the PPPI includes approaches based on human rights, gender, ethnicity, human development, peace building, rural development and environmental participation. The guiding principles of the process are transparency, participation and dialogue, inclusion, equality and continuous learning.

In the area of influence of the Biocarbon ERP, there are 100 indigenous reserves, 7 indigenous associations, 1 Afro-Colombian group (Arauca) and 3 mixed associations (Meta).

A. **PARTICIPATION IN ERP BIOCARBON DESIGN**

In the preparation and definition of the Biocarbon ERP, the PPPI has followed a process route of three (3) stages, each of them consisting of several sessions, according to the

[90] Extension in annex Stakeholder Participation Plan PPPI (corresponds to the Consultation and Information Plan approved by the World Bank for the ERP, which is being updated in compliance with the BM's EAS).

moments and themes for the construction of the ERP Biocarbon. This process is led by the Orinoquia Biocarbon Project Implementation Unit (PIU) with the guidance and support of the co-executing entities. The stages of the process are described below.

**(i) Planning**

**Status: Completed**
**Time Frame: july - november 2021.**

Focused on the preparation for the participatory consultation of the Biocarbon ERP and in which the following steps were developed: i) Identification of the consultation topics for each interested party according to impact, benefit or interest; ii) Definition of communication channels and spaces according to the parties to be consulted, taking into account the party, topic and time; iii) Selection of messages and material to be socialized with the parties; iv) Definition of methodology for participation; v) Dissemination of information.

**(ii) Collaborative Development with the different stakeholders**

**Status: In progress**
**Time Frame: september 2021 – december 2023**

The participatory and joint construction with stakeholders took place in two stages: i) Information gathering for the construction of key issues; and ii) Socialization and feedback of the preliminary proposal of the Biocarbon ERP.

To gather information, the methodological guidelines identified for each stakeholder were followed, as well as the steps illustrated in Figure 11, through (11) spaces under the workshop and focus group method (Figure 12). The stakeholders who participated and contributed in a nurtured dialogue in the different spaces carried out for the construction of key issues are listed in Table 11.

## Methodological steps for the different spaces of consultation

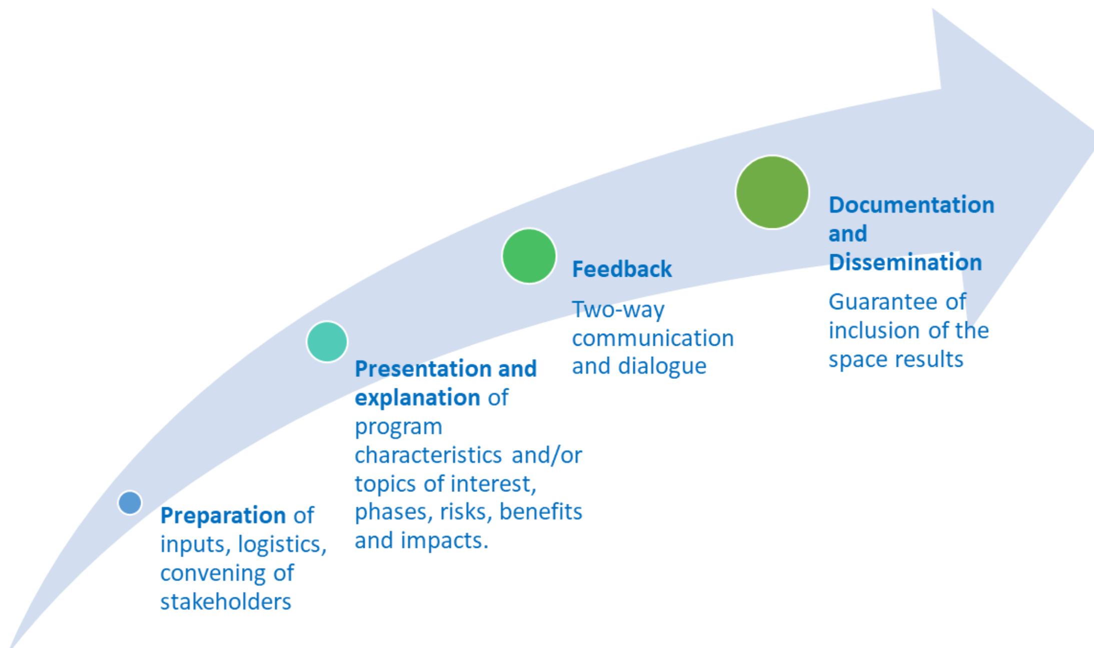


Figure 1 Methodological steps of the consultation spaces for the construction of the Biocarbon ERP.

## Spaces with stakeholders

| Number | Mode | Type Space | Topic |
|---|---|---|---|
| 6 | Virtual | Socialization Construction | GHG measures Risks and impacts |
| 1 | Virtual | Socialization Construction | Financing mechanisms and benefit sharing |
| 4 | On-site | Socialization Construction | Key ERP Topics |
| 1 | On-site | Socialization | Project, ERP |

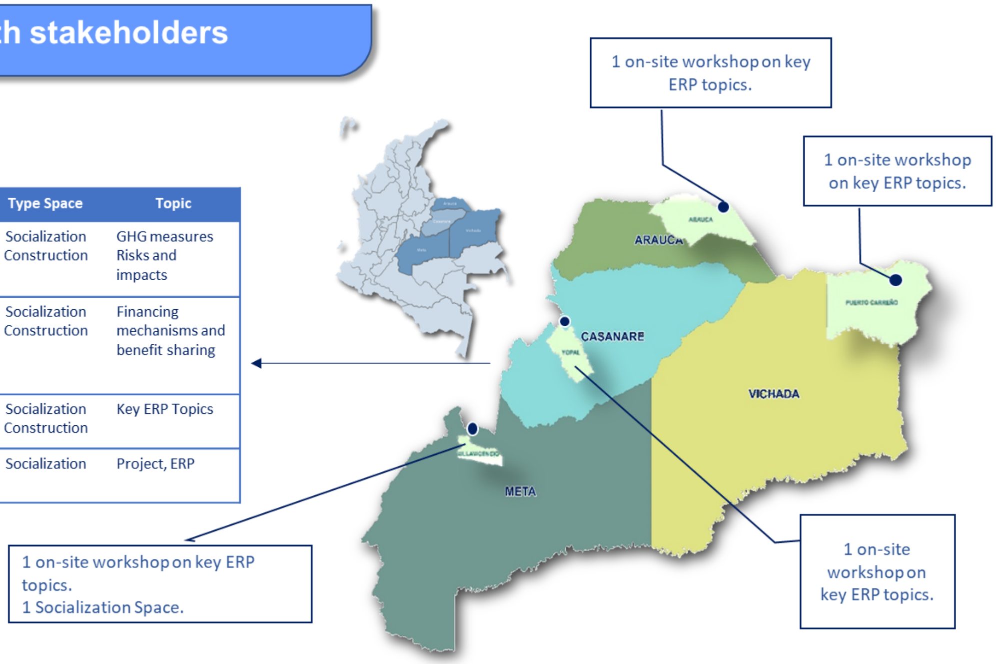


Figure 2 Socialization and Construction Spaces for the Biocarbon ERP.

Table 1. Stakeholders participating in the spaces carried out for the construction of the Biocarbon ERP

| LEVEL | DEPARTMENT | STAKEHOLDER | LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|---|---|---|
| **National** | National | National Land Agency ANT | Regional | Meta | Villavicencio's Municipal Office |
| **National** | National | Presidential Agency for International Cooperation | Regional | Meta | ARD Colombia Nuestra Tierra Prospera |
| **National** | National | National Planning Department DNP | Regional | Meta | Association of Cattle Raisers and Farmers of the Piedemonte Llanero AGAPILL |
| **National** | National | FEDEARROZ | Regional | Meta | ASORINOQUIA |
| **National** | National | National Planning Department DNP | Regional | Meta | Campo Capital |
| **National** | National | IDEAM | Regional | Meta | CENIPALMA |
| **National** | National | Fondo Acción | Regional | Meta | CORMACARENA |
| **National** | National | FEDEGAN | Regional | Meta | Corporación Universitaria del Meta |
| **National** | National | Attorney General's Office | Regional | Meta | Meta Regional Government |
| **National** | National | Guayacanal Foundation | Regional | Meta | OSM Colombia |
| **National** | National | Ministry of National Defense DPCS | Regional | Meta | Palmeras del Llano |
| **National** | National | INERCO | Regional | Meta | Secretariat of Agriculture and Rural Development Meta |
| **National** | National | UPRA | Regional | Meta | Environment Secretariat |
| **National** | National | MADR | Regional | Meta | TNC |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| **National** | National | MADS |
| **Regional** | Regional | NORECCO |
| **National / Regional** | Arauca/Meta/ Casanare/Vichada | ICA |
| **National / Regional** | Arauca/Casanare/Meta/Vichada | SENA |
| **National / Regional** | Arauca | FEDECACAO |
| **National / Regional** | Arauca | National Police |
| **National / Regional** | Arauca | AGROSAVIA |
| **Regional** | Arauca | Saravena's Municipal Office |
| **Regional** | Arauca | Brinkman Colombia |
| **Regional** | Arauca | Arauca Cattlemen's Committee |
| **Regional** | Arauca | FIDUAGRARIA |
| **Regional** | Arauca | Forestar Foundation |
| **Regional** | Arauca | FUNDEORINOQUIA |
| **Regional** | Arauca | Arauca Regional Goverment |
| **Regional** | Arauca | La Libertad |
| **Regional** | Arauca | Arauca Sustainable Livestock Board |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| Regional | Meta | Universidad Cooperativa de Colombia |
| Regional | Meta | Universidad de los Llanos |
| Regional | Meta | Universidad Nacional Abierta y a Distancia-UNAD |
| Regional PI | Meta | Indigenous community La Gaitana, Pueblo Pijao |
| Regional PI | Meta | Cabildo Nasakiwe |
| Regional PI | Meta | Indigenous Association UNUMA |
| Regional | Vichada | Control Social Climático |
| Regional | Vichada | Regional Government |
| Regional | Vichada | CORPORINOQUIA |
| Regional | Vichada | National Army-Brigade 28 |
| Regional | Vichada | Puerto Carreño's Municipal Office |
| Regional | Vichada | ASOCIAM |
| Regional | Vichada | ASOMARVI |
| Regional | Vichada | AGAF |
| Regional | Vichada | Vereda Manati |
| Regional | Vichada | Kardinuts |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| **Regional** | Arauca | Organización CO2 |
| **Regional** | Arauca | National Natural Parks PNN |
| **Regional** | Arauca | Livestock Producer Wilson Cuevas |
| **Regional** | Arauca | Profesional MVZ Giovanni Budia |
| **Regional** | Arauca | El Remanso Agropecuary |
| **Regional** | Arauca | Profesional MVZ Lady Ojeda |
| **Regional** | Arauca | Red Nacional de Jóvenes Ambiente |
| **Regional** | Arauca | El Horizonte National Civil Society Reserve |
| **Regional** | Arauca | Secretariat of Education of the Department of Arauca SEDAS |
| **Regional** | Arauca | National Protection Unit UNP |
| **Regional** | Arauca | Universidad Cooperativa de Colombia |
| **Regional** | Arauca | Universidad de Santander |
| **Regional PI** | Arauca | Arauca Traditional Captaincy Association ASOCATA |
| **Regional PI**[91] | Arauca | Association of Cabildos and Traditional Indigenous |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| Regional | Vichada | Omacha Foundation |
| Regional | Vichada | V&M Paper |
| Regional | Vichada | Cattlemen's Committee |
| Regional | Vichada | El Nativo Nursery |
| Regional | Vichada | Productores Avicultura |
| Regional | Vichada | Beekeeper La Crstalina |
| Regional | Vichada | SADE Pto. Carreño |
| Regional | Vichada | ASOAGROP |
| Regional | Vichada | WCS |
| Regional PI | Vichada | Association of Cabildos and Indigenous Authorities – ORPIBO |
| Regional PI | Vichada | La Esperanza del Tomo Reserve |
| Regional PI | Vichada | Satiba Reserve |
| Regional PI | Vichada | Independent Reserve |
| Regional PI | Vichada | Association of Cabildos and Traditional Indigenous |

[91] PI: Indigenous Groups

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| | | Authorities of the Department of Arauca ASCATIDAR |
| **Regional PI** | Arauca | San José de Lipa/La Voragine – Hitnu Reserve |
| **Regional** | Casanare | Yopal's Municipal Office |
| **Regional** | Casanare | APCA |
| **Regional** | Casanare | FEDEPALMA |
| **Regional** | Casanare | Federación N.A. |
| **Regional** | Casanare | Cataruben Foundation |
| **Regional** | Casanare | Federación N.A. |
| **Regional** | Casanare | Reserve |
| **Regional** | Casanare | La Palmita Foundation |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| | | Authorities of the Mataven Rainforest – ACATISEMA |
| Regional PI | Vichada | Panakumi Indigenous Association |
| Regional PI | Vichada | AUTIC Association |
| Regional PI | Vichada | Association of Traditional Authorities and Indigenous Councils of the Tomo Region (PALAMEKU) |
| Regional PI | Vichada | Association of Traditional Authorities and Indigenous Councils of the Vichada Spring ASOKUYAWISI |
| Regional PI | Vichada | Santa Rosalia Reserve |
| Regional PI | Vichada | La Pascua Reserve |
| Regional PI | Vichada | Indigenous Regional Council of Vichada |
| Regional PI | Casanare | Indigenous Cabildo Resguardo Caño Mochuelo |
| Regional PI | Casanare | Association of Indigenous Authorities Salibas of Orocué Casanare ASAISOC |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| **Regional** | Casanare | Casanare's Regional Government |
| **Regional** | Casanare | La Palmita Foundation |
| **Regional** | Casanare | Casanare's Regional Government |
| **Regional** | Casanare | Casanare Sustainable Livestock Board |
| **Regional** | Arauca/Casanare/ Vichada | CORPORINOQUIA |
| Regional PI | Casanare | Indigenous Organization of Casanare ORIC |
| Regional PI | Casanare | Indigenous Cabildo Chaparral Barro negro |
| Regional PI | Casanare | Kocoki Casanare |
| Regional PI | Casanare | Indigenous Coordination Corporinoquia |

The results[92] generated thorugh the spaces allowed the coordination and participatory construction with the different stakeholders at the national and territorial level, of the issues related to the Biocarbon ERP, especially: with the measures and actions, analysis of reversal risks, identification of environmental and social risks, identification of actors and roles for the MRV system. The information generated in these spaces was included in the portfolio of GHG reduction measures, in the MGAS document and in the methodological framework of the MRV system, inputs of the preliminary Biocarbon ERP proposal.

The socialization and feedback of the preliminary Biocarbon ERP proposal was carried out between July and September 2022[93], with a total of 17 spaces: four, one per department of the area of influence for the socialization and feedback of the Biocarbon ERP proposal, eight for the identification and definition of financing costs for the implementation of the measures and five for the construction of the PDB (Figure 13). The stakeholders that participated, provided feedback and contributed to the different spaces carried out, are listed in Table 12.

[92] Further development of the different areas in the reports published on the Biocarbon project website: https://biocarbono.org/
[93] The methodology used for these spaces was a combination of virtual and face-to-face sessions on specific topics associated with the Biocarbon ERP.

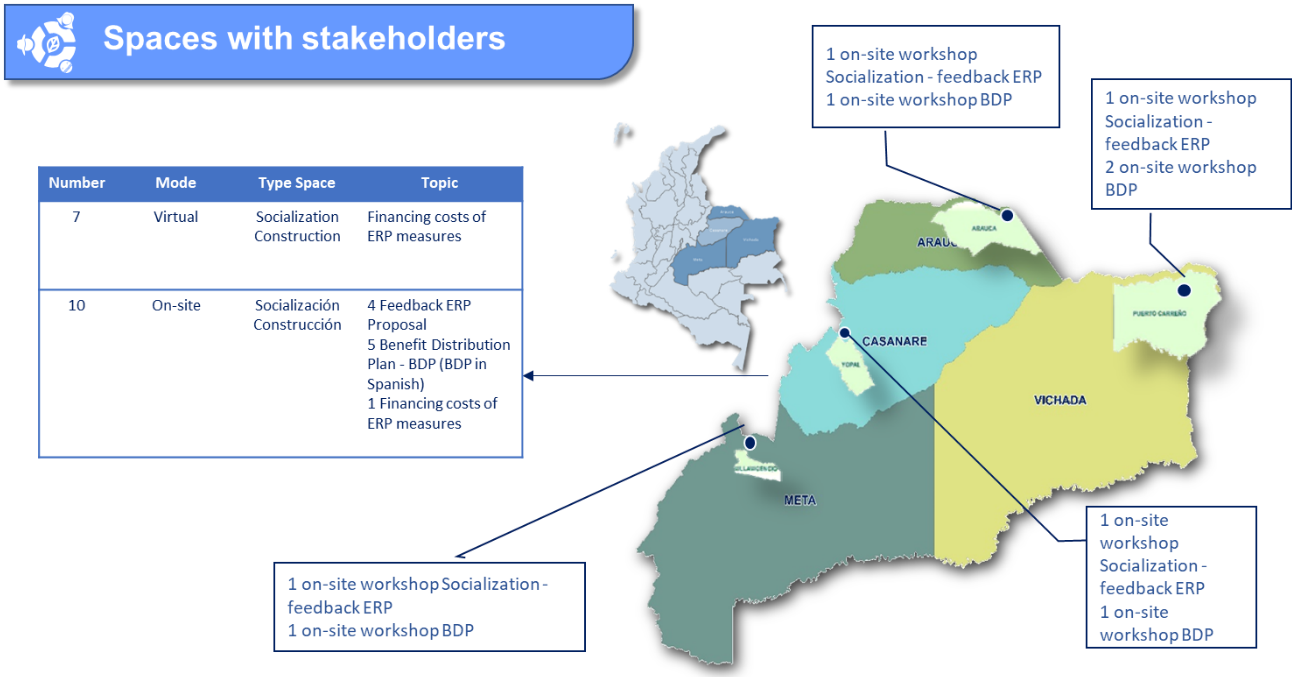


Figure 3 Spaces for Socialization and Feedback of the Biocarbon ERP proposal.

Stakeholders participating in the spaces held for the Socialization and Feedback of the Biocarbon ERP proposal.

Table 2 Stakeholders participating in the spaces held for the Socialization and Feedback of the Biocarbon ERP proposal.

| LEVEL | DEPARTMENT | STAKEHOLDER | LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|---|---|---|
| **National/ Regional** | Meta | FEDEARROZ | Regional | Meta | Meta's Regional Government |
| **National/ Regional** | Casanare/Arauca | FEDEGAN | Regional | Meta | Villavicencio's Municipal Office |
| **National/ Regional** | Meta | AGROSAVIA | Regional | Meta | Piedemonte Llanero Association of Cattle Raisers and Farmers (AGAPILL) |
| **National/ Regional** | Arauca | FEDECACAO | Regional | Meta | Association of Agricultural Engineers of El Llano ASIALL |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| **National/ Regional** | Arauca/Casanare/ Meta | ICA |
| **National/ Regional** | Arauca/Meta | National Police |
| **National/ Regional** | Vichada | National Navy |
| **National/ Regional** | Vichada | Colombian National Army |
| **National/ Regional** | Meta/Casanare | FEDEPALMA |
| **National Regional** | Meta/Casanare | CENIPALMA |
| **National/ Regional** | Meta | Universidad Minuto de Dios |
| **National/ Regional** | Meta | Universidad Antonio Nariño |
| **National/ Regional** | Arauca/Meta | Universidad Cooperativa de Colombia |
| **National/ Regional** | Casanare/Meta | Universidad Nacional Abierta y a Distancia- UNAD |
| **National/ Regional** | Arauca | Universidad Nacional de Colombia |
| **Regional** | Casanare/Meta | Business Association for the Development of Orinoquia- ASORINOQUIA |
| **Regional** | Casanare/Meta | CENIPALMA |
| **Regional** | Arauca/Casanare/ Vichada | CORPORINOQUÍA |
| Regional | Meta | National Association of Farmers' Users ANUC Villavicencio |
| Regional | Meta | Forests, soils and water |
| Regional | Meta | CORMACARENA |
| Regional | Meta | RESNATUR |
| Regional | Meta | Secretariat of Agriculture and Rural Development Meta |
| Regional | Meta | Environment Secretariat |
| Regional | Meta | Universidad de los Llanos- UNILLANOS |
| Regional | Casanare | Agua Viva |
| Regional | Casanare | Bramadora SAS |
| Regional | Casanare | Casanare Chamber of Commerce |
| Regional | Casanare | Casanare Sustainable Livestock Cluster |
| Regional | Casanare | Cataruben Foundation |
| Regional | Casanare | La Palmita Foundation |
| Regional | Casanare | Mata de Monte Foundation |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| **Regional** | Arauca/Meta | Parques Nacionales Naturales PNN |
| **Regional** | Arauca/Meta/Vichada | SENA |
| **Regional** | Vichada | Puerto Carreño's Municipal Office |
| **Regional** | Vichada | Beekeeping Association Apiarios la cristalina SAS |
| **Regional** | Vichada | Association of Agricultural Producers of Puerto Carreño ASOAGROPC |
| **Regional** | Vichada | Vichadense Agroforestry Trade Association AGAF |
| **Regional** | Vichada | Colombian National Army |
| **Regional** | Vichada | Omacha Foundation |
| **Regional** | Vichada | Vichada's Regional Government |
| **Regional** | Vichada | Inverbosques |
| **Regional** | Vichada | El Tuparro National Natural Park |
| **Regional** | Vichada | Wildlife Conservation Society WCS |
| **Regional** | Arauca | El Remanso Farming |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| Regional | Casanare | Casanare's Regional Goverment |
| Regional | Casanare | Casanare Sustainable Livestock Board |
| Regional | Casanare | Engineering Network |
| Regional | Casanare | Secretariat of Environment and Climate Change |
| Regional | Casanare | Universidad Internacional del Trópico Americano-Unitrópico |
| Regional | Arauca | Association of Sugarcane Growers of Barranca Amarilla ASOCAVERBA |
| Regional | Arauca | Rural Women's Association ASOMUAR |
| Regional | Arauca | ASOJUNTAS |
| Regional | Arauca | ASOSABANAS |
| Regional | Arauca | ASOVIDAFORESTAL |
| Regional | Arauca | Brinkman Colombia |
| Regional | Arauca | Arauca Cattlemen's Committee |
| Regional | Arauca | Arauquita's Multi-active Production and Agricultural Commercialization |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| | | |
| **Regional** | Arauca | Arauca's Municipal Office |
| **Regional** | Vichada | Puerto Carreño's Municipal Office |
| **Regional** | Vichada | Apiarios la cristalina SAS Beekeeping Association |
| **Regional** | Vichada | Association of Agricultural Producers of Puerto Carreño- ASOAGROPC |
| **Regional** | Vichada | Vichadense Agroforestry Trade Association AGAF |
| **Regional** | Vichada | Colombian National Army |
| **Regional** | Vichada | Omacha Foundation |
| **Regional** | Vichada | Vichada's Regional Government |
| **Regional** | Vichada | Inverbosques |
| **Regional** | Vichada | El Tuparro National Natural Park |
| **Regional** | Vichada | Wildlife Conservation Society - WCS |

| LEVEL | DEPARTMENT | STAKEHOLDER |
|---|---|---|
| | | Cooperative COOMPROCAR |
| Regional | Arauca | National Integrated Management District |
| Regional | Arauca | Arauca Municipal Public Utilities Company Emserpa |
| Regional | Arauca | FEDEARAUCA |
| Regional | Arauca | Forestar Foundation |
| Regional | Arauca | FUNDEORINOQUIA |
| Regional | Arauca | Arauca's Regional Government |
| Regional | Arauca | Lazos Marianos |
| Regional | Arauca | National Youth Environment Network |
| Regional | Arauca | El Remanso Agropecuary |
| Regional | Arauca | Arauca's Municipal Office |
| | | |

The main results[94] generated from the spaces for socialization and feedback of the Biocarbon ERP proposal allowed:

[94] Further development of the different areas in the reports published on the Biocarbon project website: https://biocarbono.org/

- Socialization of the preliminary proposal of the Biocarbon ERP and its associated topics, which allowed clarification of concepts, issues, contextualization of the what and how of the Biocarbon ERP and its implementation.
- Presentation and feedback on the diagnosis of land tenure and distribution of land ownership in the Orinoquia region with a focus on emissions reduction.
- Explanation of the baseline and GHG inventory.
- Complementing the proposed scope of GHG mitigation measures, key to the definition of the final portfolio of GHG reduction measures.
- Contextualization of mitigation scenarios.
- Presentation of the Environmental and Social Management Framework and its associated instruments.
- Inputs for the projection of possible costs that may be incurred for the implementation of GHG reduction measures.
- Inputs to the PDB proposal based on the relative valuation of different stakeholder preferences for benefit sharing (monetary and non-monetary).

**(iii) Participatory construction with ethnic groups**

**Status: In progress**
**Time frame: september 2022 – december 2023.**

In the multi-stakeholder spaces generated in the previously mentioned stages, representatives of the indigenous groups participated, in which they contributed and complemented from their dynamics in the territory, likewise, a specific space was created for the socialization of the national safeguards and the presentation of an initial structure of the Biocarbon ERP, generating as a result the identification and coordination with the representatives of the IPs in the territory, presentation of the national safeguards and feedback and impressions on the actions of the Biocarbon ERP.

The particularity and special attention for indigenous groups gave way to a specific process to work with them to identify the measures, actions and other issues associated with the Biocarbon ERP, including the issues referred to, according to Colombian law, that require prior consultation. The identification of actions in indigenous territory is done through meaningful consultation in spaces of socialization and general participation, spaces that allow the presentation of the Biocarbon ERP proposal and its different associated topics, with the objective of making them known in order to obtain their feedback according to their needs and interests, in order to subsequently make adjustments accordingly, guaranteeing the right of all people who may be affected and/or benefit from the measures to be adopted in the framework of the Biocarbon Orinoquia ERP. The methodology of these spaces is agreed with the authorities and/or community leaders, respecting cultural suitability, rights, traditions, knowledge and language.

The participatory construction with indigenous groups began with a first informative and exploratory meeting with the delegates of national and regional organizations from the four departments under the jurisdiction of the Biocarbon ERP, in which it was agreed to hold 15 joint construction spaces involving the 100 reserves, located in the jurisdiction of the Biocarbon ERP. To date, meetings have been held with the participation of representatives from 32 reserves. By November 2023 it is expected that the process should have ensured the participation of 75% of the indigenous reserves, considering that there are public order situations that limit access to certain territories.

The inputs gathered in the first spaces carried out have allowed to have an initial approach to the definition of the actions in the indigenous territory of the area of influence of the Biocarbon ERP.

## B. PARTICIPATION IN BIOCARBON ERP IMPLEMENTATION

For the implementation phase of the Biocarbon ERP, there will continue to be spaces for stakeholder participation that will allow a nurtured dialogue in order to strengthen, promote, provide feedback and follow up on the actions in the territory, allowing the necessary adjustments to be made according to the process.

The implementation of the Biocarbon ERP will be developed in two ways: i) Implementation of GHG reduction measures; ii) Distribution of monetary and non-monetary benefits. For stakeholder participation, the participatory methodology will continue with a systemic approach, using methods or forms adapted to the needs of the issues, particularities of the stakeholders, culture and customs.

### (i) Participation in the implementation of GHG reduction measures:

This participation will take place in each of the stages of the life cycle of the projects that are formulated for the implementation of GHG reduction measures:

a. Focusing of areas for intervention at the project level: actions that will be focused with teams of experts from the executing and co-executing entities of the Biocarbon ERP, through workshops, meetings and/or worktables. As a result of these spaces, there will be targeted areas for the development of projects for each type of the productive chains prioritized in the Biocarbon ERP.

b. Identification and prioritization of project profiles: Multi-stakeholder socialization spaces and/or focus groups with the possible implementing entities described in section 2 of this document are planned to socialize the characteristics of the BioCarbon ERP, criteria for prioritization of project profiles, route for project formulation and, above all, the possible risks and impacts, difficulties associated with each stage of implementation, and procedure for complaints and claims management. With respect to the ethnic groups, at this stage the pertinent steps will be taken to obtain free, prior and informed [95],consent, and to guarantee this right the ethnic groups will attach a letter of intent expressing their interest in participating and carrying out the actions in a voluntary, free and autonomous manner.

c. Project structuring and co-financing management: with the implementing entities and their beneficiaries, whose profile is prioritized, spaces will be created to socialize the characteristics and scope of the prioritized project profile, the next steps for project formulation, as well as to agree on the times and methods for gathering the necessary information for project formulation, in order to have a formulated and co-financed project as a result.

d. Project implementation and follow-up: spaces for follow-up and feedback with the different stakeholders, such as: project-level follow-up committees, general project assemblies and Biocarbon ERP technical committees.

(ii) **Participation in the distribution of monetary and non-monetary benefits**

In the implementation phase, the information dissemination and disclosure strategy will be intensified to inform beneficiaries of the details of the process for accessing benefits. In addition, the PCCRD (PQRSD) mechanism will be strengthened as necessary to ensure accessible and culturally appropriate channels for beneficiaries and will reinforce engagement strategies on issues of interest to them. The involvement of the affected parties is not only based on their identification as beneficiaries of the Biocarbon ERP actions, but also to guarantee access to the benefits and their distribution, in this sense there will be two committees:

a. Benefit-sharing committee at the project level, with responsibility for agreeing on payments, distribution criteria, payees, receiving comments, concerns, and feedback.
b. Biocarbon ERP distribution committee, in charge of compliance and verification of distribution criteria

**(iii) Prior Consultation**

This refers to the fundamental right of ethnic groups to be able to decide on actions, projects, works or activities that affect the dynamics of their territories, thus seeking to protect their cultural, social, and economic integrity and guarantee the right to participation. Therefore, through the Directorate of the National Authority for Prior Consultation of the Ministry of the Interior, a procedure has been established to determine whether or not actions with ethnic groups require prior consultation.

Once the Government of Colombia and the World Bank formalize the start of the Biocarbon ERP and in guarantee of the fundamental inalienable right, existing in favor of the ethnic communities, which

[95] Free, prior and informed consent (FPIC) is a development of the right to consultation that assists indigenous groups and ethnic communities, a principle through which they have the right to give or withhold their consent regarding the measure, action or project that affects them directly or indirectly, in their ways of life, governance, cultural traditions, territory or natural resources associated with their living environment. Therefore, FPIC is an essential right of indigenous groups, recognized by the norms of International Public Law, by the Political Constitution of Colombia, and other legal norms associated with indigenous peoples and ethnic groups. In this sense, the Environmental and Social Standards related to Indigenous Groups, (EAS7) of the World Bank, recognizes the protection and fulfillment of this right of indigenous groups.

has the purpose of protecting these communities, and proceeds before the occurrence of measures, norms, policies, plans, programs, projects, etc., that affect them or may affect them, either positively or negatively; the procedure that the Directorate of the National Authority for Prior Consultation of the Ministry of the Interior has established will be initiated and is summarized below:

1. Determine impact on Indigenous Groups

2. Request to the Technical Sub-Directorate of the Directorate of the National Authority for Prior Consultation of the Ministry of the Interior the Process of Determination of Propriety and Opportunity of Prior Consultation in accordance with the criterion of direct impact, based on the legal, cartographic, geographic or spatial studies required, as established in the national regulatory framework, in addition to the additional or complementary actions required to comply with the requirements of the ESS 7.

3. To make a request before the Ministry of the Interior, filling out the requirements established in the request form to determine the origin of the prior consultation, foreseen by this entity for such purpose:

    a. Applicant's data.
    b. General information about the project, work or activity.
    c. Administrative authority requesting the procedure.
    d. According to the response, the coordination and preparation of the prior consultation process proceeds, in accordance with the consultation route for the Biocarbon Orinoquia ERP and in a consensual manner with the IPs.

If the prior consultation proceeds, the following steps must be taken:

1. Certification: a request is made to the Directorate of Prior Consultation. The directorate issues a concept, based on the databases, then makes a visit with the applicant, authorities and issues a geographic and spatial concept.

2. Management: If it is determined that ethnic groups are present, and to the extent required by the activity, the initiation of the Prior Consultation must be requested. The Prior Consultation, on the other hand, follows the following work path: coordination and preparation; pre-consultation; consultation; follow-up and closure.

Each Prior Consultation process has a different dynamic, therefore, for its development there is not a unique procedure and result, nor a determined time, which makes it a continuously changing process in, which implies the rethinking of strategies to strengthen the relationship between the Biocarbono Orinoquia ERP and the communities.

### 3.2.1 DISSEMINATION OF BIOCARBON ORINOQUIA ERP INFORMATION

The dissemination process is present in each of the actions and is carried out through various means of dissemination, taking into account the cultural, logistical and socioeconomic particularities of each stakeholder. Different methods and/or tools are used to disseminate information through various media channels for disseminating information on the participation plan and the other topics associated with the ERP Biocarbon. These include the website of the Orinoquia Biocarbon Project (https://biocarbono.org), email (sent to mailings of participants in each of the spaces), social media accounts of the Project (Facebook[96], Instagram[97]), printed material, local media, mass media, including the PQRSD attention mechanism (Table 13).

Table 3 Guidance for communication, preparation and definition of the Biocarbon ERP

| Process | Stakeholder/s | Mechanisim/ Procedure | Moment | Information to disclose / By Means |
|---|---|---|---|---|
| **Planning** | Identification of the relevant parties, including the groups identified | Publication of the consultation plan on the project website. | Publication of the consultation plan. Publication of PQRSD Mechanism. | Publication on the project website https://BioCarbono.or |
| **Collaborative development with the different stakeholders** | Relevant parties including identified groups | At least one (1) focused consultation with each party or group (as defined).<br>Delivery of material<br>Form to receive comments/concerns. | Presentation and consultation of the Biocarbon Orinoquia ERP.<br>Consultation on key issues for the Biocarbon Orinoquia ERP<br>Key issues:<br>Selection of the Program area / Vision, design and expected results of the Program / Actions and Interventions to be developed / Financing plan for the implementation of planned actions and interventions / GA&S safeguards / PQRSD mechanism / Benefit sharing and benefit sharing agreements / Non-carbon benefits or co-benefits / Participation in the framework of other GHG initiatives / GHG inventory / Emission baseline | Information and dissemination material (printed material).<br>Publications on the project's web page https://BioCarbono.org and/or in local media and/or mass media.<br>Invitation to participate in consultation spaces.<br>Biocarbon ERP.<br>Information by topic.<br>Report of each consultation space developed. |

96 https://www.facebook.com/biocarbono/
97 https://instagram.com/biocarbono?igshid=YmMyMTA2M2Y=

| Process | Stakeholder/s | Mechanisim/ Procedure | Moment | Information to disclose / By Means |
|---|---|---|---|---|
| | | | for ISFL accounting / Monitoring and determination of emission reductions. Presentation and socialization of the final version of the Biocarbon Orinoquia ERP (to be carried out once the adjustments of the external audit and the approval of the Steering Committee have been made). | |
| **Participatory construction with ethnic groups** | Relevant parties including identified groups | Procedure defined in the Indigenous Groups Participation Framework (IPPM).<br>At least one focused consultation with each party or group (as defined).<br>Delivery of material<br>Form for receiving comments/concerns | Issues defined in MPPI<br>Benefit Sharing Plan (in its different stages: Draft, Final Plan) | Information and dissemination material (printed material).<br>Publications on the project's web page https://BioCarbono.org and/or in local media and/or mass media.<br>Invitation to participate in consultation spaces.<br>Biocarbon ERP.<br>Information by topic.<br>Benefit distribution plan.<br>Report of each consultation space developed. |

For the case of consultation with associated and/or identified issues for ethnic communities:

- Disclosure will include a strategy for the participation and involvement of traditional authorities and/or indigenous organizations, which will jointly agree on the most culturally appropriate tools, methodologies and means of communication (written, printed, digital, technological, etc.) for the process, including the PQRSD complaints and claims mechanism that can be used by indigenous groups and local communities.

- Facilitation of feedback on the process through local media identified in the territory (radio spots, local television) and/or information and communication technologies with traditional authorities and/or representative indigenous organizations in the area. There is also a mechanism for petitions, complaints and claims that can be used by indigenous groups and local communities.

In the implementation pashe of the BioCarbon ERP, disclosure will be carried out in the same way as in the definition and construction phases (described above), using various means to reach all interested parties and thus allowing access to information in a permanent, accurate, timely, understandable, and transparent manner.

Disclosure will emphasize the criteria for participation in the Biocarbon ERP, the benefits of participating, the distribution of benefits, the particularities for the different beneficiaries and the PQRSD mechanism as a tool that the Biocarbon ERP has to allow all interested parties to express themselves and receive a response in a timely and informative manner.

## 3.3. NON-CARBON BENEFITS

The resolution of environmental problems related to climate change brings direct and indirect benefits resulting from its mitigation and/or adaptation, these multiple benefits or co-benefits can be strategic co-benefits, collateral benefits, secondary benefits, auxiliary benefits, complementary benefits, co-effects, positive side effects and/or auxiliary effects, all these qualifiers comprising the Non-Carbon Benefits, hereinafter referred to as NCBs, which emerge, become visible, identified, valued, validated and promoted as a result of the prioritization and implementation of international agreements that materialize in actions included or integrated in national and specific regional policies that governments advance in order to adapt to climate change, These benefits emerge, become visible, identify, value, validate and promote as a result of the prioritization and implementation of international agreements that materialize in actions inscribed or integrated in national and specific regional policies carried out by governments in order to adapt environmental conditions, mitigate the impacts and effects of climate change, specifically GHG, thus expanding the spectrum of environmental goods and services in terms of their quantity, quality and diversity available to the population and that contribute to their wellbeing.

The Biocarbon ERP through the implementation of its measures will inherently provide environmental, socioeconomic and governance benefits beyond reducing emissions of carbon sequestration, the mitigation of environmental, social and cultural risks, which influence the improvement of local life, build effective governance structures and improve the conservation of ecosystem services.

The identification of potential NCBs resulting from the implementation of the Biocarbon ERP measures began with the analysis of International, National and Regional policies, plans and programs with information related to adjacent benefits; then the methodology to identify the benefits of the ISFL Emissions Reduction Program was selected, each of the measures was analyzed by means of an adaptation to the *FAO-Forests of the world*[98] methodology and finally the potential NCBs were selected.

The Biocarbon ERP measures were analyzed by recognizing the activities in the implementation of each of the actions that generate NCBs, these NCBs then impact ecosystem services, promoting wellbeing in the populations, Figure 14.

[98] Adapted from "Forests of the World & FAO. 2020-I. Defining Non Carbon Benefits" which can be consulted in the bibliography at this link https://www.forestsoftheworld.org/files/Working%20Paper%202020-1.pdf

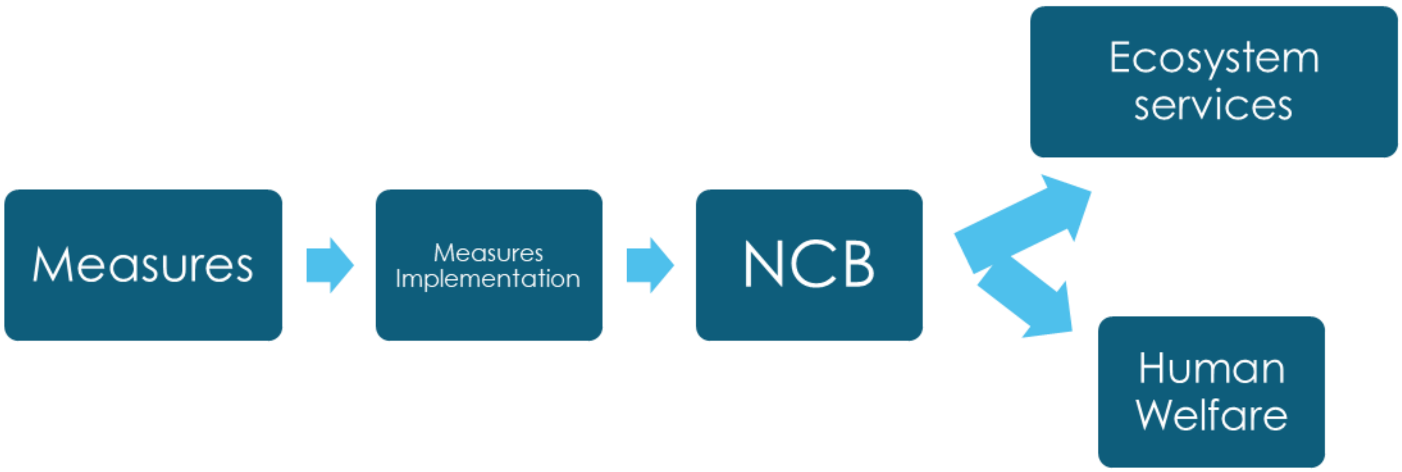


Figure 4 Process for NCB identification.

### 3.3.1. DESCRIPTION OF THE NON-CARBON BENEFITS OF BIOCARBON ERP

The selection of potential co-benefits from the implementation of the Biocarbon ERP resulted in four (4) NCBs which are described below:

- **NCB 01. FOOD SAFETY**

Food security resulting from the management and diversification of crops adapted to local conditions promotes the variety, quality and permanent food supply of communities; this agrobiodiversity provides, in addition to a varied diet, better nutrition and reduces the risk of crop pests. Encouraging good agricultural practices in traditional production systems and the implementation of agroforestry arrangements contributes to recovering food security and improving soil quality. At the same time, it strengthens the capacities of local producers on associative schemes that promote food and nutritional security, as well as the conversion of previously intervened areas to crops such as cocoa and explore alternative species such as marañón among others for their establishment. It also strenghents monitoring and traceability in agroforestry systems and low carbon practices; where growers produce, distribute and consume healthy food, thus defining their own food and agricultural systems without depending on market demands, in line with the IPCC's call to radically change these systems, prioritizing the producer as the central axis.

- **NCB 02. GOVERNANCE**

The empowerment of individuals and communities involved in climate change adaptation and mitigation activities, contributing more effectively with their own and new knowledge, is beneficial at both the local and regional levels; Therefore, research in the development of new technological packages and the transfer of this information on topics such as tolerant rice varieties, strategies for the use of varieties according to zoning by aptitude, the characterization and evaluation of practices such as water management, efficient fertilization, crop residue management, minimum tillage and sustainable and low-carbon production models, integration of cocoa cultivation in agroforestry arrangements (SAF) under PES schemes; with strategies that allow the appropriation of this information and knowledge strengthens and empowers the community. In addition to participatory planning for the definition of restoration areas and associated land uses and all sustainable management practices such as the inclusion of agroforestry and silvopastoral systems, regeneration of areas degraded by cattle ranching as well as cattle and harvest waste management, social control and sociocultural forest management, dissemination and transparency on the sources of investment aimed at preventing deforestation and promoting sustainable forest management are activities that will generate a barrier by putting into practice the knowledge on sustainable management with tangible results in their own productive units and in forest conservation, activities from which they will generate green enterprises based on extension strategy and forestry technical assistance, aimed at community strengthening. Finally, it is important to take into account the processes of participatory community monitoring, which articulates the national monitoring systems for access to information on local initiatives, the adjustment and updating of planning and land management instruments with emphasis on the relationship between climate change mitigation and land tenure.

- **NCB 03. RECOVERY AND REHABILITATION OF DEGRADED AREAS**

This secondary benefit focuses on the recovery and increase of vegetation cover through the implementation of the Participatory Land Use Planning (PPP) strategy in search of sustainable livestock production with the establishment of arrangements with native species to capture $CO_2$, rehabilitation of ecosystems with dendro energetic forest species on a local scale, technical, economic and environmental articulation for the establishment and sustainable production of forest plantations that include landscape management practices and good agricultural practices. The substitution and restoration of cover in unsuitable areas such as water strips and wetlands, among others, the change of use of areas occupied by low fertility grasslands and/or that have been degraded mainly by cattle ranching; reconversion of agricultural production areas, previously subject to inadequate management due to extensive cattle ranching, to productive units of agricultural tree species such as cocoa, rubber and/or forest crops for timber purposes. Promotion of research and the establishment of native species in accordance with the studies of aptitude and forest management of the territory for each sub-region of the Orinoquia, the increase of local biodiversity, their role as biological corridors and their integration into productive systems and models, encouraging climate regulation with historical, cultural, cosmogonic values, foreseeing in an integrated manner with economic alternatives such as beekeeping, agroforestry crops and non-timber forest products. The establishment of community nurseries and the planting of tree species for efficient use as firewood in rural households. Actions for the protection of areas, the expansion and improvement of existing areas, consolidating the processes of ecological restoration of the Andean Forest adjacent to piedmont watersheds, other forested areas, natural savannahs and wetlands, leading to the creation of biological corridors for connectivity at the landscape scale.

At the same time, the integration of plantations with fast-growing wood energy species offers the opportunity to use less firewood to obtain the same amount of energy, so it is necessary to strengthen the capacity of communities for the installation, management, and maintenance of the stoves.

- **NCB 04. AREA CONSERVATION**

The conservation of natural forests provides long-term livelihoods for the species that inhabit them by strengthening the protection of natural forests, reducing the likelihood of forest conversion to commercial uses, which directly affects the reduction of GHGs and contributes to adaptation. The use of PES for forest conservation is a productive alternative in undisturbed or relatively undisturbed areas, improving the participation and capacities of the communities through a conservation model based on the sustainable production of food crops. The planting of native trees provides connectivity of the forest cover, and the integration of plantations with fast-growing wood energy species prevents forest degradation by reducing the use of firewood in rural households. The consolidation of ecological restoration processes of the Andean forest adjacent to foothills watersheds, other forested areas, natural savannahs and wetlands, leading to the creation of biological corridors for connectivity at the landscape scale. Regarding silvopastoral and agroforestry arrangements, the aim is to increase the areas with sustainable management practices that promote the conservation or recovery of forests for the establishment of connectivity corridors and in accordance with the different ecosystems of the region. Another measure with a profound impact on forest conservation is the disclosure and transparency of investment sources aimed at preventing deforestation and promoting sustainable forest management, as well as the need to jointly agree (with communities and territorial entities) which areas, due to their environmental qualities, contribute to mitigate and regulate processes related to climate change. This will make it possible to advance coordinated processes and improve decision-making to protect and manage these spaces in a differential and sustainable manner, and to agree on areas where restoration and reconversion are required, providing the necessary elements to define the departmental, municipal or landscape-level agricultural and livestock frontier.

Interventions for the control of deforestation and sustainable forest management will be carried out through conservation and zero deforestation agreements that will be signed, which will generate schemes for monitoring the effectiveness and follow-up at the national, regional and local levels of the actions.

### 3.3.2. MONITORING AND FOLLOW-UP OF THE BIOCARBON ERP NCBs

4. The follow-up and monitoring of the Biocarbon ERP NCBs will be carried out through the indicators in Table 14.

Table 4. NCB and indicators

| Indicator's name | Definition/ Description | Frequency | Source of data | Data collection methodology | Responsibility for data collection |
|---|---|---|---|---|---|
| Food safety | Number of families that include food security actions associated with forestry, agroforestry and silvopastoral activities from the implementation of the Biocarbon ERP | Annual | Projects for the implementation of GHG reduction measures and project monitoring report | In formulating and executing projects for the implementation of reduction measures, food security actions are defined as follows | UIPRE and implementing entities |
| Governance at national, regional or local level | Number of people trained in government institutions, grassroots organizations, people involved in organizations engaged in income-generating activities related to forestry and/or agricultural activities that receive benefits from ERPA | Annual | Project monitoring reports for the implementation of GHG reduction measures. | Registration and systematization of the people trained in the spaces developed by each training project. | UIPRE and implementing entities |
| Reclamation and rehabilitation of degraded areas for protection and/or commercial purposes. | Areas restored, rehabilitated and/or recovered as a result of the implementation of GHG reduction measures of the Biocarbon ERP. | Biannual | Project monitoring reports for the implementation of GHG reduction measures. | Ratio of restored, rehabilitated and/or recovered areas in relation to projected growth trends. | UIPRE, National Entities, Implementing Entities (regional and local) |
| Conservation of natural forests, key ecosystems and environmentally important sites | Areas conserved or protected through zero deforestation agreements | Annual | Project information | Systematization of information on zero deforestation agreements and conservation agreements, corresponding to forest land remaining forest land. | UIPRE and implementing entities |

## 3.4 FEEDBACK AND COMPLAINT MECHANISM

THe Biocarbon ERP has a Grievance Redress and Feedback Mechanism (GRM) that promotes the participation of the different stakeholders that are part of its area and allows for proper management of Petitions, Complaints, Claims, Suggestions, Complaints and possible conflicts (PCCRD). The mechanism is supported by the technological resources of Agriculture, an entity that has its own mechanism; the mechanism complies with the guidelines of the ISFL's methodological framework, the WB's ESS 10. The mechanism for the Biocarbon ERP has all the procedures, protocols and response times that must be applied with all interested parties, in order to guarantee a comprehensive service in personal, telephone and virtual attention. Similarly, the mechanism seeks to serve as a learning tool to generate continuous improvement plans to achieve the objectives of the Biocarbon ERP.

The PCCRD (PQRSD) mechanism was put in place to address PCCRD during the design and preparation phase of the Biocarbon ERP, and will continue to operate during the implementation of the Biocarbon ERP; it is dynamic in that it is subject to continuous improvement as the preparation and subsequent implementation of the Biocarbon ERP progresses.

The PCCRD procedure has the following main characteristics: (i) it has a wide variety of reception channels, which are and will continue to be disseminated among all stakeholders (Figure 15); (ii) it clearly incorporates the procedure for handling PQRSD filed by citizens, including the anonymous option, as well as the deadlines for providing responses to stakeholders, respecting confidentiality when necessary, in accordance with the provisions of the constitutional and legal standards in force, and in line with the World Bank's operational policies (Figure 16); iii) It has a monitoring system to evaluate the functioning of the mechanism and take actions for continuous improvement as appropriate.

The procedure begins when the interested party submits a PCCRD through any of the reception channels established by the Biocarbon ERP. Once the PCCRD has been received, it is filed in the document management system of Agriculture, the entity executing the Biocarbon ERP. Next, the classification process is carried out; the PCCRD that enter the co-executing entities (MADS, IDEAM and UPRA) of the Biocarbon ERP are classified according to the type of request and are transferred to Agriculture. Subsequently, a response or transfer is made according to competence, if necessary, by verifying the competence to respond to the PCCRD. The head of the competent unit assigns, by e-mail, the person responsible for analyzing the PCCRD and drafting the response; a copy of the e-mail designation is sent to the environmental and social management specialists for follow-up. The projected response must lead to a solution, or at least to the clarification of what was requested in the response. In addition, the response should be timely, accurate and relevant. Once the response has been drafted and reviewed, it is filed in the system and sent to the petitioner; the PCCRD is closed when the response is sent to the petitioner.

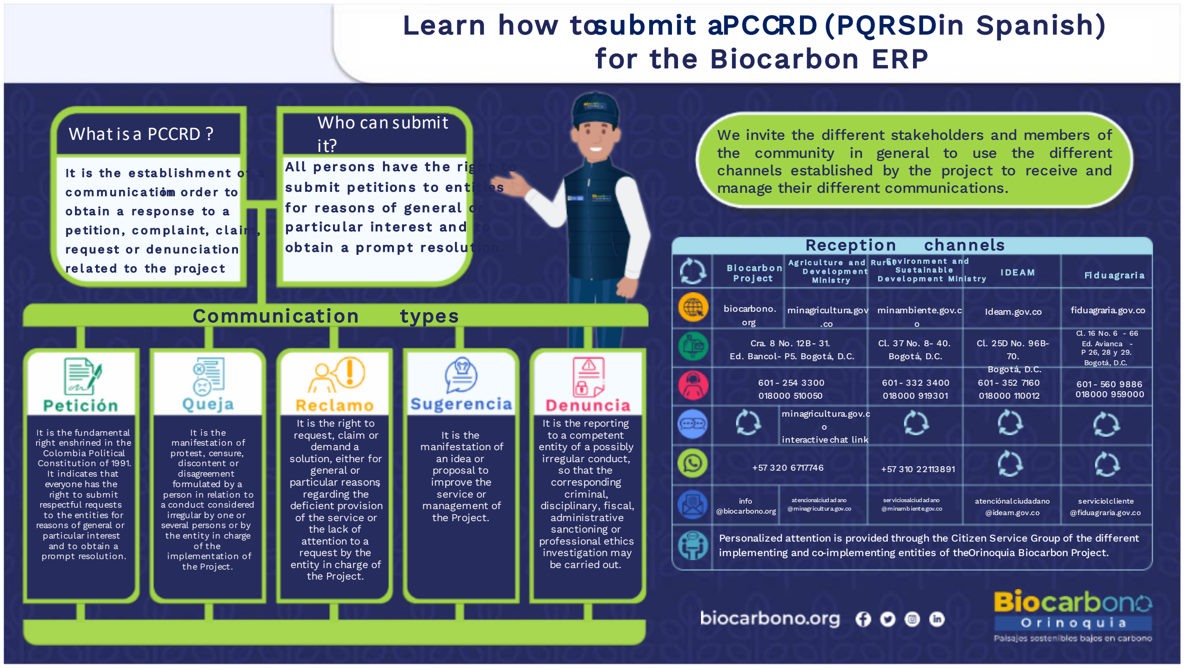


Figure 5 Infographic on how to submit a PCCRD to the Biocarbon ERP.

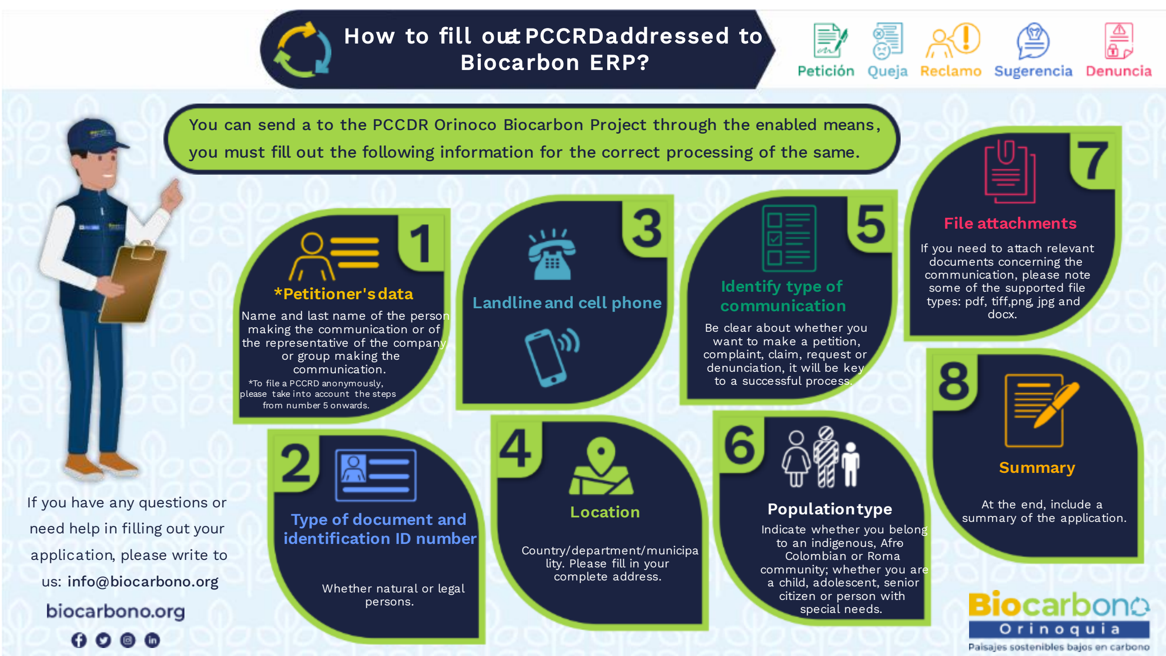


Figure 6 Infographic on how to fill out a PCCRD before the Biocarbon ERP.

As mentioned above, the mechanism for the communication process complies with the response terms established by Colombian law and which are used for each type of request (Table 15).

Table 5 Response terms established by Colombian law for each type of request.

| TYPE OF APPLICATION | WORK DAYS | DOMESTIC REGULATIONS |
|---|---|---|
| **Consultations and External Concepts** | 30 | Law 1755 June 30, 2015 Art. 14<br>Resolution 390 of November 28, 2019 |
| **Right of petition between entities** | 10 | Law 1755 June 30, 2015 Art. 14<br>Decree 103 January 20, 2015 Art. 19<br>Resolution 390 of November 28, 2019 |
| **Written Right of Petition**<br>**Verbal Right of Petition**<br>**Interest (general or particular)** | 15 | Law 1755 June 30, 2015 Art. 14<br>Decree 103 January 20, 2015 Art. 19<br>Law 1437 January 18, 2011 Art 4 and 5<br>Decree 1166 June 19, 2016<br>Resolution 390 of November 28, 2019 |
| **Petition filed by displaced population, victims of armed conflict** | 10 | Sentence T-025 January 22, 204 ordinal 10<br>Law 1448 June 10, 2011<br>Resolution 390 of November 28, 2019 |
| **Complaints, Denunciations and Claims** | 15 | Law 1437 of January 18, 2011 Art 7 and 13<br>Law 1755 June 30, 2015 Art. 13<br>Law 1952 January 18, 2019. Art 38 Numeral 35 |
| **Request for informative documents from Legislative Chambers and their Committees** | 10 | Law 5 June 17, 1992 Art 260<br>Resolution 390 of November 28, 2019 |
| **Request for information and/or copy of documents** | 10 | Law 1755 June 30, 2015 Art. 14<br>Decree 103 January 20, 2015<br>Resolution 390 of November 28, 2019 |
| **Request for access to Public Information (classified and reserved)** | 10 | Decree 103 January 20, 2015 Art. 16, 17, 18, 19<br>Law 1581 October 17, 2012 Art. 14, 15<br>Law 1712 March 6, 2014<br>Decree 1377 June 27, 2013<br>Resolution 390 November 28, 2019 |
| **Request for Information on Personal Data (Habeas Data) - Consultation** | 10 | Decree 103 January 20, 2015<br>Law 1581 October 17 de2012 Art 8, 14<br>Law 1266 December 31, 2008 Art 16 Item I<br>Resolution 390 of November 28, 2019 |

| | | |
|---|---|---|
| **Request for information regarding personal data (Habeas Data) - Claim** | 15 | Decree 103 January 20, 2015<br>Law 1581 October 17 de2012 Art 8, 15<br>Law 1266 December 31, 2008 Art 16 Item II<br>Resolution 390 of November 28, 2019 |
| **Pension Information Request** | 15 | Presidential Directive No. 4 May 22, 2009<br>Resolution 390 of November 28, 2019 |
| **Request for Information by Members of Congress** | 5 | Law 5 June 17, 1992 Art. 258<br>Resolution 390 of November 28, 2019 |
| **Request from the Ombudsman's Offices** | 5 | Law 24 of 1992 Art. 15<br>Resolution 390 of November 28, 2019 |
| **Request for control agencies (Comptroller General's Office, Attorney General's Office, Ombudsman's Office and Congress of the Republic).** | 10 | If not indicated in the communication, they will be resolved in accordance with Law 1755 of 2015 Art. 30.<br>Resolution 390 of November 28, 2019 |
| **Suggestions** | 15 | Law 1474 June 12, 2011 Art.76<br>Resolution 390 of November 28, 2019 |
| **Transfer to other Entities due to non-competition** | 5 | Law 1755 June 30, 2015 Art. 21<br>Resolution 390 of November 28, 2019 |

For the attention of PQRSD filed by indigenous groups, the mechanism also includes what is determined in Decree 1166 of 2016, in its article 2.2.3.12.9 [99] corresponding with "verbal requests in another native language or official dialect of Colombia". Likewise, the Biocarbon ERP in the community spaces carried out clarifies that PQRSD can be received, for which there are particular moments and times culturally adapted and with special emphasis on vulnerable groups, in which the form for receiving concerns and opinions is diligently filled out, for the filling out of the form people who have any difficulty will receive help, likewise, if necessary, a translator is available to facilitate the filling out of the form for people who do not speak Spanish. It is always made clear to the public that the PQRSD can be made anonymously.

Finally, for the PQRSD received, compliance with the terms of response time is monitored and bi-annual reports are sent to the BM on their status, which include the number of PQRSD received in the period, classification by type (Petition, Complaint, Claim, Suggestion, Complaint, and possible conflict) and level of timeliness in the response through statistical analysis. Likewise, satisfaction

[99] "Persons who speak a native language, or an official dialect of Colombia may submit oral petitions to any authority in their language or dialect. The authorities shall enable the respective mechanisms that guarantee the presentation, record and filing of such petitions. When the entities do not have interpreters in their staff to directly translate the petition, they shall leave a record of that fact and record the right of petition in any technological or electronic means, in order to proceed with its subsequent translation and response. "

with the responses in terms of timeliness and comprehensive attention to the PQRSD is measured by means of a satisfaction survey, whose sample is random.

### 3.4.1 DISCLOSURE OF THE FEEDBACK MECHANISM

During the design phase of the Biocarbon ERP, the dissemination of the PQRSD mechanism was carried out with the process of socialization, presentation and feedback of the ERP Biocarbon, planned with each of the stakeholders. Likewise, dissemination was done through various means and taking into account the cultural, logistical and socioeconomic particularities of each stakeholder and/or beneficiary. Different methods and/or tools are used to disseminate information locally, regionally and nationally; channels for dissemination of the mechanism include project website https://BioCarbono.org, social media networks, printed material, local media and/or mass media.

In the case of indigenous communities, the dissemination process for the mechanism includes a strategy for the participation and involvement of traditional authorities and/or indigenous organizations, through the most culturally appropriate tools, methodologies and media (written, printed, digital, technological, etc.) for the process, and agreed with these stakeholders.

The dissemination of the PQRSD mechanism will continue in the implementation process of the Biocarbon ERP as a tool to allow all interested parties to express themselves and receive a response in a timely manner, using the different methods and/or tools to disseminate information used in the design of the Biocarbon ERP and adjusted if necessary.

## 3.5 LAND AND RESOURCE TENURE IN THE ZONE OF THE BIOCARBON ORINOQUIA ERP[100]

Land tenure in Colombia is an essential element in the agrarian structure and has an important impact on the development of the sector. The concept of "land tenure" refers to the relationship of people, individually or collectively, with respect to the possession or ownership of land, its organization and governance in the territory and its relationship and interaction with the factors of production. Article 58 of the Political Constitution of Colombia provides that private property and other rights acquired in accordance with civil laws are guaranteed; property also has a social and ecological function that entails obligations.[101].

[100] See Annex III.docx for more information

[101] Article 58 Political Constitution of Colombia: Private property and other acquired rights are guaranteed in accordance with civil laws, which may not be ignored or violated by subsequent laws. When the application of a law issued for reasons of public utility or social interest results in conflict between the rights of individuals and the need recognized by it, the private interest must yield to the public or social interest.
Property is a social function that implies obligations. As such, it has an inherent ecological function.
(...)

### 3.5.1 DESCRIPTION OF LAND TENURE AND RESOURCES IN ERP AREA

The analysis of land tenure, its relationship with the range of rights and interaction in the Orinoquia region was based on the processing of secondary information mainly from the cadastral records of the properties; The UPRA methodology for the analysis of rural property was applied and complemented with information from the National Agricultural Census (DANE 2014)[102] and the National Agricultural Survey (DANE 2019) [103], in order to establish the relationship between tenure conditions in the region and the main land uses, and to determine how this interaction can contribute to or limit the implementation of the ERP.

The Biocarbon ERP is formulated for the jurisdiction of the Departments of Arauca, Casanare, Meta and Vichada. Indigenous reserves are located in 18% of the regional territory, although they are mostly represented in Vichada, where they occupy 38% of the departmental area. Environmental entities, including natural parks, paramos, wetlands, the Macarena special management area (AMEM) and forest reserve zones, among others, represent 23% of the territory, with special importance in the department of Meta, where they account for 41% of the regional area. The Orinoquia has 317.395 parcels with catastral information These properties encompass 21.865.822 hectares (~ 86% of the ERP area) where the largest share in area corresponds to the departments of Vichada and Meta, with a proportion of 39% and 29,9%, respectively, while the departments of Casanare and Arauca represent 20% and 11%. On the other hand, it was identified that Meta has the largest number of owners, with 59,2% of the regional total and, in contrast, Vichada only has 2,8% of owners.

The main economic use of the land in the region is agriculture and livestock, with about 95,8% of the regional area. The most important landowners are private owners, who account for about 60% of the area, while the State and collective properties represent about 20% each. It was also evident that the Orinoquia is a region characterized by strong asymmetries, insofar as there are few owners with large properties and a majority of owners with small areas; properties larger than 10.000 ha account for 23% of the area, distributed among 0,5% of owners, while 25,3% of owners are located in properties of up to 0,5 ha, which represent about 0,1% of the total area. The behavior of the departmental Gini index corroborates this behavior. The departments of Arauca, Meta and Casanare present high inequality, with indexes of 0,81, 0,83 and 0,87, respectively, while Vichada presents a more equal result, with 0,53 (medium level of inequality) [104]. The informality indicator[105], which made it possible to estimate, identify and delimit areas with possible presence of informality in land

[102] https://www.dane.gov.co/index.php/estadisticas-por-tema/agropecuario/censo-nacional-agropecuario-2014.
[103] https://www.dane.gov.co/index.php/estadisticas-por-tema/agropecuario/encuesta-nacional-agropecuaria-ena.
[104] The classification of inequality is based on the delimitation established by UPRA in the document https://www.upra.gov.co/documents/10184/236767/Analisis_Dist_Prop_Rural_2017.pdf.
[105] For more details on the informality indicator, see https://www.upra.gov.co/documents/10184/13821/%C3%8Dndice_informalidad.

tenure at the property level in the Orinoquia, shows that about 46% of the properties are presumed to be informal.

Finally, other possible factors associated with tenure in the Orinoquia that should be considered for the implementation of the ERP are the presumption of vacant land (approximately 26% of the land in the region), the existence of collective territories, especially in Vichada, and the presence of land management figures (jurisdiction and environmental management figures, ethnic management figures, mainly indigenous, indigenous reserves, municipalities, departments, and other figures of social property management), associated with territories outside the agricultural frontier, among others.

All matters related to the construction, feedback, and design of the PRE, including the analysis of land tenure distribution, were carried out through a participatory process that constituted an inclusive, and transparent consultation; with active participation from stakeholders, including indigenous peoples and local communities (IPLC), local associations and ethnic groups, among others (see further details in section 3.2). Contributions from stakeholders highlighted that land tenure is informal for 43% of landholders, which was considered in the analysis of Rural Land Distribution and Tenure in the Orinoco region (see section 3.5.2 and Annex III). It also became clear that there are parts of the ERP area that are subjected to significant conflicts or disputes related competing ownership claims among property owners, possessors, and occupants; with overlapping land tenure types as well as urban expansion, disposed and forcefully displaced peoples (section 3.5.2).

Considering this, stakeholders emphasized the need for regulation and understanding the nation's vacant land (Presumption of Vacant Land) and the need to work more intensively and in a decentralized manner in land regularization processes through the National Land Agency - ANT, the entity responsible for this task.

Therefore, the PRE Biocarbon identified the National Land Agency - ANT as the implementing entity (see section 2.2.3); as program beneficiary within the framework of the Benefits Distribution Plan (see section 3.6.1). Additionally, in the current phase, the Orinoco Biocarbon Project, in collaboration with ANT, developed a pilot project for land regularization with environmental criteria, which is expected to be replicated within the framework of the PRE Biocarbon implementation.

Finally, it is essential to underline that the challenges related with potential conflicts in land tenure and use must be addressed on a case-by-case basis to determine the relevance or impossibility of developing agreements and sub-agreements related to the PRE implementation on properties that fall under any of these conditions. In this process, close community participation, in conjunction with comprehensive intervention by the executing and co-executing entities, will be crucial to identify and/or resolve potential conflicts that may arise during the PRE implementation (section 3.5.2).

#### 3.5.1.1. RANGE OF LAND RIGHTS AND TENURE REGIMES

The Colombian legal system contemplates a formality for purposes of the sale and registration of real estate (Title and Mode). In the same way, tenure relations can be grouped into three large blocks, without this constituting an absolute characterization. The first block is associated with individual land tenure, which groups together owners, tenants, occupants, improvers, possessors, etc., each of whom has a defined relationship of rights. Another block is composed of collective territories (e.g., Indigenous Reserves). Finally, a third block is made up of real estate that has a property relationship with the State (e.g., vacant properties, fiscal properties).

Likewise, the different land use planning figures that exist in the territory are also considered, since their existence and extension could be taken into account either because of their potential use or because of special legislation for project development (Table 16).

Table 6 Management figures identified in the Orinoquia ERP area.

| Figure Arrangement | | Arauca (ha) | Casanare (ha) | Meta (ha) | Vichada (ha) | Total area Figure |
|---|---|---|---|---|---|---|
| Environmental Figures | | 1.037.083 | 242.436 | 5.846.820 | 2.035.644 | 9.161.983 |
| Figures of ethnic ordering | | 133.170 | 148.035 | 148.035 | 3.821.579 | 4.250.819 |
| Other OSP figures | PRZ[106] | 0 | 0 | 163 | 0 | 163 |
| | ZIDRES[107] | 0 | 0 | 174.961 | 0 | |
| | ZDE[108] | 0 | 0 | 0 | 0 | 0 |

##### 3.5.1.1.1 INDIVIDUAL HOLDING

With regards to individual tenancy relationships, the Colombian legal system contemplates the following:

- Owners (Art. 669 of the Colombian Civil Code).
- Holders (Mera tenencia Article 775 of the Civil Code).
- Possession (Article 762 of the Colombian Civil Code).
- Lessees (Article 1973 of the Civil Code).
- Lease (Article 2200 C.C.).

[106] Peasant Reserve Zone, area resulting from the cartographic cross-referencing of official layers.
[107] Zones of Rural, Economic and Social Development Interest, the related area corresponds to the Zidres delimited in the municipality of Puerto Lopez - Meta through CONPES 3940 of 2018. The national Zidres reference areas are mainly located in the area of interest of the project with 76% of them.
[108] Business Development Zones, there is no established area, however, according to the technical exercise developed by Upra, the project area has close to 10 million ha of Potential Adequate and Conditioned Areas for this type of figure.

- Financial lease (Decree 913 of 1993).
- Sharecropping (Law 6 of 1976).
- Rights of use (Law 902 of 2017).
- Occupants or those who learn of public property (e.g., vacant property).

#### 3.5.1.1.2 COLLECTIVE PROPERTY, INDIGENOUS TERRITORIES AND RESERVES

Colombian legislation distinguishes between indigenous territories and reserves. According to Article 2 of Decree 2164 of 1995, the former are the areas regularly and permanently possessed by an indigenous community, partiality, or group and those that, although not so possessed, constitute the scope of their traditional social, economic and cultural activities. For its part, the indigenous reservation is defined by Article 21 of Decree 2164 of 1995 as the collective property of the indigenous communities in favor of which they are constituted and in accordance with Articles 63 and 329 of the Political Constitution, they are inalienable, imprescriptible and unseizable. The reserves are a legal and socio-political institution of special character, formed by one or more indigenous communities, which with a collective property title that enjoys the guarantees of private property, own their territory and are governed for the management of this and its internal life by an autonomous organization protected by the indigenous jurisdiction and its own normative system. In the Orinoquia there are a total of 104 indigenous reserves with an area of approximately 4.3 million hectares.

##### 3.5.1.1.2.1. Law 70 of 1993. COLLECTIVE TERRITORIES.

Collective territories are territories that have been collectively owned by a black community in recognition of their historical, traditional, and ancestral settlement in the territory, on which they develop traditional production practices. They have the characteristic of containing great biological and environmental wealth. Like the reserves, they are inalienable, imprescriptible and unseizable. In the country they are regulated by Law 70 of 1993.

Recently, in the Orinoquia jurisdiction, in the Department of Arauca, the collective territory was constituted in favor of the Panama de Arauca Community Council by Resolution No. 20221000081486 of April 20, 2022.[109]

##### 3.5.1.1.2.2. FARMERS RESERVE ZONES.

The Peasant Reserve Zones, contemplated in Law 160 of 1994, as a constitutional ordinance figure, which help to plan the use of the territory, with the purpose of promoting the farmer economy,

[109] Collective Territory, recognized by the National Land Agency in April 2022, which is why they are not described in Anexo III which has information as of December 2021.

avoiding land grabbing, preserving the environment, containing agricultural expansion, their life plans and the right to access to land, among others.

These are geographic areas that consider the regional environmental, agroecological and socioeconomic characteristics for the territorial, economic, social and environmental management of the property, for the stabilization and consolidation of the farmer economy.

Article 80 of Law 160 of 1994 defines them as:

"... Peasant Reserve Zones are the geographic areas selected by the Board of Directors of INCORA, taking into account the regional agro-ecological and socioeconomic characteristics..."

"...In the Peasant Reserve Zones, the action of the State shall take into account, in addition to the above guiding principles, the rules and criteria on territorial environmental planning, the effectiveness of the social, economic and cultural rights of the peasants, their participation in the regional planning and decision-making bodies and the characteristics of the production modalities."

Recently, in the Orinoquia jurisdiction, the National Land Agency established the Güéjar-Cafre Peasant Reserve Zone in the department of Meta, located in the municipality of Puerto Rico, and the Losada-Guayabero CRZ, located in the municipalities of La Macarena and Uribe.[110]

#### 3.5.1.1.3 STATE ASSETS

The Political Constitution of 1991 included the concept that public assets that are part of the territory belong to the Nation. For its part, the Constitutional Court (Decision C595/95) has referred that the jurisprudence and doctrine have classified state property as follows:

- Fiscal assets, strictly speaking. They are those assets owned by public law entities and over which they exercise full dominion, that is, equal to that exercised by private individuals with respect to their own assets.

- Assets for public use. They are those destined for the common use of the inhabitants.

- Allocable fiscal assets. These are those assets held by the Nation for the purpose of transferring them to individuals who meet certain requirements established by law.

In this sense, it is important to point out that fiscal or patrimonial goods are those that belong to subjects of public law of any nature or order and that, in general, are destined to the fulfillment of

[110] Peasant Reserve Zones, recognized in December 2022 by the National Land Agency ANT, which is why they are not described in Annex III, which has information as of December 2021.

public functions or public services, such as land, buildings, farms, farms, equipment, fixtures, shares, income and budget goods, etc.; that is to say, they are assets assigned to the development of its mission and used for its activities, or that may constitute a patrimonial reserve for purposes of common utility. They are the property of the Republic, but their use does not generally belong to the inhabitants, so that the State owns and manages them in a similar way as private individuals do with their own property. These in turn may be subdivided into fiscal properties properly so called and awardable fiscal properties or brownfields; the latter correspond to the Nation's lands that may be adjudicated to persons who meet the conditions and requirements established in the legislation.

Within the range of fiscal properties are the brownfields, which have the characteristic of being awardable, of they are priorly occupated, and comply with the provisions of Law 160 of 1994. Article 675 of the Colombian Civil Code defines brownfields as all lands located within the territorial limits and lacking any other owner. The brownfields are the property of the Nation and are part of the awardable public use and fiscal goods. Their adjudication is currently carried out by the ANT, upon compliance with the requirements set forth in Law 160 of 1994; they are not subject to be acquired through acquisitive prescription, as stated in the Constitutional Court's ruling C595/1995.

As an indicative exercise, UPRA has established a presumption of vacant land, which requires a review of each of the identified properties to determine their legal nature as vacant land, as well as to establish their destination, since the marking may include State-owned properties for public use or fiscal properties for patrimonial purposes.[111].

In the development of the exercise, variables were established to determine the condition of presumed wasteland based on information from the cadastral and SNR databases, complemented with inventories of ANT management information, which makes it possible to determine the NO wasteland condition[112].

[111] Being an indicative exercise, it serves as a frame of reference, but it does not constitute an official document that determines with precision the Nation's land holdings in the Orinoquia.

[112] The variables to determine the presumption of brownfields are properties that in the cadastral base do not have a real estate registration, properties identified by name of owner as brownfield, properties identified as owner to INCODER/INCORA, properties identified as owner to departments, municipalities, governors, corregimientos and nation including, schools, hospitals, community action boards, public utilities companies, cemeteries and religious. excluding indigenous reservations, communities, INCO, INURBE, INVIAS and CAR properties, Properties with false SNR tradition: The properties reported by the SNR with a false tradition annotation are identified within the alphanumeric cadastral base. For this purpose, all the annotations reported by the SNR of false tradition that include the registry codes from 600 to 620 were taken, properties identified by SNR in reports (1 to 7) delivered to the Constitutional Court in compliance with the

As a result of the identification of the presumption of brownfields in the Orinoquia region, 26% of the properties are presumed to be vacant (Figure 17).

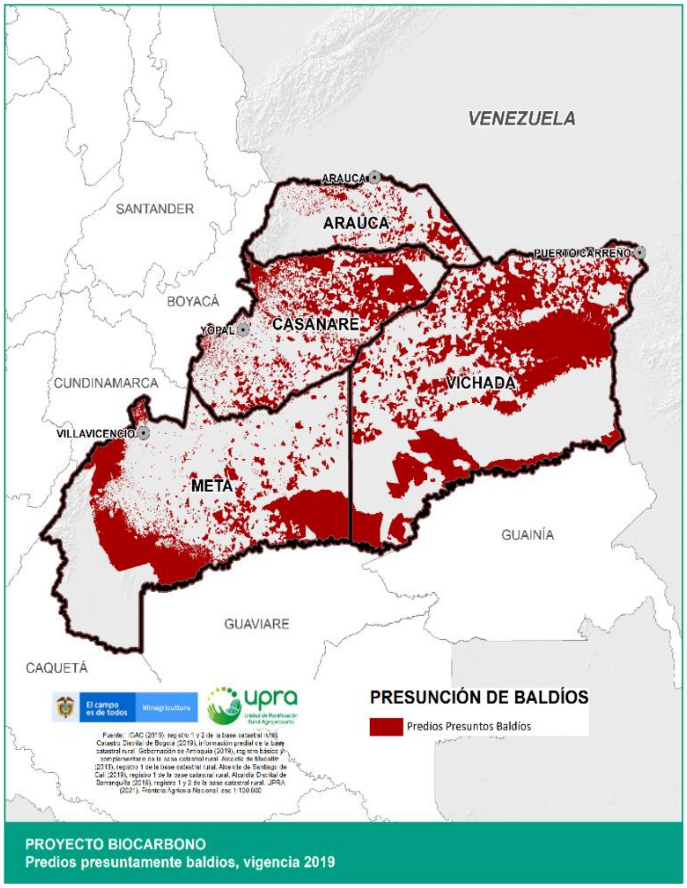


Figure 7 Presumed vacant properties identified in the Orinoquia ERP region.

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Seventh Order of Ruling T-488 of 2014 as presumed vacant land identifying within the alphanumeric cadastral base the properties reported by the SNR as presumed vacant land.

The variables to determine the NO presumption of brownfields are: Land adjudicated by INCODER (history of adjudications): The alphanumeric cadastral base identifies the adjudicated properties from the purged base as a result of the massive registration committee of brownfields, in cooperation with USAID, the properties that were found registered and those that were not registered during the exercise were taken, Properties of the national agrarian fund: The properties identified in the inventory of the national agrarian fund - FNA of INCODER are identified within the alphanumeric cadastral base.

#### 3.5.1.1.4 NATIONAL AND REGIONAL NATURAL PARKS

The Natural Resources Code (Decree 2811 of 1974) defines a National Natural Park (PNN) as the area of extension that allows its ecological self-regulation and whose ecosystems in general have not been substantially altered by human exploitation or occupation, and where the plant species of animals, geomorphological complexes and historical or cultural manifestations have national scientific, educational, aesthetic and recreational value and for their perpetuation are subject to an appropriate management regime; such park category. The Constitution states, among other things, that National Parks are inalienable, imprescriptible, and unseizable.

Specifically, the Orinoquia region has seven National Natural Parks PNN,[113], of which El Tuparro, Sierra de La Macarena and Tinigua are completely within the region, while Chingaza, Cordillera de los Picachos, El Cocuy and Sumapaz share jurisdiction with other departments, with Chingaza representing 26% of the park's total area. In addition, six (6) Regional Natural Parks (PNR) have been identified: Bosque de los Guayupes, Laguna de Lomalinda, Laguna de San Vicente, Siberia -Cuenca alta río las Ceibas, Páramo de las Oseras, Quebrada Honda and San Miguel de los Farallones, with an approximate area of 27.786 ha.

Additionally, it is important to mention other figures of the National Registry of Protected Areas - RUNAP administered by National Natural Parks present in the region such as: National Integrated Management Districts with 333,403 ha, Civil Society Natural Reserve with 157.793 ha, Regional Integrated Management Districts with 67.547 ha, National Protective Forest Reserves with 10.521 ha, Soil Conservation Districts with 294 ha and Recreation Areas with 278 ha.

#### 3.5.1.1.5 FOREST RESERVE ZONES

Within the range of rights associated with land tenure, there are also National Forest Reserve Zones NFRZ (ZRFN). The Forest Resources Code (Decree-Law 2811 of 1974) NFRZ defines a as an area of public or private property reserved exclusively for the establishment or maintenance and rational use of productive, protective, or producer-protective forest areas. Therefore, it corresponds to areas where forests must be conserved, whether they are uncultivated or privately owned, for the purpose of conserving water sources. As determined by the MADS, it includes public and private areas that are made up of those established by Law 2 of 1959 and the protective and protective-producing forest reserves. In the jurisdiction of the ERP area, ten (10) National Protected Forest Reserves have been identified in the departments of Arauca, Casanare and Meta: Cerro Vanguardia, Cuenca Alta del Caño Vanguardia, Cuenca Alta del Rio Satoca, Cuenca del Rio Tame, Cuenca Hidrográfica de la Quebrada la Tablona, Paramo El Atravesado, Quebrada Honda y Canos Parrado y

[113] In addition, a cartographic cross-referencing of the official layers shows a minimal participation of the Serranía de Chiribiquete and Pisba NNP with 0,003% and 1%, respectively.

Buque, Rio Rucio, Rios Blanco y Negro y Serrania La Lindosa - Angosturas II, covering an approximate area of 10.521 ha. There is also an area of the Forest Reserve Zones Law 2 of 1959 as follows: Category A (Cucuy and Amazonia) with approximately 36.147 ha in the departments of Arauca, Casanare and Vichada; Categories B, C and areas with previous management decision in the same departments with approximately 247.069 ha in the departments of Arauca, Casanare and Vichada.

#### 3.5.1.1.6 RURAL, ECONOMIC AND SOCIAL DEVELOPMENT INTEREST ZONES

Rural, Economic and Social Development Interest Zones (ZIDRES) correspond to special territories, suitable for agriculture, livestock, fishing, or forestry developments, far from urban centers, with low population density and limited infrastructure. The Colombian government has created these zones (Law 1776 of 2017) in order to develop comprehensive rural plans, strengthen environmental sustainability and promote the economic and social development of their inhabitants. Owners, bona fide occupants, and indigenous communities may be part of a ZIDRES if they so consent and express; persons whose property rights cannot be formalized may enter contracts that allow the use, enjoyment and disposition of the surface of the land. In the jurisdiction of the ERP area, one ZIDRES has been identified in the municipality of Puerto Lopez (Meta), which covers an approximate area of 174.961.

### 3.5.2 ANALYSIS OF LAND TENURE AND RESOURCE ASSESSMENT FOR THE DESIGN OF A LAND TENURE PLAN.

The Orinoquia has significant potential for ERP implementation, but also presents challenges due to the existence of possible land tenure conflicts associated with:

- Conflicts associated with inadequate land management and use, presenting a discrepancy between the use given to the land and the use it should have, in accordance with the environmental supply.
- Presence of illicit crops in some areas of the territory.
- Presence of irregular armed groups in the territory.
- Requests for the expansion of indigenous reserves or the creation of new reserves, which may generate tension with neighboring farmers communities and private landowners, possessors and landholders.
- High rates of informality (43%) in land tenure in the project's jurisdiction.
- Overlapping of different forms of tenure in the territory (e.g., occupants of the Nation's vacant properties). Development of agricultural or forestry activities in areas that are protected).
- Changes in land use from conservation or agricultural activities to other potentially deforesting uses.
- Pressure of urban uses on rural uses, generating a potential reduction in agricultural

production capacity in the territory.

Based on the results of the diagnostic, it is pertinent to affirm that the challenges associated with potential conflicts in land tenure and use should be addressed on a case-by-case basis to establish the relevance or impossibility of developing agreements and sub-agreements related to the implementation of the ERP in properties that are under any of these conditions. In this process, it will be very important to have close community participation, in association with an integral intervention of the executing and co-executing entities, in harmony and close collaboration with other state and private entities that can help identify and/or resolve potential conflicts that may arise in the implementation of the ERP.

The high inequity in land tenure in the region means that it is necessary to work harmoniously between the sector's entities and other institutions to regularize land tenure, supporting the development of actions that encourage the formalization of rural property, accompanied by a comprehensive sectoral policy that works to improve the living conditions of the region's rural inhabitants. This will be possible with a joint public-private action that allows access to markets and technical assistance, as well as the availability of educational, road, health, etc infrastructure. Likewise, it is important to support the efforts that allow the efficient implementation of the multipurpose cadastre and registry, as well as to continue working on the delimitation of the Nation's vacant lands. The foregoing implies that, from the ERP, taking into account the integral concept with which everything related to land tenure should be conceived, specific measures related to the reduction of deforestation and those associated with the planning and governance chain should be promoted.

Considering the range of existing rights in the territory, as well as the analysis of land tenure, the Biocarbon ERP framework, and in particular the Benefit Sharing Plan, will take into account measures and actions focused on all individuals and communities that have a land tenure relationship in the territory, this implies that the occupants, possessors, holders and other existing forms of tenure should be taken into account, having to carry out the concrete analysis of the measure to be implemented, according to the type of population, their characteristics, possibilities and other conditions that should be taken into account for their participation and that are incorporated in the Benefit Sharing Plan.

Regularization measures must be promoted in close coordination with the various entities of the rural, environmental, territorial, registry and cadastral sectors, which have the duty to plan in a coordinated manner and from the institutional point of view, the necessary steps to work in a comprehensive manner in the regularization of the existing forms of tenure in the territory.

In the current technical assistance phase, a multipurpose cadastre pilot project is underway in the Municipality of Arauquita through the Agustín Codazzi Geographic Institute (IGAC), and a property regularization strategy was implemented with the Agricultural Rural Promotion Unit (UPRA), which is focused on properties that have not been deforested, and there are plans to coordinate the formalization or regularization of approximately 250 properties with the National Land Agency (ANT). The ERPD plans to strengthen regularization through comprehensive support to the sector's entities (ANT, ADR, UPRA, etc.).

This implies that the ERP should establish measures to strengthen and expand institutional capacity in the Orinoquia, in an attempt to regularize land tenure in the territory and reduce conflicts associated with the confluence of several actors on the same property, as well as changes in land use. This conclusion is drawn from the analysis of land tenure, where it has been found that there is a high level of informality in the Orinoquia region and little institutional presence in this territory, especially in the most remote municipalities.

In addition to institutional support, the ERP's capacity to generate benefits should support the promotion of activities that contribute to the reduction of carbon emissions, such as the limitation of the process of (natural and commercial) deforestation and the limitation of the progress of deforests, for which greater presence of environmental authorities will be required to prevent the expansion of the agricultural border at the expense of an environmentally protected area. Alongside these activities, the tenancy analysis makes it possible to conclude that the form of agricultural production in the region requires a reconversion to sustainable schemes, in the livestock sector, where it is necessary to advance projects that propel for a more intensive use of the land and reduce the impact of the sector on the generation of carbon emissions. Therefore, it is relevant for the implementation of the ERP to include the most representative production sectors in the region, so that they are aware of the benefits of using sustainable forms of production and their participation in the program is encouraged.

The Biocarbon ERP must contribute to improving the existing conditions in the territory, associated with the possession and use of the land. Said improvement of the relationship of the communities, the individuals, the farmer, the rural inhabitant, with the land and its corresponding social, economic, political, and cultural environment, will have to be addressed through the strengthening that the country must do of the institutions of the rural and environmental sector. Said institutional strengthening must be focused on working more adequately in the ordering of rural land, land planning, its sustainable and efficient use, the adaptation of land, the support of the processes of formalization and regularization of rural property, the cadastre, the promotion, execution of integral projects of agricultural, forestry and environmental development, for which, it must have the recognition and participation of the communities, rural population, ethnic groups present in the territory, always from respect and recognition of their rights.

From the ERP it is conceived that, if access to land is supported by agricultural workers and residents, as well as the recognition of the rights of the different ethnic communities existing in the ERP area, the purpose associated with socio-economic development will be achieved, with environmental criteria, protecting, conserving, and making the Orinoquia landscape sustainable and resilient, hand in hand with secure land ownership. For this, in the design of the ERP, the following specific measures have been considered:

Regarding Chain IV, related to the reduction of deforestation, we have:

- Code DE4, development and implementation of comprehensive interventions for the stabilization of the NAD, including territorial ordering, as well as the resolution of conflicts related to the use, occupation and ownership of land.
- Code DE5, generation of technical capacities to develop sectoral planning and management instruments that avoid deforestation.
- Code DE6, strengthening of education, communication, knowledge and citizen participation for the governance of the territory and the sustainable management of forests.
- Code DE 8, Strengthening of the administrative, technical and legal capacities of the authorities that intervene in the prevention, investigation, prosecution and control of environmental crimes.
- Code DE9, implementation of actions to control illegal economies that drive deforestation.
- Code DE10, generation of monitoring and follow-up schemes (national, regional and local) to the territorial interventions associated with the control of deforestation.

Likewise, within Chain V, planning and governance, the following measures are contemplated:

- Code PG1, environmental and productive planning of the rural territory at different scales (subregional, departmental, local).
- Code PG2, strengthening of planning processes and capacities to advance in the adaptation and mitigation of climate change.
- Code PG3, strengthening of rural property formalization processes.
- Code PG4, articulation of economic instruments/financial incentives to enable the reduction of GHG emissions and increase the resilience of regional ecosystems.
- Code PG 5, articulation of agricultural extension strategies, environmental education and citizen participation aimed at low carbon rural development.

## 3.6 BENEFIT-SHARING ARRANGEMENTS [114]

### 3.6.1 SUMMARY OF DISTRIBUTION AGREEMENTS

The Biocarbon ERP has a Benefit Distribution Plan - BDP (PDB) that has been formulated with the involvement of stakeholders both at the national and territorial level, including indigenous communities. The principles that govern the distribution of benefits are: 1) Performance, 2) Need

[114] See Annex IV for more information.

for strengthening, 3) Impact, 4) Equity, 5) Operability of the program, 6) Transparency and zero corruption, and 7) Differential approach.

The beneficiaries of the Biocarbon ERP are all those individuals, groups and entities that receive a payment based on results according to their contributions to the fulfillment of the emission reduction objectives and targets.

The beneficiaries are structured into two categories, the institutional level and the population level. In the first, the government entities that are executing and co-executing agencies are grouped and that implement direct and indirect measures for the reduction of emissions, at the national, regional and territorial levels (departments and municipalities). Likewise, there is the academy, i) universities and research centers that provide the technical and practical foundations on low-carbon agricultural production systems and for processes of sustainable forest management, conservation and restoration of strategic ecosystems, and ii) the National Apprenticeship Service –SENA and other job skills training centers.

In the institutional category, the implementing entities are also beneficiaries, which may be public or private entities, at the national, regional or local level, with whom technical and/or administrative efforts will be combined for the structuring and execution of projects which will implement the GHG reduction measures and actions defined in the Biocarbon ERP, such as the Corporation for the Sustainable Development of the La Macarena-CORMACARENA Special Management Area, CORPORINOQUIA, PNN, ADR, ANT, Colombian Agricultural Institute, Agrosavia, Alexander von Humboldt Institute, governorships and mayoralties of the territory, ethnic groups (associations of indigenous reservations and other ethnic organizations), organizations of producers, NGOs, private sector, among others.

In the second category -population-, are the individuals and local communities organized either as beneficiaries of activities aimed at strengthening capacities and skills or as final beneficiaries who have modified practices towards the protection of forests and strategic ecosystems and a low production in carbon and the MRV has shown that they achieve a reduction in emissions.

It is estimated that the total number of direct and indirect beneficiaries will be 78.246 distributed as follows:

- 32.118 people who participate in organizations engaged in income-generating activities related to forestry and/or agricultural activities and who receive benefits from the ERP Biocarbon. 50% of these beneficiaries are women.
- 46.128 people living within and in communities adjacent to forests with monetary/non-monetary benefits from the forest.

The eligibility criteria of the implementing partners and the final beneficiaries, as well as those of the strengthening beneficiaries are presented in the following figure:

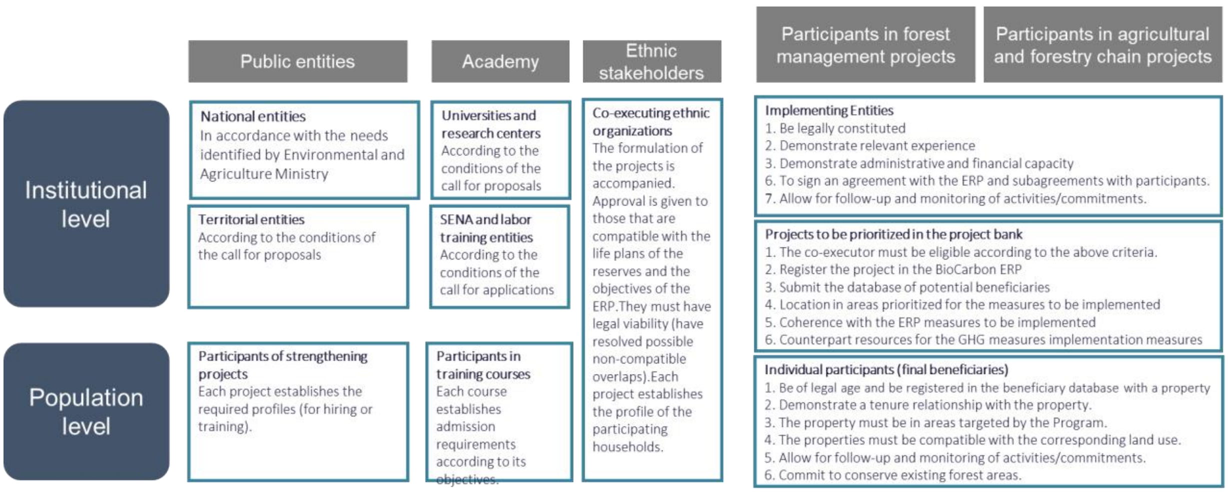


Figure 8 Roadmap of the BDP process
***Source: Econometría Consultores***

The benefits obtained by the different beneficiaries may be monetary, in which case the resources will be managed and transferred through a Trust, or they may be non-monetary, such as courses, agricultural extension visits, seeds, seedlings, etc., in which case the transfers will be made to the executing entity, and it will invest the corresponding part in supplying the corresponding goods and/or services.

The following diagram presents the general scheme of distribution of benefits and the criteria used are described below. The percentages are a preliminary proposal that is subject to discussion with the potential beneficiaries, after which the final benefit distribution proposal will be available.

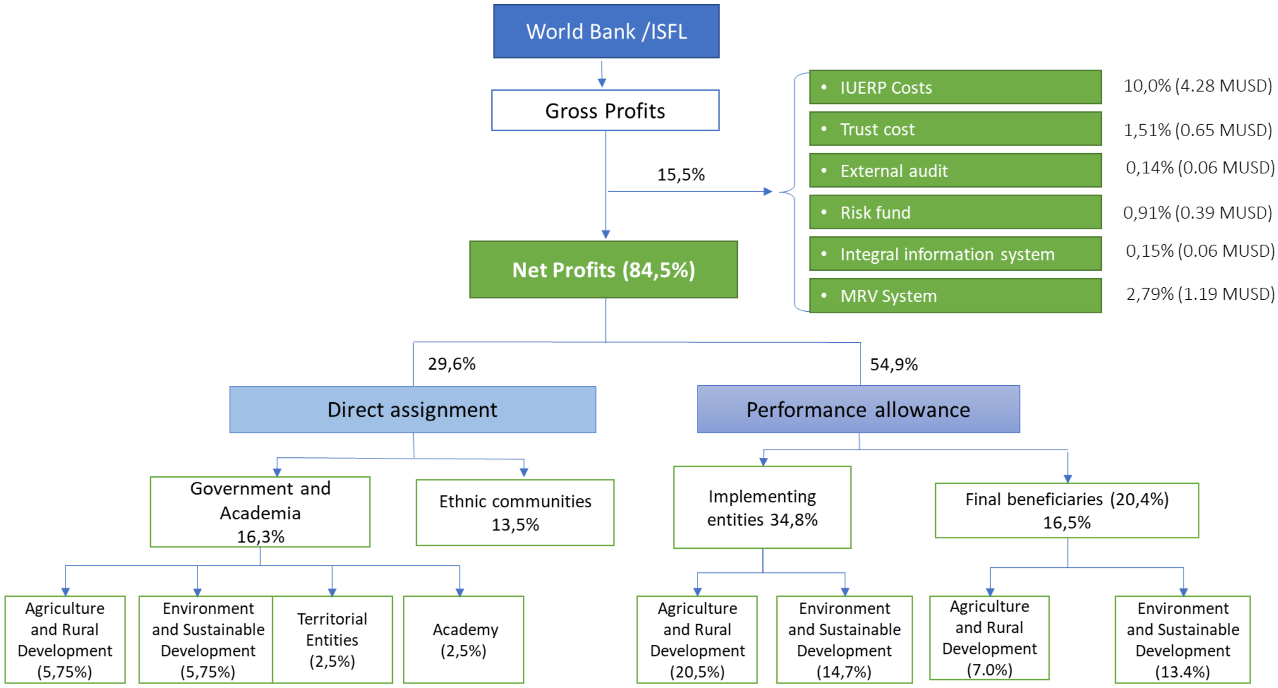


Figure 9 Benefit distribution scheme

The first step was to calculate the costs that guarantee the operation of the program, considering that once the benefits of payment for results can begin to be received, there will remain three years of operation that must be guaranteed. It was found that it is required to reserve 15% of the benefits for this purpose as shown in the figure. In order to distribute the rest of the benefits, called net benefits, the beneficiaries were classified by type of allocation according to the ability to directly influence the emission reduction results. Thus, the executing entities and final beneficiaries will be distributed according to their performance and to the others in proportions with a maximum limit as shown in the graphs.

The first assignment to be defined is that of indigenous peoples. In accordance with the workshops carried out with the indigenous population, it was defined that the communities will be accompanied to formulate their projects in accordance with their life plans and the objectives of the ERP Biocarbon, and once the projects have been designed, the agreed elements will be provided in the formulation of each project. In order to have sufficient resources and taking into account that the indigenous territories represent between 17% and 18% of the forests of the Orinoquia, but considering that due to public order reasons and due to pending legal proceedings, it will only be possible to attend to around 75 % of territories, 13,3% of total benefits were established for ethnic territories.

For the allocation of government institutional beneficiaries, the criteria of training needs was used and according to the costing carried out in the financial plan, 16,3% of the benefits were assigned to develop planning and governance measures during the last three years of ERP Biocarbon. The remaining 54,9% is assigned to final beneficiaries and executing entities, according to the percentages of preference for monetary and non-monetary benefits established through participation during the workshops held in the four departments during 2022 for this purpose, for each of the chains. This means that on average the beneficiaries obtain a monetary benefit close to 20% and the executing entities 34,8% to offer non-monetary benefits to the same final beneficiaries.

Regarding the payment mechanism, the following diagrams represent the commitment follow-up scheme for payments and the parties involved in the disbursement of resources.

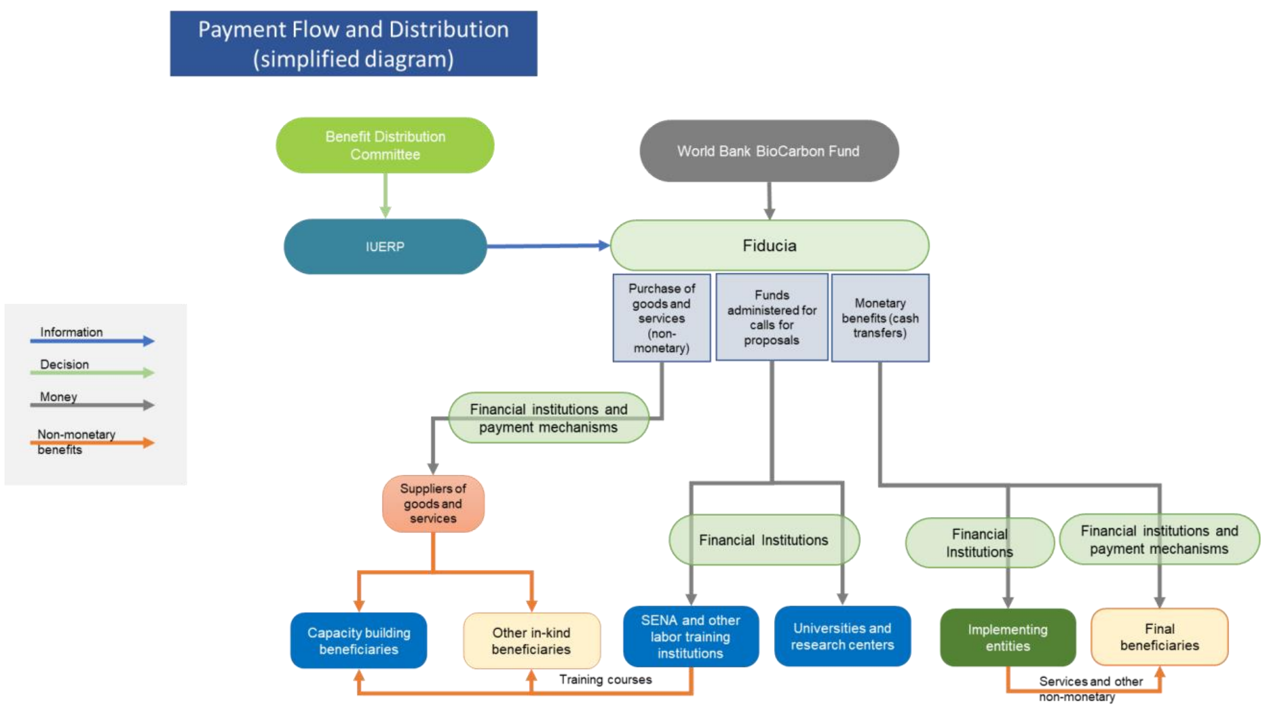


Figure 10 Payment mechanism

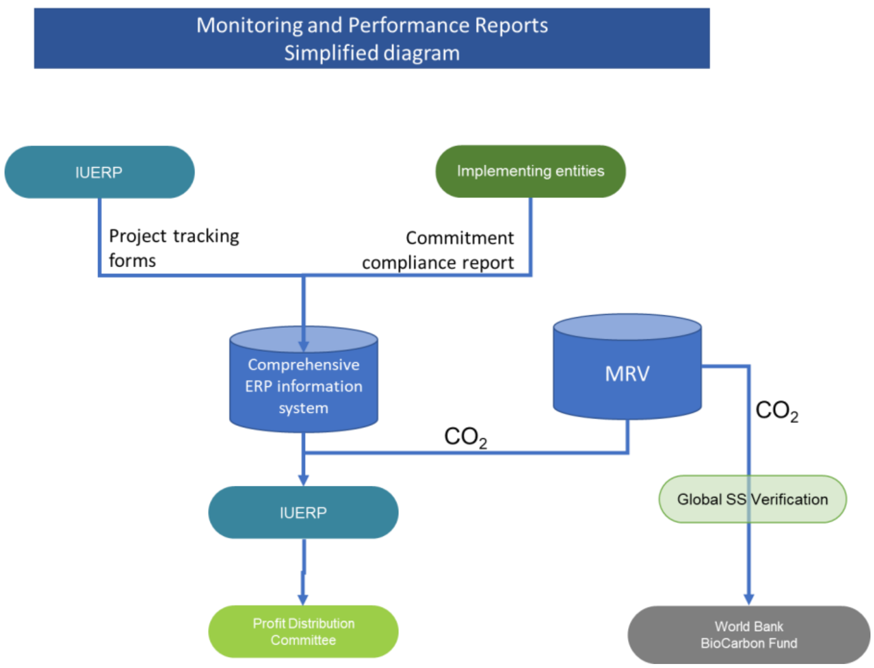


Figure 11 Mechanism for monitoring the distribution of benefits

### 3.6.2 SUMMARY OF THE BENEFIT SHARING AGREEMENT DESIGN PROCESS

In May 2022, a pilot workshop was carried out in Puerto Carreño, which made it possible to identify changes in the methodology required to reach agreements. The final methodology was applied to the workshops that were held in August and September in Villavicencio, Yopal, Arauca and Puerto Carreño[115].

These workshops included a contextualization of the ERP and the socialization of the distribution criteria and other thematic aspects of the distribution of benefits (types of beneficiaries and benefits, targeting and eligibility conditions, distribution mechanisms, institutional issues, etc.). At this stage, opinions were exchanged, and questions from the attendees were resolved.

Figure 22 shows the methodological stages carried out within the framework of the workshops.

[115] It partially used the results of the first pilot workshop held in the same municipality.

Additionally, the figure below explains in more detail how each of these stages was managed within the framework of the Delphos workshop (Rodríguez, 2008).

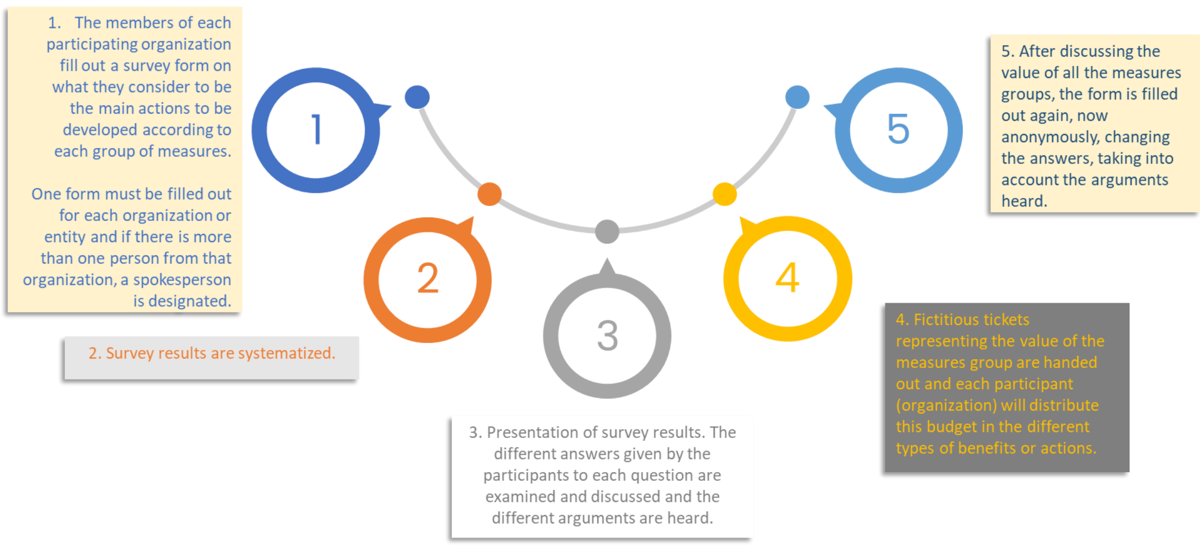


Figure 12 Methodological stages carried out within the framework of the workshops
***Source: Econometría S. A***

I. Distribution of the questionnaire among the attendees.

To analyze the survey information, , a single form was processed for individuals or when there were several representatives of an entity/organization. The form allows selecting for each group of measures (16 in total), the type of benefit or action that, depending on the territorial context, the participants considered to be the most appropriate, depending on the type of measure. To systematize the information, lunch time was used. In this space, while the guests had lunch, the workshop facilitators systematized the information provided in the surveys.

II. Presentation of consolidated responses and discussion

After lunch and once the results were systematized, they were distributed to the participants in a round table. The results were socialized by going through each of the 16 measures. Taking into account the trends of each of the responses of the participants, a discussion was promoted to find out why the responses were given, exploring and sharing the arguments and opinions.

III. Distribution of fictitious monetary units (curlews) on the measures

100 million "Alcaravanes" were distributed to each of the attendees. Which distributed that value among the different media through a set of boxes intended for this purpose. Once everyone made their distribution, the banknotes accumulated in each box were counted and the contributions were totaled. The results of the funds allocated to each activity were shared and participants shared their

motivations for allocating more money for one type of benefit than others. during the workshop.

IV. Completion of the workshop by filling out the survey once again

Once the results had been examined and shared, the survey was redistributed so that the participants can answer it a second time anonymously, considering the arguments and opinions expressed by the other participants. These new dynamic aims to see if there are changes in the answers of the participants once they have heard the arguments of the others.

### 3.6.3 DESCRIPTION OF THE LEGAL CONTEXT OF BENEFIT-SHARING AGREEMENTS

In the general normative context, presented in section 3.1.4, it was stated that the country has a broad legal and regulatory framework for the implementation of the measures and actions planned within the framework of the Low Carbon Sustainable Development Project in the Orinoquia Colombian. With regard to the definition of benefit sharing agreements, there are specific regulatory references on emission reductions, payment for environmental services and the targeting of rural extension services:

Ownership of emission reductions:

- As explained in detail in section 3.7, the ownership of emission reductions in Colombia is not specifically regulated with respect to land tenure, but is related to the actions developed to achieve those emissions.
- Law 1753 of 2015 established that any person, natural or legal, public or private who intends to qualify for payments for results or similar compensation as a consequence of actions that generate reductions in GHG emissions, must previously obtain registration in the National Registry of Reduction of GHG Emissions (RENARE).
- Resolution 1447/18, regulates the MRV System of mitigation actions at the national level, establishes the conditions to obtain payments for results and similar compensation, as well as the accounting rules for emission reductions. Among other guidelines, it indicates that RENARE must register mitigation initiatives according to their development phase, from feasibility to implementation. If any project overlaps in time, geographic area and activities with a REDD+ Program such as the ERP, it must request the status of executing partner or the exclusion of the project area by the ERP.

Payment for Environmental Services

- Decree-Law 870 of 2017, defined the payment for environmental services (PSA). The value of the PSA must be calculated through the opportunity cost. Decree 1007 of 2018 defined the modality of "Payment for environmental services for the reduction and capture of GHG and established the steps for its calculation through the opportunity cost. Decree-Law 870 of 2017 also indicated that in order to value the PSA in the case of indigenous groups, cultural and spiritual intangibles must be considered.

- Article 319 of Law 1955 of 2019 (PND18-22), orders the National Government and the indigenous organizations that assist the Permanent Coordination Table (MPC), to jointly build the regulation proposal for Payment for Environmental Services (PSA) for indigenous communities.

Targeting

- Law 731 of 2002, dictated norms to favor rural women seeking to improve the quality of life of rural women, prioritizing those with low resources and enshrining specific measures aimed at accelerating equality between rural men and women.
- Law 1876 of 2017 creates the National Agricultural Innovation System (SNIA) and, among other provisions, creates the public agricultural extension service and the rules for its provision.

## 3.7 ORINOQUIA BIOCARBON ERP TRANSACTIONS

### 3.7.1 ITMOs TRANSFER REQUIREMENTS

The Government of Colombia continues to be interested in developing initiatives that have the potential to transfer mitigation results from emission reduction programs and initiatives, which are consistent with national legislation and international agreements signed by the Country.

The current national legislation does not provide provisions related to the procedures and requirements for the transfer of mitigation results. However, and in order to achieve the proposed objectives, within the framework of the Climate Action Law number 2169 of 2021, the MADS is developing the necessary technical guidelines for the implementation and start-up of the carbon markets , including the forecasts related to programs, projects, jurisdictional payment schemes for results and mitigation initiatives developed in the national territory and that intend to trade emission reduction certificates in the national and international regulated and voluntary markets. Likewise, it will establish the criteria, conditions and requirements to obtain the authorization of these transfers.

Additionally, as described in the following section 3.7.2. “Legal analysis of the transfer of ownership”, the country has tools, which, among others, are close to the definition and precision of carbon ownership and which are being analyzed with technical and legal inputs, which will make it possible to clarify more precisely, rights over carbon ownership, as well as the necessary legal provisions that must be taken into account in the regulation of carbon markets.

Finally, the country is interested in having the possibility of developing and transferring mitigation results in carbon markets, developed through sustainable forest landscape activities, within the framework of the provisions of article 6 of the Paris Agreement to international and national level, and current Colombian legislation, which applies to this type of emission reduction programs, based on entering into parallel agreements and sub-agreements with land holders in accordance with the ISFL methodology, which minimize risk of claims associated with the ownership of MOs[116], and propose with them an adequate and satisfactory distribution of benefits.

It should be noted that, as long as the mitigation results meet the national authorization requirements and the existence of surplus units/quotas that can be transferred without affecting compliance with the NDC of Colombia is determined, they could be results that become in ITMOs.

#### 3.7.1.2 LEGAL ANALYSIS OF THE TRANSFER OF OWNERSHIP

With **Law 164 of 1994**, Colombia ratified the United Nations Framework Convention on Climate Change (UNFCCC) and from there there have been many efforts by the country to establish policies and regulations that facilitate the design and implementation of these measures. In this regard, the ratification through **Law 629 of 2000 of the Kyoto Protocol** stands out with the three flexibility mechanisms: emissions trading, joint implementation, and the Clean Development Mechanism (MDL) that allowed industrialized countries to achieve their commitments through the financing of mitigation actions outside their territories.

Subsequently, document **CONPES 3242 of Climate Change Policy Guidelines** was issued in 2002, in order to: “identify the strategies required to consolidate the necessary national capacity to respond to the possible threats of climate change; respond to the provisions of the Convention and the Kyoto Protocol, in terms of potentiating the opportunities derived from financial mechanisms and fulfilling the established commitments”.

In 2003 and 2004, the regulatory framework for the development of the Clean Development Market (MDL) projects was issued as part of the strategy to promote the reduction of emissions by sources and absorption by sinks of GHG. In this regard, **Document CONPES 3242- "Institutional strategy for the sale of environmental services for climate change mitigation"** was issued, which sought to promote Colombia's competitive incursion into the international market for verified reductions in GHG emissions.

Subsequently, **Resolution 0453 of 2004**, issued by now MADS, Housing and Territorial Development, **adopted the principles, requirements, and criteria, as well as the procedure for the national approval of GHG emission reduction projects that opt for to the Clean Development Mechanism**.

[116] The GHG mitigation results (MOs) that are authorized by the competent entity designated by the National Government to be transferred internationally are called ITMOs.

This resolution was modified in 2009, through resolutions 551 and 552 of that year, and again in 2010 through **resolutions 2733 and 2734** issued by the same Ministry.

Later on, document **CONPES 3700 of 2011** was issued, which proposed: i) a coordination framework through which sectors, territories and communities understand climate change as a matter of economic and social development and therefore integrate said problem within their planning and investment processes; ii) the articulation of information production entities, sectors and territories, in such a way that the information generated is pertinent, accessible and of quality and; iii) an adequate coordination framework so that the actions prioritized at the time by the country could be implemented.

At the same time, in compliance with the **Bali Action Plan**, in September 2015 Colombia presented its **Nationally Determined Contribution** to the Convention Secretariat, where it promised to reduce 20% of its GHG emissions by the year 2030, and in the event that sufficient international support is provided, said commitment could increase to 30% with respect to the initial scenario of emissions with a baseline for the year 2010.

This contribution becomes one of the commitments acquired by each one of the Parties regarding the implementation of the **Paris Agreement, adopted in December 2015. Decree 298 of 2016 should also be mentioned, by means of which the organization and the operation of the National System of Climate Change - Sisclima**, as an instance of coordination, articulation, formulation, follow-up and evaluation of the policies, norms and other management instruments that, in terms of adaptation to climate change and GHG mitigation, are developed by public entities, private and non-profit.

In 2017, the **National Climate Change Policy** was issued, which establishes the need to strengthen climate change management, through various planning, economic and financial instruments as a means to move towards low-carbon and climate-resilient development.

**Law 1931 of 2018** establishes the guidelines for the management of climate change in the decisions of public and private persons, the concurrence of the Nation, Departments, Municipalities, Districts, Metropolitan Areas and Environmental Authorities mainly in adaptation actions to the climate change, as well as mitigation of GHG, with the aim of reducing the vulnerability of the country's population and ecosystems to its effects and promoting the transition towards a competitive, sustainable economy and low-carbon development .

This law created **the National GHG Emission Tradable Quotas Program (PNCTE)** by virtue of which tradable GHG emission quotas will be established and auctioned based on the conditions and requirements for the verification, certification and registration of emissions, reductions of emissions and removals of GHG, defined by the MADS.

**Law 1819 of 2016,** by which the structural tax reform is adopted in Colombia, in part IX, articles 221 to 223, creates the carbon tax that seeks to discourage the use of fossil fuels and encourage technological improvements for their use more efficient, regulated by Decree 926 of 2017, which contains the **procedure to enforce the non-causation of the national carbon tax.**

**Law 1844 of 2017 approves the Paris Agreement** signed by Colombia, which seeks to strengthen the global response to the threat of climate change, committing the States Parties to strengthen management to mitigate the emission of GHG and adaptation and resilience to the adverse effects of climate change.

It is important to take into account that in December 2020, **the national commitment to reduce emissions was updated** and the "Update of the Contribution Determined at the National Level of Colombia" was submitted to the United Nations Framework Convention on Climate Change - UNFCCC -NDC" establishing that the country commits to an increase in the ambition of the emission reduction goal, in order to reach 51% by the year 2030, according to the reference scenario to 2030, for which they must strengthen the different management instruments, including economic and financial ones.

**The RENARE was created by Resolution 1447 of 2018** and modified by **Resolution 831 of 2020**. They establish that the management of GHG mitigation initiatives at the national level, which intend to qualify for payments for results or compensation, which contribute to the fulfillment of the national climate change goals established under the United Nations Framework Convention on Climate Change UNFCCC.

The RENARE platform integrates four registration phases (feasibility, formulation, implementation, and closure) through which the different types of registered GHG emission reduction and removal initiatives are monitored (NAMAs, CDM, CDM-PoAs, Projects and Low Carbon Development Programs-PDBC, REDD+ Programs and Projects).

Additionally, **Decree 446 of 2020** establishes the rules applicable to GHG reduction verification agencies, in order to strengthen the integrity of emission reductions carried out in the country.

With **Law 2169 of 2021**, the goals and minimum measures were established to achieve carbon neutrality, climate resilience and low carbon development in the country in the short, medium and long term, within the framework of the international commitments assumed by the Republic of Colombia on the matter, among which is the National Program of Tradable Emission Quotas (PNCTE).

As part of the measures for the promotion and development of carbon markets, article 16 of Law 2169 of 2021 established the **Mandatory Report on GHG Emissions (ROE)** in which public, private or mixed legal entities must report their direct and indirect GHG emissions and the information and documentation for the preparation of GHG inventories, taking into account the criteria defined by the MADS, considering, among others, the level of GHG emissions and the Company size.

Likewise, article 22 of Law 2169 of 2021 establishes that for the strengthening of carbon markets, the national government will promote the development, conditions, criteria and institutional framework required to strengthen carbon markets in Colombia, as a dynamizer of the national economy, in accordance with the provisions on the matter in current regulations, for which it may develop economic instruments of a fiscal, financial and administrative nature that encourage the implementation of actions to reduce and remove emissions.

The broad regulatory and public policy framework shows the country's commitment to address the causes and effects of climate change, and at the same time, defines a set of national, regional, and local institutions with management functions, competencies, and attributions of climate change. Regulatory framework, which is complemented by the policies and regulations of the environment and sustainable development sector contained in Law 99 of 1993 and its subsequent regulatory development, which is articulated with other provisions of the agricultural sector and other sectors.

### 3.7.2. PARTICIPATION IN OTHER INITIATIVES ON GHG

The country is exploring multiple alternatives to reduce GHG emissions at the national and subnational levels, which include nested projects or programs developed using different international standards. This includes initiatives under methodological frameworks such as the Green Climate Fund (GFC), the Verified Carbon Standard (VERRA), ART-TREES, among others; it also includes other types of initiatives with objectives similar to those of the PRE. An important part of these processes is in the early stages, both of development and of technical and/or legal feasibility. However, when due to its characteristics there are coincidences with the ERP Biocarbon Orinoquia, the government will promote the necessary synergies to guarantee its coordination and transparent accounting, always within the framework given by the current guidelines related to the EAS of the World Bank.

In terms of possible overlaps with payment-for-results programs, only one REDD+ program is identified that presents spatial overlap with the current limit proposed for the Orinoquia PRE. The REM Colombia - Visión Amazonia Program, under the ownership of the MADS, is executing the resources from the payment for the results generated in its credit period and other financing modalities. Visión Amazonia seeks to reduce GHG emissions from deforestation in the Colombian Amazon biome. The Amazon Vision Program area covers the southern part of Meta and Vichada; however, its accounting period was from 2013 to 2017, and it is currently not active under the payment by results modality. For this reason, it is identified that there is no overlap that is not compatible with the Biocarbon ERP.

Finally, Colombia has several GHG mitigation initiatives that participate in the voluntary carbon market in different phases of development within its national territory, including REDD+ and PDBC projects in the specific area of Biocarbon ERP, where in the most recent review (as of May 2022) forty (40) projects have been identified, fifteen (15) in the feasibility phase, sixteen (16) in formulation, and nine (9) in the implementation phase. As explained in Section 3.7.3, to address the participation of this type of initiative, the ISFL framework contemplates two options: i) summon the projects to be nested under the figure of "executing partner", or ii) carry out their exclusion from the ERP area (see Section 4.5.2). Table 17 contains the list of private initiatives, in the implementation phase, that are registered with RENARE and located within the ERP area.

Table 7 Private initiatives of the voluntary carbon market identified in the Biocarbon ERP area (as of May 2022).

| No | Type | Name | Project Elaboration | Department | Activity Type |
|---|---|---|---|---|---|
| 1 | PY PDBC | Afforestation of degraded grassland in Vichada, Colombia | Forest First S.A.S | Vichada | Increase in forest carbon stocks |
| 2 | PY PDBC | Forest project CO2CERO Meta_09 | CO2CERO S.A.S | Meta | Forest plantations |
| 3 | PY PDBC | CO2CERO VICHADA FOREST PROJECT | CO2CERO S.A.S | Vichada | Forest plantations |
| 4 | PY PDBC | Grouped Project of Commercial Forest Plantation Initiatives in the Department of Vichada | South Pole Carbon Asset Management SAS | Vichada | Forest plantations |
| 5 | PY PDBC | PROYECTO FORESTAL CO2CERO CAUCHO EL VIENTO | ECOLOGIC S.A.S | Vichada | Forest plantations |
| 6 | PY PDBC | CO2CERO CASANARE FOREST PROJECT | CO2CERO S.A.S | Casanare | Forest plantations |
| 7 | PY PDBC | Meta Commercial Reforestation Plant | South Pole Carbon | Meta | Forest plantations |

| No | Type | Name | Project Elaboration | Department | Activity Type |
|---|---|---|---|---|---|
| 8 | PY PDBC | Recovery of degraded soils with the use of financial incentives in central and eastern Colombia | South Pole Carbon Asset Management S.A.S | Meta | Forest plantations |
| 9 | PY PDBC | Forestry project CO2 ZERO Rubber PL UNO | CO2CERO S.A.S | Meta | Forest plantations |

RENARE was enabled to the public by means of an official communication on September 8, 2020, for the registration of GHG mitigation initiatives, which seek to qualify for payments for results or similar compensation and/or demonstrate compliance with established national climate change goals under the United Nations Framework Convention on Climate Change - UNFCCC. Since this date, the licensees have been registering their mitigation initiatives, going through the different phases provided by the regulatory framework. During the years 2021 and 2022, MADS and IDEAM, in the RENARE administration exercise itself, which includes the management of phase changes of GHG mitigation initiatives, identified opportunities for improvement and advanced in their implementation, through various development and test cycles; that will make it possible to have a renewed platform, with optimized technical and technological conditions based on updated forms for each of the stages and in accordance with the type of initiatives registered in the RENARE platform. With the foregoing and as part of the production process of the developments carried out, the platform is temporarily closed from Wednesday, August 9, 2022, likewise, by means of an Administrative Act of September 23, 2022, issued by the Council of State, the Administration of the RENARE Platform is assumed by the MADS.

On May 19, article 230 of Law 2294 of 2023 (National Development Plan 2022 – 2026) was approved, through which the NATIONAL REGISTRY OF EMISSIONS REDUCTION AND GHG REMOVAL is modified, which gives it powers to the MADS to delegate the administration of the platform.

For this reason, MADS will proceed by legal means to delegate said administration. Subsequently, the delegated entity will develop the functional tests of the platform, carry out the stabilization process of the same and open the RENARE to the public. These last steps will be corrected in the second half of 2023.

Once the platform is opened, the Biocarbon ERP will proceed to register with RENARE and will update the information presented in Table 17.

At the same time, in the current phase of the project, progress has been made in updating the identification of potential GHG mitigation initiatives that are in the formulation and/or implementation phases in the program area, by searching for projects registered on the platforms of the voluntary market, select and prioritize from this update the initiatives of greatest interest for the implementation of the measures established by the ERP and; formulate, in conjunction with the prioritized initiatives, the plan of implications for the executing partner, necessary for the nesting of the projects with the program.

For this process, Resolution 1447 of 2018 defines in its article 51 the following:

*"Requirements to offer the status of executing partner by a REDD+ Program to REDD+ Projects. To offer the status of executing partner, the holders of REDD+ Programs and Projects in non-compatible overlap must:*

> *1. The REDD+ Program holder must identify the overlapping area that is not compatible with the REDD+ Projects.*
> *2. The holder of the REDD+ Program must register the Program in the feasibility phase with RENARE, excluding areas that are incompatible with REDD+ Projects.*
> *3. The owner of the REDD+ Program must offer the status of executing partner to the owner of the REDD+ Project with which it presents an incompatible overlap, in accordance with the provisions of its plan for the involvement of executing partners mentioned in Article 33 of this Resolution.*
> *4. The holder of the REDD+ Project that accepts the condition of executing partner must inform the holder of the REDD+ Program. Subsequently, an agreement must be entered into between the two parties that includes, at a minimum, the mechanism for recognizing the reductions in GHG emissions and removals generated by the REDD+ Project, as well as the responsibilities of the REDD+ Project holder as executing partner of the REDD+ Project Program, according to the defined methodological and operational guidelines*
> *5. The holder of the REDD+ Program must publish in RENARE the list of all REDD+ Projects that have the status of executing partner within the REDD+ Program.*
> *6. The REDD+ Program holder must update the REDD+ Program information in RENARE, including the overlapping areas corresponding to the REDD+ Projects that opted for the status of executing partner.*
> *7. The holder of the REDD+ Project that has opted for the status of executing partner must change the status of its project to "Closed in RENARE".*

The previous procedure is explicit for REDD+ initiatives, however, the program will apply this procedure for initiatives of other types (for example, PDBC projects) and that present an overlap that is not compatible with the ERP.

Finally, in the face of the collective areas of ethnic communities (indigenous reservations and community councils), which in some cases are already developing GHG mitigation initiatives, mainly of the REDD+ project type, the ERP proposes to follow a similar process for their nesting in the Program, called Differential progressive inclusion, this procedure must include in compliance with numerals 3 and 4 mentioned above, the participation process to reach agreements that define the competent entities and/or the participating ethnic communities (see section 3.6.1).

Initiatives such as REDD+ projects, PDBC projects and/or areas associated with ethnic communities with which agreements cannot be reached to apply the figure of executing partner, will finally be excluded from the Biocarbon ERP.

For the accounting between projects and programs, related to the nesting of other initiatives to the ERP, it has been proposed from the Biocarbon Project in its current phase, to do it based on the technical guidelines for REDD+ projects developed by IDEAM, which is consistent with the provisions of articles 40 and 41 of Resolution 1447 of 2018. This proposal will be taken to the accounting and MRV thematic table, within the framework of the REDD+ Program Table established by MADS[117], o be discussed with the different actors that make it up.

### 3.7.3 DATA REGISTRATION AND MANAGEMENT SYSTEMS TO AVOID MULTIPLE CLAIMS TO REDUCTION EMISSIONS

RENARE was created by Law 1753 of 2015, regulated by Resolution 1447 of 2018 and modified by Law 2169 of 2021. The RENARE technology platform has been in operation since September 2020 and can be consulted on the renare.siac.gov page. co. The same standard also regulates the MRV mitigation system and establishes the GHG emission reduction and removal accounting system (SCRR – GEI). Its scope of application covers initiatives that intend to demonstrate mitigation results within the framework of national climate change goals, those that intend to apply to payment for results or similar compensation, to public entities in charge of the MRV mitigation system and to GHG validation and verification. In this sense, the Orinoquia ERP is covered by said resolution, as a REDD+ Program and as a PDBC Program.

Article 9 of Resolution 1447 of 2018 lists the principles of the MRV mitigation system, among which

[117] In accordance with the i) commitment of the National Development Plan 2022 - 2026 "Colombia World Power of Life" to create and/or adjust the criteria to strengthen the environmental integrity of the mitigation results, ii) the objectives and lines of action consigned in the Comprehensive Strategy for Deforestation Control and Forest Management - EICDGB, iii) the decisions made under the United Nations Framework Convention on Climate Change - UNFCCC in relation to the implementation of the REDD+ mechanism, access to payments for results and the Warsaw framework for REDD+, iv) the needs identified from the National Mitigation Monitoring, Reporting and Verification System regarding compliance with existing regulatory requirements by GHG mitigation initiatives, with special emphasis on those that are under the ownership of MADS, and the challenges in terms of implementation and achievement of the mitigation results required to meet the national climate goals. The need to establish a technical and legal working group from MADS was evidenced to allow progress in the discussions on addressing key issues in accounting, MRV, implementation of the EICDGB at the territorial level, nesting schemes, among others, with in order to address the identified challenges, clarify the panorama of payment possibilities by results and obtain inputs in decision-making regarding the regulatory processes that are prioritized by the Vice Ministry of Environmental Planning of the Territory and the Directorate of Climate Change and Management of Risk (See input REDD+ Program Table).

is avoiding double counting. The standard established a series of basic accounting rules aimed at guaranteeing the environmental integrity of the initiatives; additional accounting rules were approved by the Intersectoral Commission on Climate Change (CICC) in December 2020. In the case of REDD+ programs, rules were established in case of overlap with REDD+ projects, as well as parameters for the establishment of baselines, for the formulation methodologies, for the establishment of mitigation goals, for additionality and for the validation and verification of the initiatives.

RENARE consolidates the information for accounting and GHG emission reductions and removals and assigns unique serial numbers to registered REs. However, it is not a platform for verification of mitigation initiatives, nor is it a platform for transactions. The system records the reductions in GHG emissions and removals generated by mitigation initiatives, as well as those that have been verified and cancelled. The cancellation prevents the transfer in favor of another natural or legal person; cancellation by more than one person or third party is not allowed. Therefore, transactions carried out with reduced emissions credits from the Biocarbon ERP must also be recorded in another transaction register.

The requirements to manage non-compatible overlaps between REDD+ projects and programs are established and would be applicable to the Biocarbon ERP; although there are no requirements to resolve incompatible overlaps between PDBC initiatives, the ERP proposes to apply the ISFL's methodological framework.

As previously mentioned, Resolution 1447 of 2018 in its article 9 consecrates avoiding double accounting as one of its MRV principles and promulgates the accounting rules for mitigation projects and programs that seek payments or will contribute to compliance with the Colombian NDC. Taking into account that all projects and programs that seek to receive ER payments must register with RENARE, the Biocarbon ERP, forestry, REDD+ and agricultural voluntary market projects that are implemented in the Orinoquia territory must also do so. In this context, double counting will be avoided in the following ways:

- Avoid double issuance of credits: for payments based on the results of REDD+ programs, Colombia has nesting provisions in Resolution 1447 (articles 46-52) by which REDD+ projects can be nested in REDD+ programs and have their accounting covered by the program, becoming executing partners, or they can request the exclusion of the ERP, so that it has to exclude the project area. In any of these cases, the double issuance of credits is avoided. Only projects in the implementation phase registered with RENARE can request said exclusions.

  Since there is a discrepancy between the NDC Deforestation Baseline and the ERP baseline, with the ISFL baseline being the most conservative, nesting projects will not necessarily mean that all credits from deforestation projects have to be deducted from the results of the ERP Biocarbon; A good part of these results can be assigned to the ERs above the ERP baseline, and below the NDC baseline; that is, there would be results that were not eligible for the ERP but were eligible for the NDC.

- Avoid double use: Article 175 of Law 1753 of 2015, modified by Article 17 of Law 2169 of 2021, prohibits the double sale in the market of ERs that have been accredited by MADS in REDD+ programs, as is the Biocarbon ERP. For this reason, RENARE establishes that all GHG mitigation initiatives must be registered in it to opt for any payment according to their ER. Article 17 of Resolution 1447/2018 clearly establishes that ERs that are canceled may not be transferred or used again.

With the foregoing, the Biocarbon ERP, by registering properly in the RENARE once it is open to the public and, complying with the provisions of Resolution 1447 of 2018, particularly in its article 51 (see section 3.7.2), will reduce the risk that the potential reductions of the ERP in the framework of its jurisdiction are counted again by some other actor.

# SECTION 4: GHG REPORTING AND ACCOUNTING:

## 4.1 GHG INVENTORY OF THE PROGRAM

### 4.1.1 BRIEF DESCRIPTION OF THE PROGRAM'S GHG INVENTORY

The GHG inventory of the Orinoquia was prepared using the IPCC guidelines described in the documents 2006 IPCC Guidelines for National GHG Inventories and 2019 Refinement to the 2006 IPCC Guidelines for National GHG Inventories (IPCC, 2019). The ERP Biocarbon GHG inventory includes improvements and new categories that will be implemented in future Country Inventories, and is also consistent with the definitions, categories, subcategories and methodologies used in the Colombian National GHG Inventory.

According to the IPCC, the compilation of the GHG inventory corresponding to the Agriculture, Forestry and Other Land Use (AFOLU) module in the Orinoquia region includes three main categories: 3A. Livestock, 3B. Land and 3C. Aggregate sources and non- $CO_2$ emissions from land for the 2009-2018 time series, estimating carbon dioxide ($CO_2$), methane ($CH_4$) and nitrous oxide ($N_2O$) emissions.

Table 18 Describes the nomenclature of the IPCC subcategories in the AFOLU sector inventory and the adapted name explaining the estimated component.

Table 18. Orinoquia Region Inventory

| Sector | IPCC Category | IPCC Subcategory | Adapted category |
|---|---|---|---|
| **Land use and land use change** | 3B1 - Forest Lands | 3B1ai - Forest remaining forest | Forest remaining forest |
| | | 3B1aii1 - Natural forest converted to other forest land | Forest which is converted to other forest land |
| | | 3B1aii2 - Dynamic in OWV | Dynamic in OWV |
| | | 3B1aiii - Dynamic in forest plantations | Dynamic in forest plantations |
| | | 3B1bi - Land converted to forest | Land converted to forest (Regeneration) |
| | 3B2 - Crop land | 3B2aii – Oil Palm | Dynamic in oil palm cultivation |
| | | 3B2bi - Forest land converted to cropland | Forest converted to cropland (Deforestation) |
| | 3B3 - Grassland | 3B3a – Grassland remaining Grassland | Emissions from organic soils in grasslands |
| | | 3B3bi - Forest land converted to grassland | Forest converted to grassland (Deforestation) |
| | 3B4 - Wetlands | 3B4bi - Forest land converted to wetlands | Forest converted to wetlands (Deforestation) |
| | 3B5 - Settlements | 3B5bi - Forest land converted to settlements | Forest converted to settlements (Deforestation) |
| | 3B6 - Other land | 3B6bi - Forest land converted to other land | Forest converted to the other land (Deforestation) |
| **Livestock** | 3A1 - Enteric fermentation | 3A1a - Total cattle | Enteric fermentation of bovine cattle |
| | | 3A1b - Buffalo | Buffalo Enteric fermentation |
| | | 3A1c - Sheep | Sheep enteric fermentation |
| | | 3A1d - Goats | Goat enteric fermentation |
| | | 3A1f - Horses | Horses Enteric fermentation |
| | | 3A1g - Mules and asses | Enteric fermentation of mules and asses |
| | | 3A1h - Swine | Swine Enteric fermentation |
| | 3A2 - Manure management | 3A2a - Total cattle | Bovine cattle Manure management |
| | | 3A2b - Buffalo | Buffalo Manure management |
| | | 3A2c - Sheep | Sheep Manure management |
| | | 3A2d - Goats | Goat Manure management |
| | | 3A2f - Horses | Horses Manure management |
| | | 3A2g - Mules and asses | Mules and asses Manure management |

| Sector | IPCC Category | IPCC Subcategory | Adapted category |
|---|---|---|---|
| | | 3A2h - Swine | Swine Manure management |
| | | 3A2j - Poultry | Poultry Manure management |
| **Soil management -Aggregate sources** | 3C6 - Indirect $N_2O$ emissions from manure management | 3C1a - Emissions from biomass burning in forest lands | Emissions from Forest Fires |
| | | 3C1c - Emissions from biomass burning in grasslands | Emissions from grassland fires |
| | | 3C1b - Emissions from biomass burning in cropland | Emissions from crop fires |
| | | 3C2 - Liming | Emissions from lime application to soil |
| | | 3C3 - Urea application | Emissions from urea application to soil |
| | | 3C4a – Synthetic N fertilizers ($F_{SN}$) | Synthetic fertilizer nitrogenous |
| | | 3C4b - Organic N applied as fertilizer ($F_{ON}$) | Organic fertilizer |
| | | 3C4c - Crop residues including nitrogen fixers and forage residues in grasslands renewal ($F_{CR}$) | Crop residues |
| | | 3C4d – Mineralization N due to change in use or management in mineral soils ($F_{SOM}$) | Mineralization N due to change in soil use or management in minerals soils |
| | | 3C4e – Organic soil management ($F_{OS}$) | Histosols / organics soil management |
| | | 3C4f - Urine and dung from grazing animals ($F_{PRP}$) | Urine and dung deposited from grazing animals |
| | | 3C5a - Volatilization - Synthetic N Fertilizers ($F_{SN}$) | Volatilization of Synthetic N Fertilizer |
| | | 3C5b - Volatilization – Organic N applied as fertilizer ($F_{ON}$) | Volatilization of organic N fertilizer |
| | | 3C5c - Volatilization - Urine and dung from grazing animals ($F_{PRP}$) | Volatilization of urine and dung deposited from grazing animals |
| | | 3C5d - Leaching/runoff Synthetic N fertilizers ($F_{SN}$) | Synthetic N fertilizer leaching/runoff |
| | | 3C5e Leaching /Runoff Organic N applied as fertilizer ($F_{ON}$) | Leaching/runoff of organic N fertilizer |
| | | 3C5f - Leaching/runoff Crop residues including nitrogen fixers and forage residues in grassland renewal ($F_{CR}$) | Leaching/runoff from crop residues |
| | | 3C5g - Leaching/runoff Mineralization due to change in use or handling ($F_{SOM}$) | Leaching/runoff Mineralization N due to change in use or management on mineral soils |
| | | 3C5h - Leaching/runoff - urine and dung from grazing animals ($F_{PRP}$) | Leaching/runoff of deposited urine and dung from grazing animals |
| | | 3C6a - Total Cattle | Indirect cattle manure management |
| | | 3C6b - Buffalo | Indirect buffalo manure management |

| Sector | IPCC Category | IPCC Subcategory | Adapted category |
|---|---|---|---|
| | | 3C6c - Sheep | Indirect Sheep manure management |
| | | 3C6d - Goats | Indirect goat manure management |
| | | 3C6f - Horses | Indirect Horse Manure Management |
| | | 3C6g - Mules and asses | Indirect mule and asses manure management |
| | | 3C6h - Swine | Indirect Swine Manure Management |
| | | 3C6j -Poultry | Indirect poultry manure management |

**Livestock Sector**

***3A - Livestock:*** considers all direct emissions of methane ($CH_4$) and nitrous oxide ($N_2O$) from livestock that register populations in a given location. It is composed of enteric fermentation emissions[118] and direct and indirect emissions[119] from manure management of all livestock categories in the region (cattle, buffalo, goats, sheep, horses, mules, asses, swine and poultry).

- ***3A1 Enteric fermentation:*** estimates enteric $CH_4$ emissions from annual averages of live cattle (disaggregated into six age groups). For the Orinoquia region they are: low production cows, cows for meat production, bulls used for breending purposes calves pre-weaning, Replacement dairy heifers and Growing – fattening cattle, buffalo, sheep, goats, horses, mules and asses and swine. The activity data are obtained from the single municipal vaccination registry of FEDEGAN and departmental information from the ICA and the Statistics Division of the Food and Agriculture Organization of the United Nations (FAOSTAT). The emission factor attributed for bovine emissions used level 2 methodology at the subnational level, while level 1 was used for the other species.

- ***3A2-3C6 Manure management:*** quantifies direct and indirect (3C6) $CH_4$ and $N_2O$ emissions generated by animal production systems, particularly systems for the treatment, handling, storage and transport of manure from livestock species included in category 3A1. The average annual number of animals is used as activity data, using municipal statistical information provided by FEDEGAN, FAOSTAT, ICA and departmental information from the National Federation of Poultry Farmers of Colombia FENAVI The emission factor from manure used for cattle in $CH_4$ corresponds to level 2 methodology, for $N_2O$ level 1. For the

[118] Enteric fermentation: digestive process by which microorganisms break down carbohydrates into simple molecules for absorption into an animal's bloodstream. Large amounts of CH4 emissions are produced during this process. Source: United Nations Framework Convention on Climate Change Glossaries

[119] Manure management: Different management of urine and feces generated by domestic species in a specific place. Source: IPCC, Module 4, chapter 10

remaining species, level 1 methodology was used (IPCC, 2019).

***Land use sector and land-use change***

***3B Land:*** this category accounts for $CO_2$ emissions and removals from the use of land that remains in the same category, or land that was in another category and changed to another land use. This category is subdivided into six subcategories: 3B1 Forest land, 3B2 Cropland, 3B3 Grassland, 3B4 Wetlands, 3B5 Settlements, and 3B6 Other land.

- ***3B1 Forest Land:*** determined as land with forest vegetation consistent with the thresholds used to define forest land in the National GHG Inventory (NGHGI). In Colombia, the SMByC uses the word "Bosque" which is different than Forest lands, this definition is clarified in the subcategory 3B1aii1. It is important to be aware of this difference because Forest lands refers to both natural and planted trees Meanwhile, "Bosque" refers to Natural Forest, but it is used in this text as "Forest". The category considers five subcategories as described below:

  *3B1ai Forest remaining forest:* Emissions from firewood consumption in the rural population are estimated as an indicative factor of forest degradation. The activity data were obtained from information on rural population generated by the DANE and the percentage of the population that consumes firewood from the Sustainable Rural Energy Plans PERS of the UPME. The emission factors used are Tier 2 and correspond to the firewood consumption established in the PERS. This subcategory also reports the estimated emissions from organic soil management in forest lands based on the IGAC geopedological map and default factors from the 2006 IPCC Guidelines.

  *3B1aii1 Natural forest converted to other forest land:* This subcategory reports the decreases (deforestation[120]) of the forest area[121] which is transformed into other land cover considered in the forest land category, specifically OWV and forest plantations. The activity data were generated by the SMByC for the period 2009-2018 based on "The protocol for the treatment of satellite data for the generation of activity data", which includes the following four phases for its development: i) digital pre-processing of satellite images; ii) digital image processing; iii) data validation; and iv) reporting of activity data[122]. The proportion of forest that changed to other land cover was estimated from a post-stratified

[120] Deforestation is defined as: the direct and/or induced conversion of forest cover to another type of land cover in a given period of time (DeFries et al. 2006, GOFC-GOLD 2009).

[121] The definition of forest for Colombia under the UNFCCC and used by the SMBYC for its analysis is: "land occupied mainly by trees, which may contain shrubs, native palms, guaduas, herbs and lianas, in which tree cover predominates with a minimum canopy density of 30%, a minimum canopy height (in situ) of 5 m at the time of identification and a minimum area of 1,0 hectare. Tree cover of commercial forest plantations, oil palm plantations and trees planted for agricultural production are excluded". . NREF_Colombia_2020

[122] 11-DA_Protocolo_cuantificación_deforestación.pdf

point sampling over the areas identified as deforested in the Program region for each period (deforestation typification).

The emission factor is level 2, particularly to determine the carbon contents of forest biomass, and are obtained from those reported by the IFN. Estimates of changes in carbon content in the DOM are level 1.

*3B1aii2 Dynamic in OWV:* OWV refers to land occupied mainly by natural and/or anthropogenic trees, shrubs, native palms and/or bamboo, whose canopy density is between 10 to 30%, the canopy height (in situ) varies between 0,5 to 5 m at the time of identification and its minimum extension is 0,5 hectares. Includes natural vegetation, trees planted for timber and non-timber agricultural[123] and forestry production, excluding forest plantations (see category 3B1aiii) and oil palm plantations (see category 3B2aii).

In the subcategory dynamic in OWV, $CO_2$ removals are estimated by the gain of carbon content in stable areas and new areas of this cover and emissions by carbon losses due to the reduction of areas. The SMByC estimated these areas for the period 2009-2018, applying the protocol for the treatment of satellite data already mentioned. The biomass emission factor for this subcategory corresponds to the information gathered by Yepes et al. (2011).

*3B1aiii Dynamic in forest plantations*: Refers to land occupied by mostly planted tree vegetation with different levels of management. It includes plantation types for afforestation and reforestation for timber agricultural production and/or non-timber products or environmental goods and services. Trees, shrubs, native palms, natural and/or anthropogenic bamboo, and oil palm and coconut plantations are excluded. The area of this subcategory was identified based on the differentiation of forest plantations from areas the OWV Dynamic category, using remote sensing and field information and from MADR and ICA records.

This subcategory estimates $CO_2$ removals due to the gain of carbon content in new areas and stable areas of this cover and emissions due to carbon losses due to the reduction of areas by harvesting or change of use. The SMByC estimated these areas for the period 2009-2018, applying the protocol for the treatment of satellite data already mentioned. The biomass emission factors are level 2 and are obtained from particular records for the species in the region.

*3B1bi - Land converted to forest:* This subcategory accounts for the increase in carbon content due to the reported change in land use from other land uses to forest, a process

[123] For example, the categories coffee, lemon, mandarin, tangelo, orange, mango and avocado, which meet the definition of OWV and were previously included in cropland remaining cropland.

called regeneration. Activity data are generated by the SMByC. Emission factors for biomass and soils are level 2 and were obtained from the IFN. Level 1 was used for DOM.

- *3B2 Cropland:* quantifies $CO_2$ emissions and removals from forest that is converted to cropland. This category is divided into two broad groups: 3B2a Cropland Remaining Cropland and 3B2b Land Converted to Cropland.

  *3B2a Cropland Remaining Cropland:* This subcategory only reports $CO_2$ estimates for oil palm cultivation (adapted category, Oil Palm Dynamic), emissions from biomass burning in crop areas (Ha) obtained from statistical reports consolidated by the SNIF, as well as emissions from organic soil management on cropland from the geopedological map of the IGACO, with default emission factors from the 2006 IPCC Guidelines.

  *3B2aii Oil Palm cultivation dynamic:* Refers to land occupied by plantations of African oil palm (Elaeis guineenis and E. oleifera x E. guineensis). The area of this subcategory was identified from the differentiation of this crop from the other types of OWV, using remote sensing, field information and CENIPALMA records. This category excludes trees, shrubs, native palms, natural and/or anthropogenic bamboo, coconut crops and forest plantations reported in categories 3B1aii2 and 3B1aiii. In this subcategory, $CO_2$ removals are estimated for the gain of carbon content in new and stable areas of this cover and emissions for carbon losses due to the reduction of areas due to replanting or change of use. The SMByC estimated these areas for the period 2009-2018, applying the protocol for the treatment of satellite data. The biomass emission factor is specific to the Orinoquia (Tier 2) and is taken from Henson et. al. 2012.

  *3B2bi Forest land converted to cropland:* Includes information on forest areas converted to cropland (oil palm plantations and other crops), as part of the deforestation analysis carried out by the SMByC, based on the protocol for processing satellite data and the deforestation typification method mentioned in category 3B1aii. The factors for carbon content in biomass and soils were obtained from the IFN.

- ***3B3 Grassland:*** $CO_2$ emissions and removals are accounted for by the use of grasslands and areas of forest that are converted to grassland. This subcategory is divided into two major groups:

  *3B3a Grassland remaining Grassland:* emissions from biomass burning in burned grassland areas are accounted for, with information from statistical reports consolidated by the SNIF as well as emissions from organic soil management on grasslands land from the geopedological map of the Agustín Codazzi Geographic Institute (IGAC) and default emission factors from the 2006 IPCC Guidelines.

*3B3b Land Converted to Grassland:* Only includes GHG estimates for the Forest Converted to Grassland subcategory and incorporates the deforestation analyses performed by SMByC, based on the protocol for satellite data processing and the deforestation typification method mentioned in category 3B1aii. The biomass and soil carbon content factors were obtained from the IFN and the DOM contents are default factors from the 2006 IPCC Guidelines.

- ***3B4 Wetlands:*** Refers to areas of peat extraction, land covered or saturated with water for part or all of the year and that do not fall into the categories of forest land, cropland, grassland or settlements.

  In this category only $CO_2$ emissions from the decrease in forest cover due to deforestation processes are accounted for, particularly from changes in forest that is converted to wetlands (wetlands bodies and vegetation). The activity data are obtained by SMByC from the protocol for satellite data processing and the deforestation typification method mentioned in category 3B1aii. The biomass and soil carbon content factors were obtained from the IFN and the DOM contents are default factors from the 2006 IPCC Guidelines.

- ***3B5 Settlements:*** All built-up land, including transport infrastructure and human settlements of any size, unless already included in other categories. This category only accounts for $CO_2$ emissions from the decrease in forest cover due to deforestation processes, particularly from changes in forest that is converted to settlements (urban which includes infrastructure). The activity data are obtained by SMByC from the protocol for the treatment of satellite data and the method of deforestation typification mentioned in category 3B1aii. Biomass and soil carbon content factors were obtained from the IFN and DOM contents are default factors from the 2006 IPCC Guidelines.

- ***3B6 Other land:*** Includes bare soil, rock, ice and all areas not included in any of the other five categories. In this category, only $CO_2$ emissions from the decrease in forest cover due to deforestation processes are accounted for, particularly changes in forest that becomes other land (bare soil). The activity data are obtained by SMByC from the protocol for satellite data processing and the deforestation typification method mentioned in category 3B1aii Biomass and soil carbon content factors were obtained from the IFN and DOM contents are default factors from the 2006 IPCC Guidelines.

***Land Management Sector - Aggregate Sources***

***3C Aggregate sources and non-$CO_2$ emissions from land:*** quantifies all non-$CO_2$ GHG emissions from managed covers, estimated emissions from biomass burning, $CO_2$ emissions from lime and urea application on agricultural soils, direct and indirect $N_2O$ emissions from managed soils and manure management systems (agricultural activities) and $CH_4$ from rice cultivation.

- ***3C1 Estimates GHG emissions biomass burning:*** Estimates GHG emissions from fire (for both $CO_2$ and non-$CO_2$ gases) caused by humans. These include C monoxide (CO), $CH_4$, $N_2O$ and nitrogen oxides (NOx). These gases are estimated in three land use types: 3C1a Forest Land, 3C1b Cropland and 3C1c Grassland. Their activity data are the annual area burned (Ha) reported by SNIF at the departmental level, using the advanced level 1 methodology.

- ***3C2 $CO_2$ emissions from lime application:*** Quantifies carbonate emissions to soils, in the form of lime (e.g., calcium limestone ($CaCO_3$) or dolomite ($CaMg(CO_3)_2$) in agricultural soils. For the quantification of this category, the quantities of lime (t) were estimated based on the areas sown per department considering the information from the Agricultural Assessments and the Statistical Yearbook (available on the AGRONET portal). In addition, indicators of use and consumption by crop were used, through consultation with experts. The calculation considers a level 1 methodology.

- ***3C3 $CO_2$ emissions from urea application***: $CO_2$ emissions from urea added to soils during fertilization leads to $CO_2$ loss. Similar to the soil reaction when lime is added, the bicarbonate formed is converted to $CO_2$ and water. The activity data and methodological level of estimation were determined similar to those described in the Synthetic N fertilizer subcategory.

- ***3C4-3C5 Direct and indirect $N_2O$ emissions from managed soils***: This subcategory estimates direct (from soil) and indirect (leaching and volatilization) $N_2O$ emissions generated by nitrogen aggregates in agricultural and livestock systems or by changes occurring on the land and/or its management. Direct emissions (subcategory 3C4) are produced from N sources that are applied directly to the soil and indirect emissions (subcategory 3C5) by $N_2O$ generated through two pathways: 1) volatilization of nitrogen as $NH_3$ and N oxides (NOx), and deposition of these gases and their products $NH_4$+ and $NO_3$- on soils and surfaces of lakes and other water bodies and 2) leaching and runoff of N primarily as $NO_3$ from managed soils.

  The aggregates or sources of nitrogen considered in the estimation of these subcategories in the Orinoquia regional inventory are:

  - Synthetic N fertilizers ($F_{SN}$): estimates emissions from annual fertilizer consumption, the source of information is official country statistics recorded as fertilizer sales and/or as local production and imports with an approximation by crop demand for the region.
  - Organic N applied as fertilizer, e.g., animal manure, compost, sewage sludge, waste ($F_{ON}$): calculates nitrous oxide emissions from managed manure N available for land application corresponding to the dry lot system, solid storage, daily distribution, open anaerobic lagoon, liquid manure < 1 month and biogas anaerobic digestion (kg N). Activity data for calculating kg N. $yr^{-1}$ are from estimates previously made in subcategories 3A2 and 3C6 of direct $N_2O$ emissions from manure management systems.

- Nitrogen from urine and dung deposited on grasslands, range and paddocks by grazing animals ($F_{PRP}$): estimates $N_2O$ emissions from N deposited on grasslands and paddock soils by grazing animals. It is estimated from the fraction of N deposited on grasslands and paddock soils by each livestock species. The average annual amount of N excreted by each livestock species is estimated considering the number of animals in each species.
- Nitrogen in agricultural residues (aerial and uderground), including nitrogen-fixing and forage crops during grasslands renewal ($F_{CR}$): emissions from crop residues to by-products remaining in the paddock after harvesting, i.e. plants or part of them that are separated to obtain the fruit or agricultural product within them are roots, leaves, decomposing fruits, stems and in general aerial and underground parts of plants.
- **Nitrogen mineralization related to loss of soil organic matter as a result of changes in land use or management of mineral soils ($F_{SOM}$):** estimates $N_2O$ emissions by the amount of N mineralized from the loss of soil organic C in mineral soils due to changes in land use or management practices. Its estimation is because changes made in land use and all management practices on the soil can have a significant impact on organic C storage.
- **Drainage/management of organic soils (Histosols) ($F_{OS}$)**: quantifies the $N_2O$ emissions given in the total annual area of drained/managed organic soils. The activity input used considers N2O emissions from organic soil drainage/management (FOS) and the total annual area of drained/managed organic soils for all land uses.

- ***3C7 $CH_4$ emissions from rice cultivation:*** refers to the annual amount of $CH_4$ generated by the anaerobic decomposition of organic material in flooded rice fields. It depends mainly on the amount and duration of the type of cultivation, water regimes and organic and inorganic fertilizers in the soil. Two specific systems corresponding to irrigated and rainfed are characterized for the Orinoquia region. The methodological level involves the calculation by department, considering the consultation of experts from FEDEARROZ and AGROSAVIA to assign the IPCC 2019 values (Advanced Level 1), according to the current conditions of the country and/or region.

***3D1 Harvested Wood Products:*** Wood harvested from forests is converted into a wide variety of wood products. Carbon content from wood fluxes within wood products through their life cycle. In this subcategory the contribution of Harvested Wood Products (HWP) to the annual $CO_2$ emissions/removals of the AFOLU sector is estimated and reported.

Finally, it is important to mention that the estimation of the subcategories and the methodological approach for estimating emissions and removals in the Orinoquia region is consistent with the BUR 3, submitted by Colombia and reported by the UNFCCC for the period 1990-2018 (IDEAM, 2021). Regarding BUR 3, improvements were included, for example: estimates based on spatially explicit information for oil palm cultivation and forest plantations. Additionally, a new category was included that corresponds to information on OWV[124]. On the other hand, "top-down" approaches were developed to arrive at specific information (based on national information) and "bottom-up" approaches, which started from local data at a more detailed level (based on departmental and municipal information). This information can be seen in the emission estimation spreadsheets for each category.

### 4.1.2 SUMMARY OF THE ERP-BIOCHARBON GHG INVENTORY

Table 8 presents the GHG inventory with the corresponding subcategories and their net emissions contribution in absolute and relative values for the program area. Relevant subcategories that make part of the cumulative 91% of net emissions for the region are observed, which are presented in order of importance to: Forest converted to grassland (Deforestation), Cattle Enteric Fermentation, Dynamic in OWV, Forest converted to other forest land, Rice cultivation, Forest remaining forest, Dynamic in forest plantations, Urine and dung deposited from grazing animals.

Table 8. Summary of the ERP GHG inventory

| IPCC Subcategory Net emissions and removals | Adapted subcategory | 2009-2018 series average emissions (given in Gg de $CO_2$ eq) | Percentage of participation series | Estimated GHG |
|---|---|---|---|---|
| 3B3bi - Forest land converted to grassland | Forest converted to grassland (Deforestation) | 9.951,14 | 33,05% | $CO_2$ in AGB, BGB, SOC y DOM |
| 3A1a - Total Cattle | Cattle Enteric Fermentation | 7.330,37 | 24,35% | $CH_4$ |
| 3B1aii2 - Dynamic in OWV | Dynamic in OWV | -4.023,18 | 13,36% | $CO_2$ in AGB, BGB |
| 3B1aii1 - Natural forest converted to other forest land | Forest converted to other forest land | 3.235,07 | 10,75% | $CO_2$ in AGB, BGB, SOC y DOM |
| 3C7 - Rice cultivation | Rice cultivation | 1.423,12 | 4,73% | $CH_4$ |
| 3B1ai - Forest remaining forest | Forest remaining forest | 636,87 | 2,12% | $CO_2$ in AGB, SOC |

[124] The categories coffee, lemon, mandarin, tangelo, orange, mango and avocado, which were previously included in cropland remaining cropland, are now grouped together in the category OWV dynamic to avoid double counting. The dynamic category of OWV is not reported in BUR 3 because it was an improvement developed after its publication. It is expected that these methodological improvements will be reported in the next National GHG Inventory that Colombia will report to the UNFCCC

| IPCC Subcategory Net emissions and removals | Adapted subcategory | 2009-2018 series average emissions (given in Gg de $CO_2$ eq) | Percentage of participation series | Estimated GHG |
|---|---|---|---|---|
| 3B1aiii - Dynamic in forest plantations | Dynamic in forest plantations | -448,21 | 1,49% | $CO_2$ in AGB, BGB |
| 3C4f - Urine and dung from grazing animals ($F_{PRP}$) | Urine and dung deposited from grazing animals. | 415,84 | 1,38% | $N_2O$ |
| 3B2aii - Oil Palm | Dynamic in oil palm cultivation | -330,32 | 1,10% | $CO_2$ in AGB, BGB |
| 3B2bi - Forest land converted to cropland | Forest converted to cropland (Deforestation) | 287,06 | 0,95% | $CO_2$ in AGB, BGB, SOC y DOM |
| 3B4bi - Forest land converted to wetlands | Forest converted to wetlands (Deforestation) | 232,65 | 0,77% | $CO_2$ in AGB, BGB, SOC y DOM |
| 3C1a - Emissions from biomass burning in forest lands | Emissions from Forest Fires | 203,75 | 0,68% | $CH_4$, $N_2O$ |
| 3B1bi - Land converted to forest | Land converted to forest (Regeneration) | -198,33 | 0,66% | $CO_2$ in AGB, BGB, SOC y DOM |
| 3C5c - Volatilization - Urine and dung from grazing animals ($F_{PRP}$) | Volatilization of Urine and dung deposited from grazing animals. | 196,03 | 0,65% | $N_2O$ |
| 3C5h - Leaching/runoff - urine and dung from grazing animals ($F_{PRP}$) | Leaching/runoff of deposited urine and dung from grazing animals | 176,03 | 0,58% | $N_2O$ |
| 3B3a - Grassland remaining Grassland | Emissions from organic soils and grasslands fires | 167,90 | 0,56% | $CO_2$ in AGB, SOC |
| 3C4d - Mineralization N due to change in use or management in mineral soils ($F_{SOM}$)) | Mineralization due to change in soil use or management | 125,35 | 0,42% | $N_2O$ |
| 3A1f - Horses | Enteric fermentation of horses | 105,32 | 0,35% | $CH_4$ |
| 3B6bi - Forest land converted to other land | Forest converted to other land (Deforestation) | 89,35 | 0,30% | $CO_2$ in AGB, BGB, SOC y DOM |
| 3A2a - Total Cattle | Cattle manure management | 74,23 | 0,25% | $CH_4$, $N_2O$ |
| 3C4a - Synthetic N fertilizers (FSN) | Synthetic fertilizer | 66,61 | 0,22% | $N_2O$ |

| IPCC Subcategory Net emissions and removals | Adapted subcategory | 2009-2018 series average emissions (given in Gg de $CO_2$ eq) | Percentage of participation series | Estimated GHG |
|---|---|---|---|---|
| 3C5g - Leaching/runoff Mineralization due to change in use or handling ($F_{SOM}$) | Leaching/runoff Mineralization N due to change in use or management on mineral soils | 55,15 | 0,18% | $N_2O$ |
| 3A2h - Swine | Swine manure management | 45,57 | 0,15% | $CH_4$, $N_2O$ |
| 3A1b - Buffaloes | Enteric fermentation of buffaloes | 31,58 | 0,10% | $CH_4$ |
| 3B2axi - Other | Emissions from organic soils and crop fires | 28,60 | 0,09% | $CO_2$ in AGB, SOC |
| 3C4c - Crop residues including nitrogen fixers and forage residues in grassland renewal ($F_{CR}$) | Crop residues | 26,65 | 0,09% | $N_2O$ |
| 3C2 - Liming | Emissions from lime application to soil | 24,98 | 0,08% | $CO_2$ |
| 3B5bi - Forest land converted to settlements | Forest converted to settlements (Deforestation) | 20,14 | 0,07% | $CO_2$ in AGB, BGB, SOC y DOM |
| 3C5d - Leaching/runoff Synthetic N fertilizers ($F_{SN}$) | Synthetic N fertilizer leaching/runoff | 17,42 | 0,06% | $N_2O$ |
| 3A2j - Poultry | Poultry manure management | 15,91 | 0,05% | $CH_4$, $N_2O$ |
| 3A1g - Mules and asses | Enteric fermentation of mules and asses | 14,87 | 0,05% | $CH_4$ |
| 3D1 - Harvested wood products | Harvested wood products | -13,80 | 0,05% | $CO_2$ |
| 3C5f - Leaching/runoff Crop residues including nitrogen fixers and forage residues in grassland renewal ($F_{CR}$) | Leaching/runoff from crop residues | 11,74 | 0,04% | $N_2O$ |
| 3C3 - Urea application | Emissions from urea application to soil | 11,34 | 0,04% | $CO_2$ |
| 3A2f - Horses | Horse manure management | 10,89 | 0,04% | $CH_4$, $N_2O$ |

| IPCC Subcategory Net emissions and removals | Adapted subcategory | 2009-2018 series average emissions (given in Gg de $CO_2$ eq) | Percentage of participation series | Estimated GHG |
|---|---|---|---|---|
| 3C5a - Volatilization - Synthetic N Fertilizers ($F_{SN}$) | Volatilization of Synthetic | 10,16 | 0,03% | $N_2O$ |
| 3A1c - Sheep | Sheep enteric fermentation | 8,33 | 0,03% | $CH_4$ |
| 3C1c - Emissions from biomass burning in rangelands | Emissions from grassland fires | 7,80 | 0,03% | $CH_4$, $N_2O$ |
| 3C6h - Swine | Indirect Swine Manure Management | 6,20 | 0,02% | $N_2O$ |
| 3A1h - Swine | Swine Enteric fermentation | 5,93 | 0,02% | $CH_4$ |
| 3C6j - Poultry | Indirect poultry manure management | 4,29 | 0,01% | $N_2O$ |
| 3C1b - Emissions from biomass burning in cropland | Crop fire emissions | 3,64 | 0,01% | $CH_4$, $N_2O$ |
| 3C4b - Organic N applied as fertilizer ($F_{ON}$) | Organic fertilizer | 3,24 | 0,01% | $N_2O$ |
| 3A2g - Mules and asses | Mule and asses manure management | 2,47 | 0,01% | $CH_4$, $N_2O$ |
| 3C5b - Volatilization – Organic N applied as fertilizer ($F_{ON}$) | Volatilization of organic N fertilizer | 1,59 | <0,01% | $CO_2$ in AGB, BGB, SOC y DOM |
| 3C5e - Leaching /Runoff Organic N applied as fertilizer ($F_{ON}$) | Organic fertilizer leaching/runoff | 1,43 | <0,01% | $N_2O$ |
| 3A1d - Goats | Goat enteric fermentation | 1,17 | <0,01% | $CH_4$ |
| 3A2b - Buffaloes | Buffalo manure management | 1,15 | <0,01% | $CH_4$, $N_2O$ |
| 3C6a - Total Cattle | Indirect cattle manure management | 0,76 | <0,01% | $N_2O$ |
| 3C6f - Horses | Indirect Horse Manure Management | 0,74 | <0,01% | $N_2O$ |
| 3A2c - Sheep | Sheep manure management | 0,53 | <0,01% | $CH_4$, $N_2O$ |

| IPCC Subcategory Net emissions and removals | Adapted subcategory | 2009-2018 series average emissions (given in Gg de $CO_2$ eq) | Percentage of participation series | Estimated GHG |
|---|---|---|---|---|
| 3C6g - Mules and asses | Indirect mule and asses manure management | 0,14 | <0,01% | $N_2O$ |
| 3C6b - Buffalo | Indirect buffalo manure management | 0,09 | <0,01% | $N_2O$ |
| 3C6c - Sheep | Sheep indirect manure management | 0,09 | <0,01% | $N_2O$ |
| 3A2d - Goats | Goat manure management | 0,08 | <0,01% | $CH_4$, $N_2O$ |
| 3C6d - Goats | Indirect goat manure management | 0,01 | <0,01% | $N_2O$ |
| 3C4e - Organic soil management ($F_{OS}$) | Histosols / organics soil management | <0,01 | <0,01% | $N_2O$ |
| **TOTAL** | | 20.077,52 | 100,00% | |

The construction of this table was carried out considering the information compiled from the AFOLU sector inventory, which can be consulted at 4_1_2_Orinoquia_GHGIN_2009_2018.xlsx. The traceability of the data can be found at: 4_1_2_Inventario_Resumen_Historico.xlsx.

## 4.2 IDENTIFICATION OF SUBCATEGORIES THAT ARE ELIGIBLE FOR ISFL ACCOUNTING.

### 4.2.1 STEP 1: INITIAL SELECTION OF SUBCATEGORIES

***Analysis of subcategories involving conversions between land use categories***

Table 9 presents information on the subcategories that involve conversions between land use categories, identifying their relative contribution to total NGHGI emissions and removals from the ERP, as well as the cumulative contribution to total absolute emissions and removals. According to the analysis it is observed that the largest contribution in these subcategories corresponds to: Forest Converted to Grassland (Deforestation) (71,01%) followed by Forest converted to other forest land (23,08%).

Table 9. Subcategories involving conversions between land use categories.

| Subcategory involving conversions between land use categories | Net emissions and removals (Gg $CO_2$ eq) | Relative contribution to total absolute GHG emissions and removals associated with all land-use conversions in the Program's GHG Inventory | Cumulative contribution to total absolute GHG emissions and removals associated with all land use conversions in the Program's GHG Inventory |
|---|---|---|---|
| Forest converted to grassland (Deforestation) | 9951,14 | 71,01 | 71,01 |
| Forest converted to other forest land | 3235,07 | 23,08 | 94,09 |
| Forest converted to cropland (Deforestation) | 287,06 | 2,05 | 96,14 |
| Forest converted to wetlands (Deforestation) | 232,65 | 1,66 | 97,80 |
| Forest converted to other land (Deforestation) | 89,35 | 0,64 | 98,44 |
| Forest converted to settlements (Deforestation) | 20,14 | 0,14 | 98,58 |
| Land converted to forest (Regeneration) | 198,33 | 1,42 | 100,00 |
| **Total absolute GHG emissions and removals associated with all land-use conversions** | **14.013,74** | **100** | |

The construction of this table was carried out considering the information compiled from the AFOLU sector inventory, which can be consulted at: 4_1_2_Orinoquia_GHGIN_2009_2018.xlsx

***List of subcategories included in the initial selection***

The list of subcategories included in the initial selection is shown in Table 10.

Table 10. List of subcategories included in the initial selection.

| subcategories | Justification for initial selection |
|---|---|
| Forest converted to grassland (Deforestation) | Mandatory category for involving land use changes, estimates by methodological level 2, GHG historical line |

| subcategories | Justification for initial selection |
|---|---|
| | data for a 10-year period (2009-2018), spatially explicit information generated by SMByC, land use change information). |
| Forest converted to other forest land | Mandatory category for involving land use changes, estimates by methodological level 2, GHG historical line data for a 10-year period (2009-2018), spatially explicit information generated by SMByC, land use change information. |
| Forest converted to cropland (Deforestation) | Mandatory category for involving land use changes, estimates by methodological level 2, GHG historical line data for a 10-year period (2009-2018), spatially explicit information generated by SMByC, land use change information. |
| Forest converted to wetlands (Deforestation) | Mandatory category for involving land use changes, estimates by methodological level 2, GHG historical line data for a 10-year period (2009-2018), spatially explicit information generated by SMByC, land use change information. |
| Forest converted to other land (Deforestation) | Mandatory category for involving land use changes, estimates by methodological level 2, GHG historical line data for a 10-year period (2009-2018), spatially explicit information generated by SMByC, land use change information. |
| Forest converted to settlements (Deforestation) | Mandatory category for involving land use changes, estimates by methodological level 2, GHG historical line data for a 10-year period (2009-2018), spatially explicit information generated by SMByC, land use change information. |
| Land converted to forest (Regeneration) | Mandatory category for involving changes in land use, estimates by methodological level 2, GHG historical line data for a period of 10 years (2009-2018), spatially explicit information generated by the SMByC and according to numeral 4.3.14 of the ISFL requirements it has a short-term improvement plan that will allow meeting the requirements regarding information on the use prior to the conversion to forest land. |
| Forest remaining forest | Mandatory category because it is part of forest land remaining forest land, however, it does not have estimates of the complete analysis of natural forest degradation and the existing GHG estimates are estimated from spatially referenced information. |

| subcategories | Justification for initial selection |
|---|---|
| Dynamic in OWV | Category that is part of the forest land remaining forest land; it presents new information for the project in a spatially explicit manner for the 2009-2018 time series, has estimates of methodological level 2 and according to numeral 4.3.14 of the ISFL requirements has a short-term improvement plan that will allow meeting the requirements regarding information on the use prior to the increase of areas and the use after the decrease of these areas. |
| Dynamic in forest plantations | Mandatory category because it is part of the forest land remaining forest land, it presents new information for the project in a spatially explicit manner for the 2009-2018 time series, it is estimated under methodological level 2 and according to numeral 4.3.14 of the ISFL requirements, it has a short-term improvement plan that will allow meeting the requirements regarding information on the use prior to the increase of areas and the use after the decrease of these areas. |
| Cattle Enteric Fermentation | Largest non-forest category, has historical GHG line data for a 10-year period (2009-2018), methodological level 2 estimates. |
| Rice cultivation | Important subcategory for the region in terms of agricultural land use and economic production. It has GHG historical line data for a 10-year period (2009-2018), advanced methodological level 1 estimates. In accordance with numeral 4.3.14 of the ISFL requirements, this category has a short-term improvement plan that will allow meeting the requirements against the methodological level used in the estimates. |
| Urine and dung deposited from grazing animals. | Selected to count all emissions from cattle to reflect emission reductions from mitigation activities in this sector. |
| Dynamic in oil palm cultivation | Important subcategory for the region, it presents new information for the project in a spatially explicit manner for the 2009-2018 time series, it has estimates of methodological level 2 and according to numeral 4.3.14 of the ISFL requirements it has a short-term improvement plan that will allow meeting the requirements regarding information on the use prior to |

| subcategories | Justification for initial selection |
|---|---|
| | the increase of areas and the use after the decrease of these areas. |
| Volatilization of Urine and dung deposited from grazing animals. | Selected to count all emissions from cattle to reflect emission reductions from mitigation activities in this sector. |
| Leaching/runoff of deposited urine and dung from grazing animals | Selected to count all emissions from cattle to reflect emission reductions from mitigation activities in this sector. |
| Cattle manure management | Selected to account for all cattle emissions to reflect emission reductions from mitigation activities in this sector. Has GHG historical line data for a 10-year period (2009-2018), methodological tier 1 estimates for $CH_4$ and 2 for $N_2O$. |
| Indirect Manure Management of Cattle | Selected to count all emissions from cattle to reflect emission reductions from mitigation activities in this sector. |

### 4.2.2 STEP 2: SUMMARY OF THE REVIEW OF THE AVAILABLE DATA AND METHODS FOR THE SUBCATEGORIES FROM THE INITIAL SELECTION AGAINST THE QUALITY AND BASELINE SETTING REQUIREMENTS FOR ISFL ACCOUNTING.

describes the review of the available data and methods in each of the selected subcategories.

Table 11 describes the review of the available data and methods in each of the selected subcategories.

Table 11. Summary of the review of available data and methods for the initial screening

subcategories with respect to quality and baseline setting requirements for ERP accounting.

| | |
|---|---|
| **Subcategory** | • **Forest converted to grassland (Deforestation)**<br>• **Forest converted to other forest land**<br>• **Forest converted to cropland (Deforestation)**<br>• **Forest converted to wetlands (Deforestation)**<br>• **Forest converted to other land (Deforestation)**<br>• **Forest converted to settlements (Deforestation)** |
| **Historical time series and available data source for activity data needed to calculate the baseline** | The analysis of emissions from deforestation in these subcategories includes information on changes from natural forest to other forest cover and land uses, such as shrublands, grasslands, crops, oil palm cultivation, forest plantations, urban soils, swamp vegetation, water bodies and bare soil, for the period 2009 to 2018 in the Orinoquia, Amazon and Andean biomes, all of them represented in the jurisdiction of the Orinoquia region. Information on the proportion of these changes by cover type proposed in the IPCC (2006) guidelines is also considered, based on a deforestation typification analysis that provides information on the percentages of change from natural forest to each cover, obtained from a post-stratified sampling of points at the project level. The SMByC estimates forest cover decline based on the country-specific definition of natural forest; for this reason, the decrease in forest cover that does not change its use and remains as forest land is also reported as deforestation, these changes are associated with the decrease in natural forest that is converted to other vegetation that falls within the forest classification thresholds, such as commercial forest plantations (low occurrence) or OWV (woody shrubs and/or secondary vegetation), these emissions are recorded in the subcategory Forest converted to other forest land[125]. |
| **Data source for determining emission factors or emission or elimination factors** | The emission factors for the carbon content of aboveground biomass, belowground biomass and soil carbon for the country's reference forests are broken down by biome (Amazon, Orinoquia, Andes, Caribbean and Pacific) and are taken from the information generated by IFN, and are the same as those established for Colombia's Forest Reference Emissions Level - FREL.[126]. For the Orinoquia emissions baseline, only the factors corresponding to the Amazon, Orinoquia and Andean biomes, which fall within the jurisdiction of the Orinoquia region, are used[127]. Estimates of dead organic matter use the Tier 1 |

[125] View activity data support in the archives 03-DA_Region_Departmento.zip, 03-DA_SMBYC_tif.zip, 11-DA_Tipificacion_deforestación.zip and spreadsheets in: "Orinoquia Deforestación.xlsx
[126] Available in:https://redd.unfccc.int/files/02012019_nref_colombia_v8.pdf.
[127] View support files 03-FE_Estudio_Yepes_2011.pdf 03-FE_NIR-BUR3_Colombia.pdf and 11-FE_Manual_Campo_v5.2_IFN.pdf, as supports for the factors used in the country's deforestation estimates.

| | |
|---|---|
| **Subcategory** | • **Forest converted to grassland (Deforestation)**<br>• **Forest converted to other forest land**<br>• **Forest converted to cropland (Deforestation)**<br>• **Forest converted to wetlands (Deforestation)**<br>• **Forest converted to other land (Deforestation)**<br>• **Forest converted to settlements (Deforestation)** |
| | default value for litter and dead wood carbon stocks in tropical forests presented in Table 2.2 of the 2006 IPCC Guidelines. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | These categories are estimated using the gain-loss method and methodological tier 2 with emission factors based on country-specific data from the IFN for the Orinoquia, Andean and Amazon biome. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use.** | The country has spatially explicit information consistent with Approach 3 described in Chapter 3 (Consistent representation of land) of Volume 4 of the 2006 IPCC Guidelines.<br><br>This information is specific to conversions between forest cover and other cover types. Forest is defined as: "land occupied mainly by trees, which may contain shrubs, native palms, guaduas, herbs and lianas, in which tree cover predominates with a minimum canopy density of 30%, a minimum canopy height (in situ) of 5 m at the time of identification and a minimum area of 1,0 hectare. Tree cover of commercial forest plantations, oil palm plantations and trees planted for agricultural production are excluded"<br><br>For the identification of post-deforestation land cover, the country has information consistent with approach 2 of the IPCC (2006) guidelines. |

| Subcategory | Land converted to forest (Regeneration) |
|---|---|
| **Historical time series and available data source for activity data needed to calculate the baseline.** | In this subcategory, removals corresponding to the forest regeneration rate are estimated, assuming a default time frame of 20 years for total forest recovery. After this time it is assumed that the regenerated area enters into dynamic equilibrium and its accumulation rate is zero. To date, the country does not have an analysis of the temporality of the forest and regenerated areas. The |

| Subcategory | Land converted to forest (Regeneration) |
| --- | --- |
| | analysis of change from forest to non-forest areas does not allow identifying the state or age of the forest, it only allows identifying the thresholds established in the country's definition of forest (area, height, density, etc.). When the SMByC already detects forest, it is because the evaluated areas meet the analysis thresholds and it is assumed that there are areas of forest in an advanced state of maturity; however, there is no specific information on this state of regeneration, which is why the default values for temporal analysis are used for the estimations. Information on spatially explicit activity data is available for the 2009-2018 historical series, based on information generated by the SMByC.[128]. |
| **Data source for determining emission factors or emission or elimination factors** | The factors used correspond to the carbon contents of aboveground biomass, belowground biomass and soil carbon in the natural forest, established from IFN information at the biome level (Amazon, Orinoquia and Andean), which are presented within the program area. Estimates of dead organic matter use the Tier 1 default value for carbon stocks in litter and dead wood of tropical forests, presented in Table 2.2 of Chapter 2, Volume 4 of the 2006 IPCC Guidelines. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | It is estimated using the Tier 2 gain-loss method with emission factors based on country-specific data obtained from the IFN |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use.** | The country has spatially explicit information consistent with Approach 3 described in Chapter 3 (Coherent representation of land) of Volume 4 of the 2006 IPCC Guidelines, which is obtained from the analysis of change of stable areas, increase and decrease of areas of natural forest cover. These data are obtained from the analysis of Landsat satellite images developed by the SMByC, which are available for the Orinoquia region in raster format for the 2009-2018 series. As an improvement plan for this category, it is proposed to establish a typification analysis as robust as that of deforestation and that allows knowing the use prior to the forest regeneration process, which is why, so far, estimates of gross removals are made for this category, in which only the carbon gains due to the growth of the natural forest are determined. This subcategory is of great importance within the emissions baseline for the region and the country, since it reflects efforts to implement regeneration and recovery processes in natural forest areas. |

[128] View activity data support in the files "03-DA_SMBYC tif.zip and spreadsheet: "Orinoquia Regeneración.xlsx

| Subcategory | Forest remaining forest |
|---|---|
| **Historical time series and available data source for activity data needed to calculate the baseline** | In this subcategory, $CO_2$ emissions resulting from the extraction of fuel wood (firewood) from the natural forest are reported, assuming that this activity has a direct impact on forest degradation and not on deforestation. For the GHG estimation, spatially referenced information is available from the statistical data of the rural population of the departments of the Orinoquia region from the 2018 National Population Census (DANE, 2018) and the information of the percentage of rural population consuming firewood from the 2018 quality of life survey, both data provided by DANE. The historical GHG emissions line has estimates for the period 2009-2018. |
| **Data source for determining emission factors or emission or elimination factors** | The emission factor used is the information on average firewood consumption in the rural population, established for the different regions of the country based on the Sustainable Rural Energization Plans - PERS of the UPME, information with which the carbon content of the firewood consumed is obtained, which is lost as an emission. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | The estimation of GHG emissions for this subcategory uses the Tier 2 methodology according to IPCC (2006) guidelines, taking into account activity-specific data and country-specific fuelwood consumption factors. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use** | This information is not spatially explicit and does not have land use change information, so it uses Approach 1 for consistent land representation. |

| Subcategory | Dynamic in OWV |
|---|---|
| **Historical time series and available data source for activity data needed to calculate the baseline** | This category estimates emissions and removals due to changes in the carbon content of biomass in stable areas, increase and decrease of cover classified as OWV and not included in the definition of forest in the country. This information is obtained from the SMByC change analysis and has a baseline of emissions for the period 2009-2018[129]. |

[129] View activity data support in the archives 03-DA_Region_Departmento.zip and "03-DA_SMBYC tif.zip. The spreadsheets are located in: 03-3B1aii2 Dinámica OVL

| Subcategory | Dynamic in OWV |
|---|---|
| **Data source for determining emission factors or emission or elimination factors** | The factors of carbon content in above and below ground biomass for the estimations of this subcategory are taken from studies developed for the country and compiled in Yepes et. al. (2011)[130] for shrub cover. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | It is estimated from the gains and losses method, Tier 2, with emission factors based on country-specific data from Yepes et. al. (2011). |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use** | The country has spatially explicit information consistent with Approach 3 described in Chapter 3 (Coherent representation of land) of Volume 4 of the 2006 IPCC Guidelines, which is obtained from analyses of change of stable areas, increase and decrease of areas of OWV cover that is not included within the definition of forest. These data are obtained from the analysis of Landsat satellite images developed by the SMByC, which are available for the Orinoquia region in raster format for the 2009-2018 series. However, there is no information on the use prior to the increase in area or the use after the decreases, therefore, obtaining this information will be part of the improvement plan. |

| Subcategory | Dynamic in forest plantations |
|---|---|
| **Historical time series and available data source for activity data needed to calculate the baseline** | For the analysis of removals and emissions from commercial forest plantation areas, there is spatially explicit information on areas of permanence, decrease and stable areas of commercial forest plantations, identified from the analysis of Landsat satellite images carried out by the SMByC with the support of spatial information provided by MADR and ICA on forest plantation area records. Information is available for the Orinoquia region in raster format for the 2009-2018 series[131]. |

[130] 03-FE_Estudio_Yepes_2011.pdf
[131] View activity data support in the files 03-DA_Region_Departmento.zip, 03-DA_SMBYC_tif.zip, and spreadsheets in: 04-3B1aiii Dinámica Plantaciones

| Subcategory | Dynamic in forest plantations |
|---|---|
| **Data source for determining emission factors or emission or elimination factors** | It is estimated from the gains and losses method, tier 2 with emission factors based on country-specific data obtained from statistics and studies of commercial forest plantations for the Orinoquia region, applying this information to the records obtained from the Forestry Statistical Bulletin, to consolidate emission factors by year and department[132]. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | It is estimated using the tier 2 gains and losses method with emission factors specific to the country for commercial forest plantations in the Orinoquia region. The factors for commercial forestry plantations used for the estimates of $CO_2$ removals and emissions of the ERP baseline were obtained from the compilation of secondary information from studies of factors for forestry plantations in the country, and discriminated and presented by regions of the country. This information was consolidated by the University of Tolima in the framework of Consultancy No. 011 of 2021 in the framework of the Orinoquia BioCarbon Project. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use** | The country has spatially explicit information consistent with Approach 3 described in Chapter 3 (Coherent representation of land) of Volume 4 of the 2006 IPCC Guidelines, which is obtained from analyses of change through satellite images of stable areas of increase and decrease of commercial forest plantation cover that are not included in the definition of forest. Which are available for the Orinoquia region in raster format for the 2009-2018 series. However, there is no information on the use prior to the increase in area or the use after the decrease in area; therefore, obtaining this information will be part of the improvement plan. |

| Subcategory | Cattle Enteric Fermentation |
|---|---|
| **Historical time series and available data source for activity data needed to calculate the baseline.** | The historical time series for the analysis of emissions corresponds to the years 2009 – 2018. In this sense, there is a 10-year line that is compatible with the ISFL methodological framework. The source of information for the activity data corresponds to the RUV reported by the ICA and FEDEGAN through the livestock censuses; this information was homologated with the age groups detailed in the RUV with |

132 See files “04-FE_Plantaciones.xlsx”, “04-FE_Estudio_UTolima.pdf” and “04-BD_FE_UTolima.xlsx” as supports for the factors used for the estimations in the forest plantations category.

| **Subcategory** | **Cattle Enteric Fermentation** |
|---|---|
| | those proposed by the IPCC (Refinement 2019). The activity data can be consulted at: 4_6_DA_Bovinos_Histórico_2009_2018.xlsx |
| **Data source for determining emission factors or emission or elimination factors** | The enteric $CH_4$ emission factor was calculated under a Tier 2 methodology, using the AFOLU 1 Colombia - IDEAM Model (4_6_Modelo_AFOLU 1_Colombia_IPCC_IDEAM_FE_CH4.xlsx), with information from the following sources: (AGROSAVIA- platform AlimenTro) (bromatological information from different feed sources such as grasslands and legumes), the Colombian Federation of Cattle Breeders - FEDEGAN (information on productive and reproductive variables such as daily weight gains, milk production, birth and mortality percentages), academia (fat and protein contents in meat and milk, genotypic characterization, manure management systems) and IDEAM (climatic information). |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | The enteric fermentation category of cattle currently has methodological tier 2 and is grouped into the IPCC subcategories: low production cows, cows for meat production, bulls used for breeding purposes, calves pre-weaning, Replacement dairy heifers and Growing - fattening cattle, buffalo, sheep, goats, horses, mules and assesand Swine. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use.** | N/A. |

| **Subcategory** | **Cattle manure management** |
|---|---|
| **Historical time series and available data source for activity data needed to calculate the baseline.** | The historical time series for the analysis of livestock emissions corresponds to the years 2009 - 2018, in that sense there is a 10-year line that is compatible with the ISFL methodological framework. The source of information for the activity data corresponds to the RUV reported by the ICA through the livestock censuses (4_6_DA_Bovinos_Histórico_2009_2018.xlsx); this information was homologated with the age groups detailed in the RUV with those proposed by the IPCC (Refinement 2019). |

| Subcategory | Cattle manure management |
| --- | --- |
| **Data source for determining emission factors or emission or elimination factors** | In the cattle manure management category, the combined emissions of $CH_4$ and direct $N_2O$ generated in the different manure management systems are reported. The emission factor for CH4 was calculated under a Tier 2 methodology, using the AFOLU 1 Colombia - IDEAM Model, with information from the following sources: (AGROSAVIA- platform AlimenTro) (bromatological information from different feed sources such as grasslands and legumes), the Colombian Federation of Cattle Breeders - FEDEGAN (information on productive and reproductive variables such as daily weight gains, milk production, birth and mortality percentages), academia (fat and protein contents in meat and milk, genotypic characterization, manure management systems) and IDEAM (climatic information).<br><br>On the other hand, for the calculation of direct $N_2O$ emissions from cattle manure management, the default emission factors suggested by IPCC (2019) tier 1 were used. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | The Cattle Manure Management category currently has methodological Tier 1 for $N_2O$ and Tier 2 for $CH_4$. It is grouped into IPCC subcategories: low production cows, cows for meat production, bulls used for breeding purposes, calves pre-weaning, Replacement dairy heifers and Growing - fattening cattle, buffalo, sheep, goats, horses, mules and assesand Swine. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use.** | N/A. |

| Subcategory | Rice cultivation |
| --- | --- |
| **Historical time series and available data source for activity data needed to calculate the baseline.** | Historical data is available for the 2009 - 2018 time series. The source of information for the activity data takes as reference the harvested areas (technified and traditional irrigated and rainfed rice), compiled in the Statistical Yearbook of the Agricultural Sector and the EVA of AGRONET of MADR (Base_Agrícola_EVA_2007_2019.xlsb). This database has records at the municipal level with technification levels throughout the time series. |
| **Data source for determining emission factors or emission or elimination factors** | For the adjustment of the daily emission factor proposed by the IPCC For the adjustment of the daily emission factor proposed by the IPCC (Refinement 2019), scale values suggested by FEDEARROZ and by the |

| Subcategory | Rice cultivation |
|---|---|
| | consultancy "*characterization, validation and socialization of sustainable low-carbon production models for rice cultivation in the municipalities of Arauca (Arauca), Paz de Ariporo (Casanare), Villavicencio, Puerto López and Puerto Gaitán (Meta)*, in the Colombian Orinoquia" AGROSAVIA. These factors are used in the estimations with the objective of adjusting the daily emission factor (EFi), for this information is required from variables such as: Basic emission factor (EFc), which is a single value, determined by the IPCC guidelines, 2019. Default $CH_4$ emission adjustment factors for water regimes during the growing season (SFw). Adjustment factor to compensate for differences in the water regime during the pre-cropping season (SFp). Adjustment factor that varies according to the type and amount of organic fertilizer applied (SFo). |
| **Adjustment of the data used with IPCC Tier 2 methods and data.** | According to the new guidelines proposed by the IPCC, 2019 $CH_4$ emission factor for irrigated and rainfed rice cultivation is currently at advanced methodological Tier 1. As a plan to improve the estimates, it is expected to use emission factors estimated by the consultancy "Generate Tier 2 (IPCC 2019) emission factors for nitrous oxide in livestock grasslands and for methane ($CH_4$) for two irrigated and rainfed rice producing regions for the Orinoquia region", which is currently being executed by CIAT. Using these new factors will allow us to achieve Tier 2 estimates that more accurately reflect the edaphoclimatic conditions of the region, which in turn will help improve the data reported at the national level in the next Biennial Update reports of the country. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use.** | N/A |

| | |
|---|---|
| **Subcategory** | ● **Urine and dung deposited from grazing animals.,**<br>● **Volatilization of Urine and dung deposited from grazing animals.**<br>● **Leaching/runoff of Urine and dung deposited from grazing animals.** |
| **Historical time series and available data source for activity data needed to calculate the baseline.** | The historical time series for the analysis of livestock emissions corresponds to the years 2009 - 2018, in that sense there is a 10-year line that is compatible with the ISFL methodological framework. The source of information for the activity data corresponds to the RUV reported by the ICA and FEDEGAN through the livestock censuses; this information was homologated with the age groups detailed in the RUV with those proposed by the IPCC (Refinement 2019). |
| **Data source for determining emission factors or emission or elimination factors** | For direct and indirect $N_2O$ emissions from urine and dung deposited by grazing animals, the default emission factors suggested by IPCC (2019) tier 1 were used. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | Direct and indirect $N_2O$ emissions from urine and dung from grazing animals have a methodological Tier 1. As a short-term improvement plan, the development of a methodological Tier 2 sub-model for the estimation of direct $N_2O$ emissions from urine and dung from grazing animals is proposed. The consultancy "*Generate Tier 2 (IPCC 2019) emission factors for nitrous oxide ($N_2O$) in grasslands for livestock breeding and for methane ($CH_4$), for two irrigated and rainfed rice producing regions in the Orinoquia region*" is currently underway, which will provide the necessary information for the estimation of methodological Tier 2 emission factors in the future. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use.** | N/A |

| Subcategory | Dynamic in oil palm cultivation |
|---|---|
| **Historical time series and available data source for activity data needed to calculate the baseline.** | For the analysis of removals and emissions from oil palm cultivation areas, information is available on the permanence, increase and decrease of area (crop renewal) for the period 2009 to 2018 in the Orinoquia, Amazon and Andean biomes, all of them represented in the jurisdiction of the Orinoquia region. This information is obtained from satellite image analysis carried out by the SMByC, supporting this identification with spatial information provided by the oil palm sector[133]. |
| **Data source for determining emission factors or emission or elimination factors** | It is estimated from the Tier 2 gain-loss method with emission factors based on country-specific data obtained from studies by Hensel et al. (2012)[134], on changes in carbon content in oil palm cultivation in four oil palm-growing regions of the country. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | This subcategory is included in the program accounting and is estimated based on the gains and losses method, Tier 2, with country-specific emission factors for oil palm crops in four oil palm-growing regions of the country. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use.** | The country has spatially explicit information consistent with Approach 3 described in Chapter 3 (Coherent representation of land) of Volume 4 of the 2006 IPCC Guidelines, which is obtained from analyses of change through satellite images of stable areas of increase and decrease in oil palm cultivation coverage. However, there is no information on the use prior to the increase in area or the use after the decrease in area; therefore, obtaining this information will be part of the improvement plan. |

[133] See activity data support in the files "03-DA_Region_Departmento.zip, 03-DA_SMBYC tif.zip. Spreadsheets are located in the folder07-3B2aii Dinámica Palma.
[134] See support in file "07-FE_Palma_Henson.et.al.pdf

| Subcategory | Indirect Cattle  Manure Management |
|---|---|
| **Historical time series and available data source for activity data needed to calculate the baseline.** | The historical time series for the analysis of livestock emissions corresponds to the years 2009 - 2018, in that sense there is a 10-year line that is compatible with the ISFL methodological framework. The source of information for the activity data corresponds to the RUV reported by the ICA and FEDEGAN through the livestock censuses; this information was homologated with the age groups detailed in the RUV with those proposed by the IPCC (Refinement 2019). |
| **Data source for determining emission factors or emission or elimination factors** | For indirect $N_2O$ emissions from manure management, the default emission factors suggested by IPCC (2019) advanced tier 1 were used. |
| **Adjustment of the data used with IPCC Tier 2 methods and data** | Indirect $N_2O$ emissions from cattle manure management have an advanced methodological Tier 1. The improvement plan for this category seeks to improve the calculation of nitrogen excretion rates, carrying out nitrogen balances that reflect the production particularities of the region, this objective is expected to be *achieved through the information generated in the consultancies "Generate Tier 2 (IPCC 2019) emission factors for nitrous oxide ($N_2O$) in grasslands for livestock breeding and for methane ($CH_4$) for two irrigated and rainfed rice producing regions for the Orinoquia region" and "Consultancy for the management of sustainable low-carbon livestock agroecosystems in prioritized landscapes of the Orinoquia*". It is expected that research institutions and/or universities will carry out projects in the future to gather sufficient information to be able to develop a methodological tier 2 model. |
| **Assessment of whether the data used for the subcategory allows Approach 3 in the representation of land use.** | N/A |

## .2.3 STEP 3: FINAL SELECTION OF THE SUBCATEGORIES ELIGIBLE FOR ISFL ACCOUNTING

The Table 12 describes the subcategories of the initial screening (Step 1) by identifying those for which Step 2 has demonstrated that the historical activity data, available emission factors, and the methods used to collect these activity data and emission factors meet the quality and benchmarking requirements for ERP Accounting.

Table 12. Final selection of eligible subcategories for ERP accounting purposes.

| Subcategory | Are the baseline setting requirements met? (Yes/No) | Methods and data requirement(s) met? (Yes/No) | Are the spatial information requirements met (Yes/No)? | Is it possible to apply the accounting of the ISFL methodological framework? (Yes/No) |
|---|---|---|---|---|
| Forest converted to grassland (Deforestation) | Yes | Yes | Yes | Yes |
| Forest converted to other forest land | Yes | No | Yes | No |
| Forest converted to cropland (Deforestation) | Yes | Yes | Yes | Yes |
| Forest converted to wetlands (Deforestation) | Yes | Yes | Yes | Yes |
| Forest converted to other land (Deforestation) | Yes | Yes | Yes | Yes |
| Forest converted to settlements (Deforestation) | Yes | Yes | Yes | Yes |
| Land converted to forest (Regeneration) | Yes | Yes | No | No |
| Forest remaining forest | Yes | No | No | No |
| Dynamic in OWV | Yes | Yes | No | No |
| Dynamic in forest plantations | Yes | Yes | No | No |
| Cattle Enteric Fermentation | Yes | Yes | N/A | Yes |
| Rice cultivation | Yes | No | N/A | No |
| Urine and dung deposited from grazing animals. | Yes | No | N/A | No |

| Subcategory | Are the baseline setting requirements met? (Yes/No) | Methods and data requirement(s) met? (Yes/No) | Are the spatial information requirements met (Yes/No)? | Is it possible to apply the accounting of the ISFL methodological framework? (Yes/No) |
|---|---|---|---|---|
| Dynamic in oil palm cultivation | Yes | Yes | No | No |
| Volatilization of urine and dung deposited by grazing animals | Yes | No | N/A | No |
| Leaching/runoff of Urine and dung deposited by grazing animals. | Yes | No | N/A | No |
| Cattle manure management | Yes | No | N/A | No |
| Indirect cattle manure management | Yes | No | N/A | No |

According to Table 12 There are some categories that do not meet several of the requirements (Forest converted to other forest land, Land Converted to Forest (Regeneration), Dynamic in OWV, Dynamic in Forest Plantations, Rice Cultivation and Dynamic in oil palm cultivation and otrhers), however, they were included in the program accounting as it is expected to obtain improved data and methodologies in the short and medium term (see Annex III.docx). This is in accordance with section 4.3.14 of the ISFL requirements where it specifies: " *If a subcategory selected in step 1 has historic data available to construct an Emission Baseline over a Baseline Period of approximately 10 years but these data do not meet the other quality requirements of Section 4.2, it can only be included for accounting in the ISFL ERPA Phase if all the quality requirements can be met through the application of improved methods and data. ISFL ER Programs that intend to include such a subcategory need to ensure that the quality requirements can be met at the latest at the end of the ISFL ERPA Phase. In this case, ISFL ER Programs shall provide an interim Emissions Baseline at the beginning of the ISFL ERPA Phase using best available data to be able to provide ex-ante estimations of the emission reductions*".

## 4.3 SUMMARY OF TIME BOUND PLAN TO INCREASE THE COMPLETENESS OF THE SCOPE OF ACCOUNTING AND IMPROVE DATA AND METHODS FOR THE SUBSEQUENT ERPA PHASES DURING THE ERPA TERM

Improvements to achieve completeness of emissions and removals accounting for the ERPD implementation stage focus on achieving the consistent land representation approach 3 and a historical time series, in addition to generating spatially explicit emission factors and activity data for all applicable land use changes between forest and non-forest categories. It is clarified that the activity data used to estimate the GHG inventory (2009 - 2018) of the ERP, have more than 10 years of information.

As shown in Table 12 some subcategories do not meet all the criteria for inclusion in the program, however, the subcategories: **Forest converted to other forest land, Land Converted to Forest (Regeneration), Dynamic in OWV, Dynamic in Forest Plantation, Rice Cultivation and Dynamic in oil palm cultivation**, are included in the interim baseline as improvements in data and methodologies are expected in the short and medium term under the program (in accordance with section 4. 3.14 of the ISFL requirements). It should be noted that these subcategories were also considered within the accounting because they are a priority for the region due to their productive contribution and mitigation potential. To fill these gaps in data information, factors, methods and spatialization, the country has proposed an improvement plan to include adjustments within the first period of verification of Program results. It is expected that with the execution of the consultancies associated with these chains and the hamornization of information generated by IDEAM and other institutions, information (geospatial, characterization of low-carbon development models (base vs. improved model), among others) will be obtained to improve GHG estimates reflecting the regional context.

Within the improvements proposed for the forestry sector and land use and land use change, specifically associated with natural forests, the SMByC will generate information to include estimates of forest degradation categories, based on the integration of information collected in the IFN (field information) and satellite image analysis.

For the category Forest converted to other forest land, the integration of the IFN information with the spatial data and typification already identified by the SMByC will allow adjusting the carbon content of the OWV category. Additionally, this subcategory will be divided into Forest Converted to OWV and Forest Converted to Forest Plantation, which is already discriminated in the calculations, but not in the report[135].

In the case of the subcategory Land Converted to Forest (Regeneration), there is currently no information on the previous use of the conversion to forest, therefore, a sampling methodology similar to the one used for deforestation classification will be implemented.

For the subcategories of Dynamic in OWV, Dynamic in forest plantations and Dynamic in oil palm cultivation, the typification of previous and subsequent changes in use will be implemented based on a sampling design in the areas where increases or reductions in areas have been identified.

For other types of crops, such as cocoa, cashew, rice, among others, the baseline areas will be established based on georeferenced information from the field and remote sensing.

[135] See disaggregation of deforestation typification in: Orinoquia Deforestation.xlsx, sheet AGB Typification, columns C and D.

In the livestock production and agricultural land management sector, improvements are focused on generating Tier 2 emission factors (IPCC 2019) for direct nitrous oxide in grasslands with breeding cattle (cows for beef production and replacement calves) and for methane ($CH_4$) from rice cultivation in irrigated and rainfed systems (which will be reflected in the following subcategories: 1) Urine and dung deposited from grazing animals., 2) Volatilization of Urine and dung deposited from grazing animals., 3) Leaching/runoff of Urine and dung deposited from grazing animals., 4) Direct and indirect manure management from Cattle and 5), Rice cultivation). At the beginning of the year 2024, emission factors will be available to perform nitrous oxide estimations with the requirements of the ISFL methodological framework in Bovine Livestock. Annex VIII.docx complements this information.

## 4.4 EMISSIONS BASELINE FOR ISFL ACCOUNTING

### 4.4.1 APPROACH FOR ESTIMATING EMISSIONS BASELINE

The final selection of the program categories was made taking into account the ISFL requirements related to the availability of historical data, (Orinoquia historical line of a 10-year period (2009-2018); Tier 2 estimates, availability of spatially explicit information and land use change analysis. Based on the above, the following subcategories were selected that meet all the requirements: Forest converted to Cropland (Deforestation), Forest converted to Grassland (Deforestation), Forest converted to Wetlands (Deforestation), Forest converted to Settlements (Deforestation), Forest converted to Other Land (Deforestation), and Cattle Enteric Fermentation.

As mentioned in section 4.2.3 of this document, other categories were included that do not meet all the requirements, but are considered of great importance for the development of the project in the region. According to section 4.3.14 of the ISFL requirements these subcategories can be included within the baseline of the program since they have GHG estimates with the best available information in a 10-year reference period and an improvement plan that contemplates the refinement of data quality and methods in the short and medium term. The subcategories selected with this condition were: Forest converted to other forest land, Dynamic in OWV, Dynamic in forest plantations, Land converted to forest (Regeneration), Dynamic in oil palm cultivation and Rice cultivation.

The estimation of the interim baseline of ERP emissions used information from the National Greenhouse Gas Inventory of Colombia, taking information from the 4 departments of the project area (Arauca, Casanare, Meta and Vichada), which considers in its calculations the IPCC guidelines of 2006 and refinement of 2019. All selected subcategories were based on a baseline established over a 10-year historical period (2009-2018).

The interim baseline was established from the average historical net emissions from the emissions inventory (2009-2018) except for the livestock sector for which it was estimated using an emissions intensity approach[136]. The combination of average values and livestock emissions intensity was used as a reference for projections from 2019 to 2029. Emissions intensity (ratio of $CO_2$ equivalent emissions to animal protein (meat and milk) production was calculated based on equation 1 (Eq 1), reported in section 4.2.7 of the ERP requirements version 1.3.[137].

On the other hand, estimates in the forestry, land use and land use change sector included new categories with respect to the national inventory: Dynamic of OWV, Dynamic in forest plantations and Dynamic in oil palm cultivation, estimated with spatially explicit information generated by the SMByC, which represents an improvement in the quality of the data compared to the estimates of the NGHGI, which are estimated with statistical information from official sources. This new information will allow for more agile and reliable monitoring through the SMByC in future phases of the ERPA.

In the case of rice cultivation, it was estimated considering the average of historical data, the scale emission factors were by default adjusted according to the IPCC and taking into account the edaphoclimatic characteristics and crop management in the region, these data were suggested by AGROSAVIA in the framework of the consultancy: "*low carbon rice in the Orinoquia region"*. Other variables in the calculation were included in consultation with technical experts from FEDEARROZ[138].

The identification and evaluation of uncertainty in the determination of the historical emissions baseline was based on the use of Monte Carlo type simulations and error propagation in each subcategory, generating variables with 10.000 simulations, for each component of the emission factor estimation models and activity data. For the subcategories in the agricultural sector, Cattle Enteric Fermentation obtained the lowest uncertainty (3,95 %), which is fundamental for the general estimation of uncertainty due to its contribution of emissions within the inventory. Likewise in the Land use and land use change sector, the subcategory Forest converted to other forest land registered the lowest uncertainty (9,17%), followed by Forest converted to settlement (Deforestation) 17,88%, Forest converted to wetlands (Deforestation) 20,00%, Forest converted to grassland (Deforestation) 24,40 % and Forest converted to crops (Deforestation) 47,81%. Regarding the subcategories of Dynamic in OWV, Dynamic in forest plantations, Land converted to forest (Regeneration) and Dynamic in oil palm cultivation the uncertainty was estimated in the order of 20,79, 19,70, 23,42 y 77,86% respectively. Finally, the estimated uncertainty for rice cultivation was 26,0%[139].

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[136] 4_4-4_6_ISFL_Methodology_Livestock.xlsx
[137]Available in: https://www.biocarbonfund-isfl.org/sites/isfl/files/2023-01/ISFL%20ER%20Program%20Requirements_V1.3_2023.pdf
[138] 4_4-4_6_BAU-Mitig_Arroz_Orinoquia.xlsx
[139] 4_5_3_Incertidumbre

### 4.4.2 EMISSIONS BASELINE ESTIMATE

Tabla 13 shows the year and baseline emissions for the series established as the accounting period (2019-2029). It can be seen that in the column " *Subcategory by land use and rice*" there are average values and in those of the livestock sector there are values with an increasing behavior along the baseline, this is due to the estimation used in livestock farming with an emissions intensity approach[140].

Tabla 13. Estimated Baseline Emissions

| Year | Baseline emissions ($tCO_2$ eq) | Subcategory Livestock | Subcategory Land use and rice |
|---|---|---|---|
| *2019* | 17.911.348 | 7.672.866 | 10.238.482 |
| *2020* | 17.973.597 | 7.735.115 | 10.238.482 |
| *2021* | 18.035.846 | 7.797.365 | 10.238.482 |
| *2022* | 18.098.096 | 7.859.614 | 10.238.482 |
| *2023* | 18.160.345 | 7.921.863 | 10.238.482 |
| *2024* | 18.222.594 | 7.984.113 | 10.238.482 |
| *2025* | 18.284.844 | 8.046.362 | 10.238.482 |
| *2026* | 18.347.093 | 8.108.611 | 10.238.482 |
| *2027* | 18.409.342 | 8.170.861 | 10.238.482 |
| *2028* | 18.471.592 | 8.233.110 | 10.238.482 |
| *2029* | 18.533.841 | 8.295.360 | 10.238.482 |

The baseline information was constructed from the total net BAU emissions, the values can be found at: 4_6_Escenario_BAU&Mitigación.xlsx

Table 14 shows the estimated values in the historical line and baseline by subcategory.

[140] See calculation in: 4_4-4_6_ISFL_Methodology_Livestock.xlsx

Table 14. Summary of program history and baseline [141]

| Año | Ferment. Entérica de ganado b. | Bosque convertido a otras tierras forestales | Dinámic en otra veget leños | Dinámic plant forest | Tierras convert en bosque | Dinam en cultiv palma | Bosque que se convierte en cultivos | Bosque que se convierte en pastizal | Bosque que se convierte en humedal | Bosque que se convierte asentamiento | Bosque que se convierte en otras tierras | Cultivo de arroz | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.009 | 7.135.738 | 1.739.178 | - 2.749.120 | - 127.229 | - 147.282 | - 174.397 | 111.647 | 6.954.818 | 277.211 | 3.247 | 59.957 | 1.526.713 | 14.610.482 |
| 2.010 | 7.333.967 | 1.739.178 | - 2.775.643 | - 139.017 | - 177.613 | - 198.554 | 113.275 | 7.060.327 | 282.099 | 3.247 | 61.565 | 1.348.815 | 14.651.646 |
| 2.011 | 7.294.630 | 3.208.299 | - 4.599.540 | - 196.851 | - 192.745 | - 268.918 | 258.710 | 10.740.725 | 433.554 | 3.247 | 32.523 | 1.516.433 | 18.230.067 |
| 2.012 | 7.173.033 | 3.208.299 | - 4.658.115 | - 254.529 | - 207.877 | - 355.363 | 262.295 | 10.900.534 | 440.680 | 3.247 | 33.026 | 1.263.725 | 17.808.956 |
| 2.013 | 7.087.590 | 3.063.480 | - 4.637.631 | - 345.965 | - 208.569 | - 381.671 | 524.420 | 7.930.779 | 101.268 | 33.141 | 32.601 | 1.277.403 | 14.476.847 |
| 2.014 | 7.116.233 | 2.767.106 | - 4.043.635 | - 439.669 | - 209.139 | - 369.512 | 292.781 | 6.241.820 | 83.981 | 4.192 | 29.936 | 1.032.745 | 12.506.839 |
| 2.015 | 7.126.322 | 1.977.192 | - 4.487.026 | - 501.652 | - 209.168 | - 362.782 | 445.671 | 7.185.946 | 104.302 | 4.192 | 29.248 | 1.417.189 | 12.729.432 |
| 2.016 | 7.370.650 | 2.457.307 | - 4.374.437 | - 722.926 | - 209.227 | - 490.485 | 363.316 | 10.000.817 | 177.673 | 64.879 | 291.978 | 1.660.451 | 16.589.996 |
| 2.017 | 7.515.059 | 4.354.605 | - 3.758.238 | - 787.992 | - 209.227 | - 368.391 | 204.975 | 15.791.282 | 164.193 | 73.798 | 185.906 | 1.772.466 | 24.938.437 |
| 2.018 | 8.151.721 | 7.836.074 | - 4.148.425 | - 966.287 | - 212.496 | - 333.103 | 293.462 | 16.704.320 | 261.522 | 8.244 | 136.722 | 1.415.304 | 29.147.058 |
| 2.019 | 7.672.866 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 17.911.348 |
| 2.020 | 7.735.115 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 17.973.597 |
| 2.021 | 7.797.365 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.035.846 |
| 2.022 | 7.859.614 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.098.096 |
| 2.023 | 7.921.863 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.160.345 |
| 2.024 | 7.984.113 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.222.594 |
| 2.025 | 8.046.362 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.284.844 |
| 2.026 | 8.108.611 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.347.093 |
| 2.027 | 8.170.861 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.409.342 |
| 2.028 | 8.233.110 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.471.592 |
| 2.029 | 8.295.360 | 3.235.072 | - 4.023.181 | - 448.212 | - 198.334 | - 330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.533.841 |

Translator's note: Headings of the table are Year/ Cattle Enteric Fermentation /Forest converted to other forest land/ Dynamic in other woody vegetation/Dynamic in forest plantations/ Land converted to forest / Dynamic in oil palm cultivation / Forest converted to cropland /Forest converted to grassland/ Forest converted to wetlands /Forest converted to settlements/Forest becoming other land.

[141] See calculations in: 4_6_Escenario_BAU&Mitigación.xlsx

## 4.5 MONITORING AND DETERMINATION OF EMISSION REDUCTIONS FOR ISFL ACCOUNTING

### 4.5.1 DESCRIPTION OF THE MONITORING APPROACH

The monitoring of emission reductions for ISFL accounting for the Orinoquia BioCarbon Program, will be carried out consistently and in compliance with Resolution 1447 of 2018[142], , of the MADS, which established regulations for the MRV of Mitigation Actions, as well as, the RENARE and the SCRR-GEI.

On the one hand, considering a top-down approach the SMBYC[143], together with the IFN [144] and the SNIF[145], all hosted by IDEAM, provide, according to the annual monitoring of the natural forest area and annual deforestation, including the characterization of its causes and agents of GHG emissions and removals of the AFOLU sector; early deforestation alerts (quarterly/weekly), and updating of carbon contents by forest type, among others.

These data are inputs for the SINGEI, which for the AFOLU sector also compiles agricultural sector information from multiple sources such as AGRONET, (agricultural databases). In addition, specific sectoral associations have their own information systems, such as those for oil palm (FEDEPALMA), rice (FEDEARROZ), cocoa (FEDECACAO) and livestock (FEDEGAN). In the case of forestry plantations and livestock species, data from the ICA is used, and for ecological restoration and efficient cooking technologies, various sources of information are consolidated by IDEAM. It should be noted that the national GHG inventories are produced by the IDEAM and from them the inventory for the Orinoquia for the AFOLU sector can be derived, homologated with the ISFL accounting.

On the other hand, considering a bottom-up approach, RENARE was designed to register all GHG mitigation initiatives that wish to contribute to comply with Colombia's NDC, and be recognized as such, and/or that wish to receive results-based payments or similar compensation and be eligible for the GHG Reduction and Removal Accounting System (SCRR-GHG).

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142 Available at: https://www.minambiente.gov.co/wp-content/uploads/2022/01/15.-Resolucion-1447-de-2018.pdf
143 Available at: http://www.ideam.gov.co/web/siac/smbyc
144 Available at : http://www.ideam.gov.co/web/ecosistemas/inventario-forestal-nacional
145 Available at: https://www.minambiente.gov.co/wp-content/uploads/2021/08/decreto-1655-de-2017.pdf

In this sense, the ISFL Program will be registered in the RENARE and the mitigation results will be processed by the National Accounting System to generate the Biennial National Transparency Reports which present the evidence about the progress of the implementation of the NDC.

- Orinoquia Biocarbon Program in RENARE

The National Registry of GHG Emission Reduction[146] is a technological platform belonging to the MRV system that aims to manage information on GHG mitigation initiatives and is part of the national information system on climate change in Colombia. In addition, the National Registry REDD+ Programas and projects is also part of RENARE.

Any holder of a GHG mitigation initiative that wishes to opt for payments for results or similar compensations, or demonstrate compliance with national climate change targets established under the UNFCCC, must register its initiative in the RENARE from the feasibility phase.

The types of GHG mitigation initiatives that can be registered in RENARE are GHG mitigation programs such as Nationally Appropriate Mitigation Actions (NAMAs), Low Carbon Development Programs (LCDPs) and REDD+ Programs; as well as GHG mitigation projects such as Clean Development Mechanism (CDM) projects and programs of activities, Low Carbon Development Projects (LCDPs) and REDD+ projects.

For the purposes of RENARE and in accordance with Resolution 1447/2018 of the MADS, the ERP Orinoquia will be registered as a sectoral low carbon development program aimed at the agricultural sector, and a REDD+ program. Sector Programs and REDD+ programs have several provisions that must be followed.

The Program will follow a methodology proposed and approved for the UNFCCC GHG mitigation mechanisms applicable to Colombia (Article 23 and 28). In this sense, it is expected that the BioCarbon ERP will be considered an eligible mechanism that could be traded under Art. 6 of the Paris Agreement whereby internationally traded mitigation outcomes (ITMOs) are generated. Sectoral REDD+ Programs must be in line with the Warsaw Framework for REDD+ of UNFCCC decision 9/CP.13 and Article 5 of the Paris Agreement. Due to this, Colombia must register REDD+ payments under the ISFL in the Lima Information Center.

Since the program incorporates forestry activities as well as REDD+ activities, the methodology needs to incorporate a risk management mechanism for leakage, non-permanence and uncertainty management (Articles 23 and 28). The ISFL RE Methodological Framework has an uncertainty deduction, a buffer mechanism for reversion and requires a strategy to mitigate displacement of

[146] Available in: https://www.minambiente.gov.co/wp-content/uploads/2022/04/Cartilla-RENARE.pdf

emissions, so it complies with national regulations.

The CBDP Sector Program must establish its baseline taking into account the reference scenario published by the MADS or those related to the mitigation measures approved by the Intersectoral Commission on Climate Change (CICC), applying the emission sources included in the program's accounting specifically.

In case the BioCarbon ERP has more detailed information for the construction of the baseline, it can be incorporated as long as it does not lead to an overestimation of the results with respect to the national information (Article 24). In the case of REDD+ programs the baseline has to follow the Forest Reference Emission Level presented and assessed by the UNFCCC (Article 29). These provisions are key and may be considered in conflict with the ISFL RE requirements for the baseline, given that both the NDC reference scenario and the National Forest Reference Emission Level (2018-2022) use projected baselines. However, being an average-type baseline and therefore considered conservative, it is feasible to obtain results under the program and the FREL. Therefore, the solution is to create a broader Orinoquia program in which the ERP baseline for payments is nested, but which has a baseline that is fully consistent with the NDC National Reference baseline. In this sense, it is the responsibility of the program to present its results divided in those referring to the ISFL baseline and those referring to the national baseline. In the RENARE the information of the BioCarbon ERP should be provided, including the emission reductions that are verified for the ERP.

A similar structure exists for the Amazon Vision Program, where in RENARE the Amazon Biome Forest Emissions Reference Level is used as the Program Baseline, but where the REDD Early Movers (REM) payment program only rewards emission reductions below an average of historical deforestation.

The REDD+ Program must account for results under the National Forest Emissions Reference Level starting in 2018 (Article 29). This would apply for the years 2020-2022. Given that the national FREL is fully consistent with the NDC reference scenario, a solution similar to the one outlined in the previous paragraph would apply.

The PDBC Sector Program can adopt third party verification schemes as required (Article 27), so the ERP complies with this section. Verification should also consider consistency with MRV principles, emission factors and activity data from the national GHG inventory. Therefore, it is important that the verification of the results of this program takes these elements into account. The Program must also accept the validation process by the UNFCCC of the FREL applicable to the REDD+ program, according to Article 32, i.e. the National FREL 2018-2022. This means that this is an element that must be taken into account by the third party verifiers of the ERPD, specifically its application of Articles 40 and 41 established by Resolution 1447 of 2018.

The Program must register emission reductions in RENARE (Article 10). This means that, in addition to the ISFL registry, the RENARE registry must also be used.

EDD+ mitigation projects and smaller scale sectoral mitigation projects must also be registered in

RENARE. To avoid double counting, Resolution 1447/2018 establishes a procedure to address "non-compatible" overlaps between REDD+ programs and REDD+ projects (Articles 46 - 52).

The Orinoquia BioCarbon Project will formulate in the second half of 2023, the first version of the "engagement plan for implementing partners" for REDD+ projects located in the same jurisdiction based on the review already conducted by the Project (see section 3.7.2).

### 4.5.2 ORGANIZATIONAL STRUCTURE FOR MONITORING AND REPORTING OF THE ORINOQUIA BIOCARBON PROGRAM

A GHG Monitoring, MRV system is a complex task that requires the participation and coordination of different institutions and actors. Institutional coordination is essential to ensure that the MRV system is efficient and effective to the extent that it allows each institution to contribute its knowledge and experience in the fight against climate change.

To this end, the ERP Orinoquia MRV will have inter-institutional agreements that guarantee coordination to ensure the transparency and reliability of the MRV system.

This implies that based on the agreements, the necessary technical and procedural procedures and guidelines will be developed to ensure transparency and consistency of the program's information, ensuring that information and data are shared in a timely and accurate manner.

On the other hand, institutional coordination is also essential to guarantee the long-term sustainability of the MRV system. This implies that each institution must work together to ensure that the MRV system is able to adapt to changes in the environment and societal needs, and that it can continue to be useful and relevant in the future.

In Colombia, at the national level, the IDEAM and MADS are the leading entities of the MRV, system for GHG emissions. MADS provides regulation and guidance, while IDEAM administers and manages various subsystems and registries, such as the SMByC, SNIF, (NCCIS), the GHG Information System (GHGIS) and the RENARE, in this registry the costs, payments and financing of mitigation initiatives are reported. In addition, the MADS manages the National Climate Change Information System, and the National Planning Department manages the Climate Finance MRV system.

In addition, the Orinoquia ERP MRV will include the participation of the UPRA for the generation of activity data associated with the prioritized production chains.

The success of a GHG emissions reduction program depends largely on its ability to measure, report and verify emissions accurately and reliably. Therefore, the program's MRV, system has a solid and well-defined institutional structure to ensure its proper implementation and operation.

This structure involves different entities and agencies, each in charge of different aspects of the system. In line with this, the MRV of the ERP is based on the advances and subsystems of the National MRV, and is complemented by the crop monitoring system initiative and the Spatial Data Infrastructure promoted by MADR from the Rural Agricultural Planning Unit. In this way, a clear and efficient organization is achieved for the monitoring of the measures associated with each sector, thus allowing a comprehensive evaluation of the impact of the program on the reduction of GHG emissions.

In order to carry out an accurate accounting of GHG emissions in an emission reduction program, it is necessary to have detailed information on the subcategories selected for accounting.

Table 15 presents the land coverages associated with the highest priority chains for the emission reduction program. In addition, detailed information is provided on the time period available for the land covers. The matrix also identifies the entity responsible for generating the data on the area or extent of land cover, the corresponding increase and decrease in area and their respective classification.

The activity data for the agricultural sector are represented through alphanumeric information, which means that they are not related in this matrix..

Table 15. Activity Data Matrix.

| Typification | Increase/Decrease in area | Stock | Coverage | NF | OWV | FP | P | M | C | R | Ps | Time period available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SMByC | SMByC | SMByC | NF | Permanence | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 1990 (90 - Decennial) - 2021 |
| SMByC | SMByC | SMByC | OWV | ✓ | Permanence | X | X | X | X | X | X | 2000 - 2018 |
| SMByC | SMByC | ICA-MADR-IDEAM(SMByC-SNIF) | FP | ✓ | X | Permanence | X | X | X | X | X | 2000 - 2021 |

| Typification | Increase/Decrease in area | Stock | Coverage | NF | OWV | FP | P | M | C | R | Ps | Time period available |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| SMByC | UPRA - IDEAM Cenipalma | UPRA - Cenipalma | OP | X | X | X | Permanence | X | X | X | X | 2000 - 2019 |
| SMByC | UPRA | UPRA | M | X | X | X | X | Permanence | X | X | X | 2020 - 2022 |
| SMByC | UPRA | UPRA | C | X | X | X | X | X | Permanence | X | X | 2020 - 2022 |
| SMByC | UPRA | UPRA | R | X | X | X | X | X | X | Permanence | X | 2020 - 2022 |
| SMByC | UPRA | UPRA | Ps | X | X | X | X | X | X | X | Permanence | 2020 - 2022 |

NF = Natural Forest OWV = Other woody vegetation FP = Forest plantations OP = Oil Palm, M = Marañón, C = Cocoa, R = Rice Ps = Grassland
✔= Existing change information
**X** = there is no change information
▢ = Information provided by MADR (UPRA)
▢ = Information provided by IDEAM (SMByC)

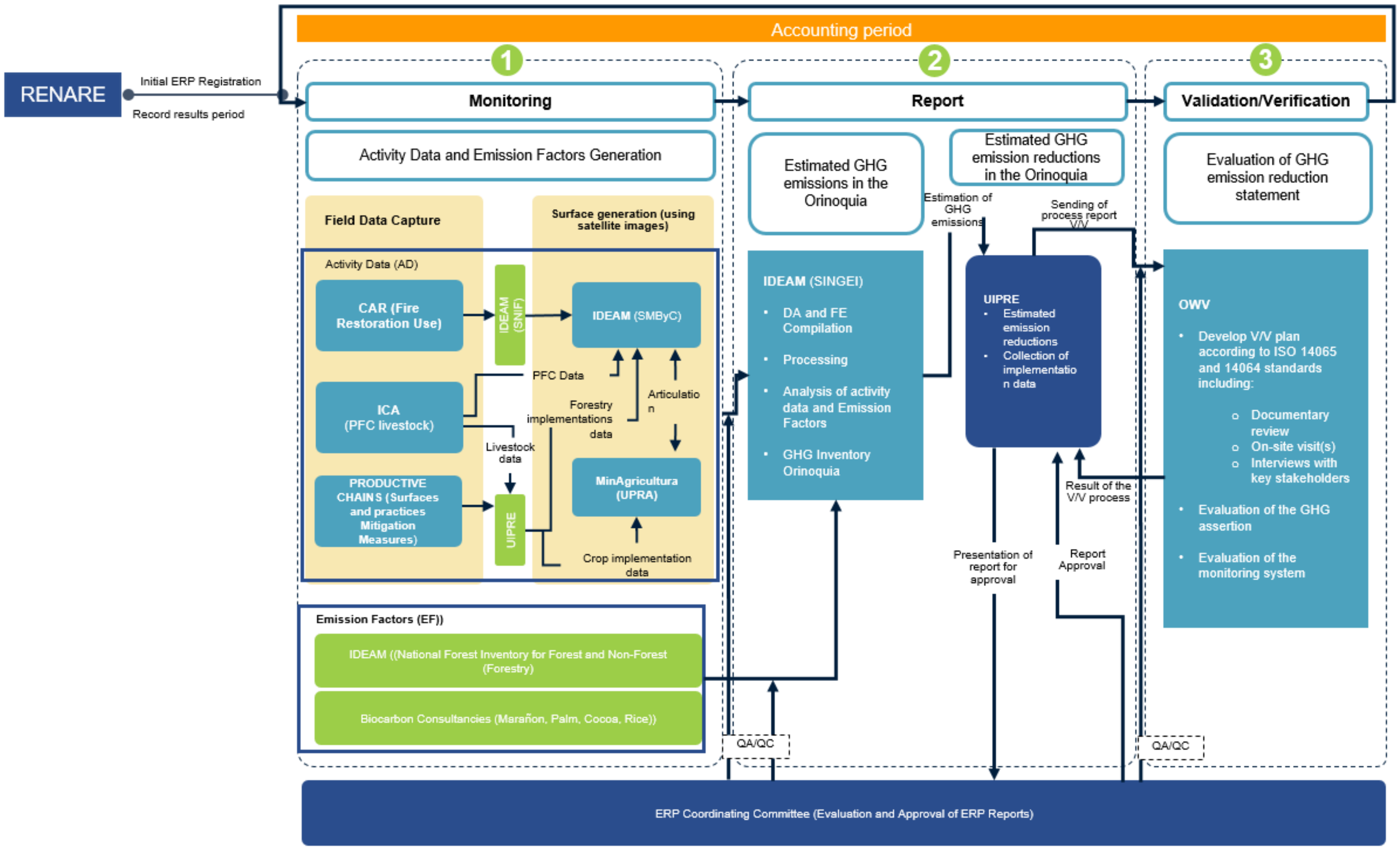


Figure 13. MRV ERP Biocarbon Scheme

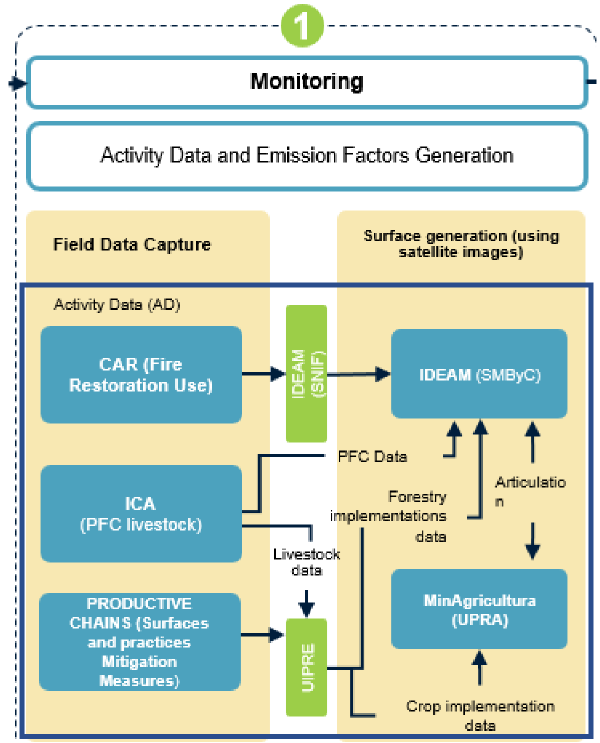


Figure 14. MRV Biocarbon Orinoquia Biocarbon scheme for activity data.

- Field information generation component

"SNIF is a set of processes, methodologies, protocols and tools that aim to integrate and standardize the capture, storage, analysis, processing, dissemination, management, verification and consultation of data, databases, statistics and documentary material related to the forest resources. Its purpose is to guarantee the efficient, timely and quality flow of forestry information, which contributes to a more effective management of the resources.

The regional and urban environmental authorities, the ANLA and the MADS are responsible for reporting to the SNIF on a quarterly basis the relevant information on forest harvesting, mobilization of wild flora products, seizures, protective plantations and fires of the vegetation cover generated within the framework of forest resource management. This ensures that the SNIF has the necessary information to carry out its work effectively and efficiently".

The Colombian Agricultural Institute collects information on commercial forestry plantations (CFP) and cattle ranching; in the case of the former, it will be an input for the joint work with the SMByC in which these plantations are spatially identified.

The productive chains represented by the guilds will collect information in the field on both the areas planted and the practices implemented; the data collected in this process will be managed by the UIPRE; this management includes the reception, processing, analysis and availability of the data for consultation by the spatial component (SMByC and UPRA).

- Surface information generation component

For the subcategories: Forest converted to other forest land, Forest Converted to Crops (Deforestation), Forest Converted to Grassland (Deforestation), Forest Converted to Wetlands (Deforestation), Forest Converted to Settlements (Deforestation), Forest Converted to Other Land (Deforestation), Dynamic in OWV, Dynamic in Forest Plantations, Land Converted to Forest (Regeneration) and Dynamic in oil palm cultivation, IDEAM will be in charge of generating data on the permanence, increase and decrease of areas associated with forest and OWV through the Forest and Carbon Monitoring System, which established a protocol for monitoring the area based on the interpretation and comparative analysis of satellite images of average resolution for two consecutive years, generating maps with minimum mapping units of 1 ha (See Imput MRV).

From the data of areas of OWV, IDEAM through the SMBYC and through coordinated work with the ICA, MADR and IDEAM, SNIF, generates the data of forest plantation area permanence.

SMByC is an official scientific tool designed to continuously and frequently monitor forest area and deforestation in Colombia. Its main objective is to issue early warning reports on deforestation, estimate carbon contents in natural forests and provide technical inputs to the development of the National GHG Emissions Accounting System, especially in relation to REDD+.

SMByC generates data through digital processing of satellite images and analysis of available primary and secondary information. This approach allows quantifying deforestation in Colombia and understanding the dynamic of land cover change.

The methodological process of digital processing of satellite images consists of four main phases to generate activity data:

1. Digital preprocessing of satellite images: band stacking, geometric correction, radiometric calibration, masking of clouds and water bodies, and radiometric normalization.
2. Digital image processing: automated detection of changes in the forest surface, visual verification of detected changes, and quality control of the process
3. Data validation using a stratified random sampling design:
4. Activity data reporting: calculation and reporting of changes in natural forest area:

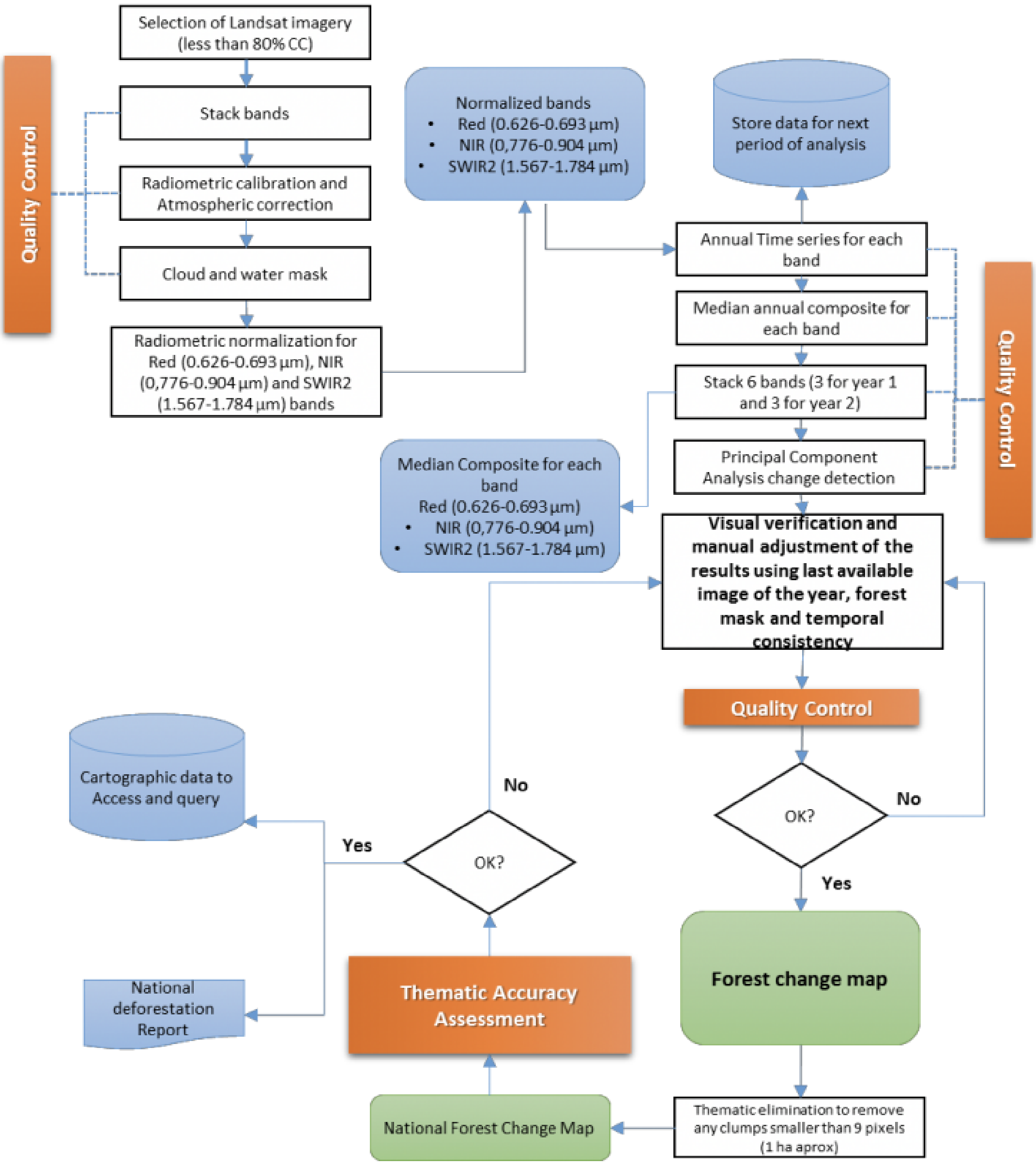


Figure 15. Outline of the methodological process applied in the Digital Image Processing Protocol.

Within the framework of the ERP Orinoquia and for the subcategories associated with cropland (Dynamic in oil palm cultivation, Rice cultivation), the UPRA Crop Monitoring System has implemented various methods to carry out continuous, timely and accurate monitoring of the production chains of interest for the ERP. For this, machine learning algorithms and optical and radar data from Planet (NICFI - high spatial resolution) and Sentinel-1 (radar) and Sentinel-2 (high spectral resolution) sensors are used, and climatic variables and terrain characteristics of the areas of interest are incorporated.[147]

[147] Avalaible in: https://storymaps.arcgis.com/stories/b2fdf0801e8d44188fe84696b4f39875

In summary, a methodology for digital processing of satellite images and spatial analysis has been developed with three main objectives: to generate relevant information on the extent and change of the land cover of interest, to process these data using advanced detection, analysis and monitoring techniques to facilitate the generation of maps and reports, and to distribute these maps and reports through the Spatial Data Infrastructure of the Orinoquia.

The data are generated in raster format with a pixel size of 1, 5 and 10 meters, depending on the production chain, and are handled in the Magna Sirgas single origin coordinate system to ensure geographic accuracy. To estimate the accuracy and uncertainty of the data, a technique similar to that used by the SMByC will be applied.

For the specific case of the identification of permanence and changes (increase and decrease of area) over time of the areas planted with oil palm, the activities will be developed through a collaboration between the UPRA crop monitoring system team, IDEAM, SMByC and the CENIPALMA association responsible for the Colombian Oil Palm Cadastre, which has worked on the development of a continuous inventory of the areas planted with oil palm in Colombia through the Oil Palm Cadastre, which focuses on two fundamental aspects: Physical and agronomic. In the first aspect, a periodic inspection of the oil palm areas is carried out using satellite images to identify the areas planted with oil palm. Subsequently, in the agronomic aspect, field work is carried out to individualize the plantations and lots, integrating detailed information such as the year of planting, the cultive planted and the number of oil palms.

In the Orinoquia region, UPRA will consolidate the layer with the areas planted with oil palm to create updated surface data and identify changes on an annual basis. This will provide detailed and accurate information that can be used for monitoring and follow-up of activities in the region.

For the accounting of emissions from the subcategories Cattle Enteric Fermentation, the ICA is responsible for generating the necessary activity data. The ICA is a state entity in Colombia responsible for promoting the development of the country's agricultural sector through the implementation of policies, programs, and projects to improve the sector's productivity, competitiveness, and sustainability. Given its importance in the agricultural sector, ICA works in close collaboration with other government and private entities, such as FEDEGAN, which collects data associated with the livestock sector through the RUV.

- Typification of area increase and decrease [

Typification of the decrease in area involves the identification of replacement cover, while in the areas of increase the cover prior to the appearance of the current vegetation is identified. This process will be carried out by the SMByC, using a statistical approach involving stratified random sampling in the areas of increase and decrease. This process will also benefit from data generated by UPRA to improve its accuracy and efficiency.

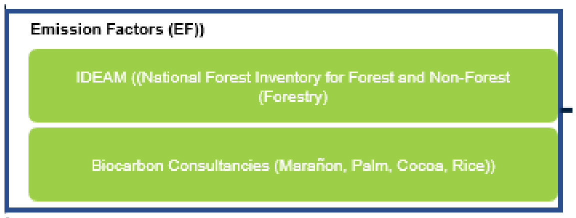


Figure 16. Emission factors section of Figure 23..

The sources used to establish the emission factors for each ERP-eligible subcategory are detailed below (Figure 16). In addition, possible improvements to be applied are presented. For the subcategories Forest converted to Cropland (Deforestation), Forest converted to Grassland (Deforestation), Forest converted to Wetlands (Deforestation), Forest converted to Settlements (Deforestation), Forest converted to Other Land (Deforestation) and Land converted to Forest (Regeneration) the carbon emission factors for above and below ground biomass and soil in reference forests in the country are based on the IFN In addition, the default value of Tier 1 is used for estimates of dead organic matter in tropical forests according to the 2006 IPCC Guidelines. For the subcategory Dynamic in OWV the factors for carbon contents in above and below ground biomass for the estimates were taken from studies developed for the country and compiled in Yepes et. Al. (2011) for shrub cover. Information on carbon emission factors for reference forests at the biome level will be updated with data from 100% of the IFN and the non-forest inventory of the Orinoquia Biocarbon Project. Complete results will be obtained by the end of the first semester of 2023 and the information will be focused on grassland, clean grassland, wooded grassland, and weededed grassland in the departments of Arauca, Casanare, Meta and Vichada.

For the subcategory Dynamic in Forest Plantation the emission factor is based on country specific data obtained from statistics and studies of commercial forest plantations for the Orinoquia region. For the subcategories Cattle Enteric Fermentation, the enteric $CH_4$ emission factor and manure management are calculated using the AFOLU 1 Colombia - IDEAM Model, with information from the AGROSAVIA, the Colombian Federation of Cattle Ranchers - FEDEGAN, academia and IDEA.
For $N_2O$ emissions from manure management and urine and dung from grazing animals, the default emission factors suggested by IPCC (2019) advanced tier 1 are used. In the subcategory Dynamic in oil palm cultivation, the emission factor is based on country-specific data, which correspond to changes in carbon contents in oil palm crops in four oil palm regions of the national territory.

The daily emission factor proposed by the IPCC (Refinement 2019) for the Rice Crops subcategory was adjusted, using scale values suggested by FEDEARROZ and AGROSAVIA. For this purpose, variables such as the basic emission factor (EFc), adjustment factors for $CH_4$ emissions during the growing season (SFw) and for the pre-cropping season (SFp), and an adjustment factor that varies according to the type and amount of organic fertilizer applied (SFo) were considered. These factors were used to adjust the daily emission factor (EFi) in the GHG emissions estimates.

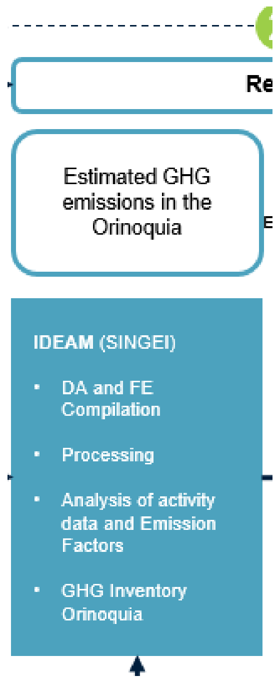


Figure 17. Estimation of GHG emissions in the Orinoquia region section of Figure 23.

The estimation of GHG emissions in the Orinoquia region (Figure 17) will be the result of joint work between IDEAM's technical teams (AFOLU NGHGI) and the teams in charge of generating activity data and emission factors and the UIPRE. The AFOLU team is responsible for analyzing the measured and monitored data and combining them with the emission factors to generate GHG emission estimates, taking into account their respective uncertainty.

Once the GHG emissions information for the Orinoquia region is available, it will be needed to:

- Incorporate the results in the GHG emissions and removals reports to the competent authorities according to the specific requirements of the country or region. For example, the BUR which is a report that provides an update on GHG emissions, measures taken to mitigate these emissions and the needs and support received for climate change mitigation and adaptation. In addition, for the Orinoquia region, specific reports will be generated to provide a detailed assessment of GHG emissions and removals in the area.

- Comunicate GHG emissions and removals results to internal and external stakeholders, the general public, partners and implementers. This is essential to maintain transparency in the processes and results of projects or actions implemented to reduce GHG emissions, which can help strengthen the trust and commitment of the stakeholders involved in the process. Communication of results can also be used as a tool to raise awareness in society about the importance of climate change and the need to act to reduce GHG emissions. In addition, it allows the identification of opportunities for improvement and feedback for future climate change mitigation and adaptation actions.

- Analyze and present GHG emissions and removals results to determine the effectiveness of

GHG emissions mitigation actions and identification of opportunities for continuous improvement of the emissions reduction program.

- Monitor and implement GHG emissions mitigation actions to assess progress toward established objectives and identification of possible adjustments needed in the mitigation strategy.

The participation of the entities and groups responsible for the generation of activity data and emission factors in the preparation of the results reports is required. This is because the selection and presentation of data should be the result of close collaboration between the parties involved.

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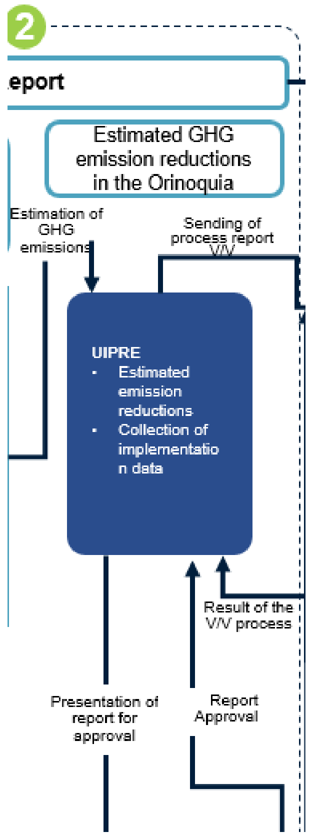


Figure 18. UIPRE in the MRV scheme section of Figure 23

UIPRE is a group of people with specific skills, knowledge and experience in different areas relevant to the program. This team is responsible for carrying out the tasks necessary for program implementation, including program planning, design, resource management, execution and evaluation. Each team member has specific responsibilities and roles within the program and works together to achieve the established objectives.

Within the MRV system, this team will be in charge of managing the capturing of relevant information in the field, as well as the reception, processing and organization of the observations or evidence collected during the field data capture, in a geographic and/or alphanumeric database including the polygons of the properties and lots where the mitigation measures implementation processes are developed, as well as alphanumeric data and photographic records (Figure 18).

We will work together with groups such as the SMByC and the crop monitoring system to define the appropriate methodologies for capturing information in the field and the places where the survey will be carried out. This will make it possible to align field work with the needs of these groups and ensure that the data captured can be used in monitoring processes, for example in validation tasks and/or adjustments to land cover interpretation models.

To process the data obtained, the use of various tools and techniques will be required, such as spatial analysis software to work with the polygons and data analysis tools to work with the alphanumeric and photographic data. It is important to note that the processing of the data must be done cautiously and rigorously to ensure the accuracy and reliability of the results. Once processed, the data will be consolidated into a database for further analysis. Data processing may include tasks such as quality control, integration of data from different sources, data cleaning and transformation, among others. Finally, reports will be generated regarding the state of progress and achievements in the implementation of mitigation measures, for example, the number of hectares implemented per municipality of low carbon cocoa. These reports will be fundamental to evaluate the progress of the project and make informed decisions on the implementation of the measures.

The exchange of information between the UIPRE and the above mentioned groups will be done through a geographic web service with OGC standards deployed by the UIPRE. This means will allow the integration and analysis of information in real time, which in turn will favor informed decision making around the implementation of mitigation measures. It should be noted that interoperability between the different systems and platforms is essential to ensure data quality and reliability at all times.

The UIPRE will lead the ERP coordinating committee, which will be the body that will approve the emission reduction reports to be submitted to the validation/verification process. This committee will also centralize communications with the Validation and Verification Body (VVB) and will coordinate the tasks of the different entities participating in the process.

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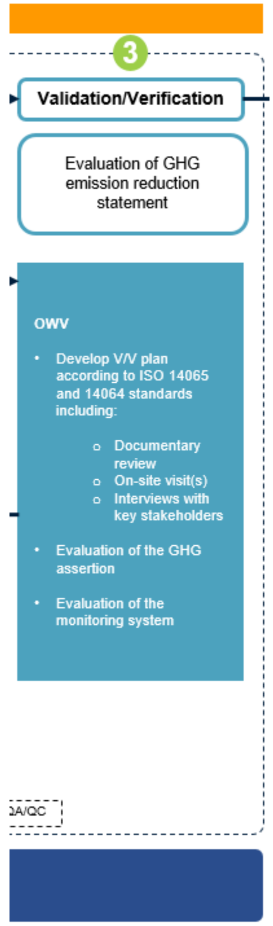


Figure 19. Verification in the MRV scheme section of Figure 23.

Validation and verification of GHG emission reductions is a key process in the implementation of climate change mitigation initiatives in this sector (Figure 19). The ISFL validation and verification process is carried out by internationally recognized and accredited bodies, and consists of the evaluation of the results of the activities implemented by an ISFL entity, project or program to demonstrate GHG emission reductions and its compliance with established requirements.

The validation process includes the review of the documentation and data submitted by the ISFL entity, project or program to verify its compliance with the established criteria and requirements. Validation also involves the assessment of GHG mitigation risks and opportunities in the ISFL sector, as well as the identification of possible improvements in the design and implementation of activities. Once validated, the next step is verification, which is the independent assessment of the results of the ISFL activities to confirm that the stated GHG emission reductions have been achieved. Verification also involves assessing the accuracy and completeness of the data and documentation submitted by the ISFL entity, project or program, as well as confirming that the requirements of the carbon standards have been met.

ISFL validation and verification are rigorous processes that ensure transparency and reliability of the results of climate change mitigation activities in the land use, land use change and forestry sector.

In addition, ISFL validation and verification may be required to access carbon markets and international climate change mitigation funds.

The results achieved and reported under the ERP Orinoquia will be subject to the validation and verification process by an independent third party agreed between Colombia and the donor countries with the facilitation of the World Bank. This process implies the joint and articulated work of the different entities involved in the reduction program, both those that generate activity data and emission factors as well as those that process and analyze the data. In order to carry out a successful process of validation and verification of the emission reductions generated by the implementation of the portfolio of ERP mitigation measures, it will be necessary to form a working group led by the UIPRE (ERP coordinating committee) to coordinate the necessary activities among the different participating entities.

In addition, the inclusion of the data generated within the framework of the ERP in the national reports (BUR, BTR) implies a validation and verification implicit in the international commitments with the UNFCCC under the International Consultation and Analysis (ICA) process. This ensures that emissions estimates and program results are incorporated into country data and are consistent with national accounting. The findings derived from this international technical analysis will be part of the support for the validation and verification process coming from the ERP.

- Quality Control and Quality Assurance

Data quality control and quality assurance (QA/QC) is a process that ensures that a data set is reliable and useful for its intended purpose.

The objective of QA/QC is to ensure that the data is accurate, reliable, precise and free of errors or inconsistencies, this involves testing and evaluating the data at all stages of the project, from data acquisition to final delivery.

In the ERP MRV system, quality assurance (QA/QC) is addressed from each of the teams responsible for generating both the activity data and the emission factors used in the estimation of the program's GHG emissions. Each team has developed methodologies that include processes to ensure the quality of the information they generate.

The SMByC methodology addresses quality control at all stages of implementation, from the download of satellite images, through the preprocessing and processing of the images, to the generation of the final results of the Forest Change Map and Non-forest Forest Cover Map, which are used to generate data for variables such as Forest Cover Change and Forest Cover. To ensure the quality, completeness and consistency of the data, the SMByC has consolidated a set of quality control tools and processes (See Insumo MRV).

In the case of the IFN a quality assurance and quality control program is implemented to ensure that the information collected in the field is complete, accurate, unbiased and of high quality. This systematic monitoring program begins with a training process and continues with quality control in data collection and the production of results, all with the objective of providing information with a low degree of uncertainty.

The quality control brigades carry out verifications in some clusters where the regular brigade has already taken the information, in order to check and verify the quality of the work done, and to solve possible errors or problems that may arise in the data collection. These checks can be of hot, cold or blind type:

- Hot check: It is performed at the same time by the two brigades.
- Cold check: The control brigade performs the check after the work of the regular brigade to verify the data collected.
- Blind check: The cluster is established again without having the data already taken by the regular brigade to perform an independent verification.

For the case of information captured in the field as mentioned above, work will be done in conjunction with groups such as the SMByC and the crop monitoring system and the Spatial Data Infrastructure to define the appropriate methodologies for this activity.

In the case of the data used for GHG estimates, the quality processes are based on the tools and methods developed from the National MRV system, which consists of five quality controls applied to the information used in the NGHGI (National GHG Emissions Inventory), ranging from quality control of the input information to the SINGEI, to the quality of the calculations and final results of the NGHGI.

Currently, SINGEI has a protocol that proposes five quality controls applied to NGHGI input information, which are listed below:

- Initial quality control (CC0): Quality control to the work plan and to the updating of SINGEI instruments or evolutionary maintenance.
- First quality control (CC1): Quality control of the input information to SINGEI
- Second quality control (CC2): Quality control to the preliminary calculations and results (per module) of the NGHGI.
- Third quality control (QC3): Quality control of the final calculations and results of the NGHGI.
- ourth quality control (CC4): Quality control to SINGEI reports NGHGI Quality Assurance (QA).
- Fifth quality control (CC5): Quality control of the SINGEI filing system and the NGHGI improvement plan.

### 4.5.3 UNCERTAINTY

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General methodology

The evaluation of uncertainty in the categories has had important advances, due to the availability of more robust sources of information and with methodologies that allow involving the sources of error of the variables that intervene in the estimation models of the emission factors mainly, measuring in a clearer way the uncertainty of the GHGs[148]. The methodology for the evaluation of GHG uncertainty is based on the use of Monte Carlo type simulations and error propagation in each category, generating variables with 10.000 simulations, for each component, of the emission factor estimation models.

In the aggregate levels of information, uncertainty is estimated by applying the error propagation method. For the AFOLU sector, the Monte Carlo method was applied at the most disaggregated levels of information, that is, for emission factors by subcategories, and for categories the error propagation method was applied.

The methodology for estimating the subcategories consisted of replicating the emission factor estimation models through Monte Carlo type simulations, considering in each case the uncertainty associated with each of the model components. The general estimation scheme comprises:

a. Definition of the parameters for each component involved in the estimation model of each of the emission factors (functions) of each of the categories selected for the GHG evaluation. In cases where the source did not allow the establishment of such parameters, these were defined based on expert consultation.
b. Generation of random values from Monte Carlo simulations for the components of each function, assuming in each case a normal distribution, since it was not possible to determine the theoretical distribution of the components, considering that in many cases the value of the uncertainty associated with each one was obtained from the consultation with experts or with the results of the uncertainty estimation.
c. Estimation of the emission factors from the combination of the k simulated variables, according to the model designed by the IDEAM for each selected subcategory (see insumo Incertidumbre), as follows

$$FE_k = f_k(x_1, x_2, x_3, \dots, x_i)$$

d. Estimation of the uncertainty (in relative terms) of each of the factors, as follows:

$$U(FE_k) = \frac{\sqrt{\frac{\sum_{j=1}^{n} \left(FE_{kj} - \underline{FE_k}\right)^2}{n}}}{\underline{FE_k}}$$

Uncertainty in activity data (in the cases where required) [

a scheme similar to that of emission factors is established:

a. Definition of the parameters for each component $X_i$ nvolved in the activity data estimation model in each of the categories selected for the GHG assessment.
b. Generation of $n$ random values for each function $Z_i$, assuming in each case a normal distribution $N(\mu, \sigma^2)$.
c. Consolidation of the $m$ activity data estimation functions (DA), considering the models

148 The methodology used does not necessarily imply a decrease in uncertainties, but rather shows with greater confidence the calculation

selected by IDEAM for each selected category, as follows

$$DA_m = g_m(z_1, z_2, z_3, \dots, z_l)$$

d. Estimation of the uncertainty (in relative terms) of each activity data, thus:

$$U(DA_m) = \frac{\sqrt{\frac{\sum_{h=1}^{m} \left(DA_{mh} - \underline{DA_m}\right)^2}{m}}}{\underline{DA_m}}$$

To calculate the combined uncertainty estimate between activity data and emission factors we consider:

$$U\left(GEI_p\right) = (\sqrt{U(DA_m)^2 + U(FE_k)^2}$$

Finally, the total uncertainty is defined as:

$$U(GEI) = \sqrt{\sum_{p=1}^{w} U\left(GEI_p\right)^2}$$

The variables are assumed to have a normal distribution, since this is considered adequate when the uncertainty range is small and symmetrical with respect to the mean (IPCC 2006). Likewise, this estimation process established a weight for each category, which are evaluated based on the value of the estimated emissions, in other words, key categories, so that high uncertainties in categories with low contribution to GHGs will not greatly affect the overall uncertainty estimate.

#### 4.5.3.1 UNCERTAINTY ESTIMATE FOR CATEGORY 3A-LIVESTOCK

Livestock category 3A composed of subcategories 3A1-Enteric fermentation and 3A2-Manure management presented gross uncertainties of 3,9% and 6,5% respectively.

Uncertainty 3A1 - Enteric fermentation

It was estimated from the $CH_4$ gas emissions information. According to the evaluation, it is established that the highest levels of uncertainty were presented in categories 3A1b and3A1d, reaching uncertainties of 46,5% and 35,2% respectively. On the other hand, the uncertainty of GHG associated with category 3A1a-total cattle was 4,0%, which was positioned as key for the overall uncertainty estimate of the category, as it has a higher weight due to the GHG it contributes.

Uncertainty 3A2 - Manure Management

Considering $CH_4$ and $N_2O$, gas emissions, subcategories 3A2a, 3A2h and 3A2j presented the lowest levels of uncertainty, reaching uncertainties of 4,6%, 15,4 y 16,6% respectively. In addition, 3A2a was identified as a key category, since it showed the greatest sensitivity to changes in uncertainty.

Table 16 shows the results of the uncertainties that are part of the category corresponding to livestock activities in the Orinoquia region:

Table 16. Uncertainty estimate for the category Enteric fermentation in the Orinoquia 2018

| Category | All | Emissions | |
|---|---|---|---|
| | | $CH_4$ (±) | $N_2O$ (±) |
| **3A1 - Enteric fermentation** | **3,9%** | **3,9%** | **-** |
| 3A1a - Total Cattle | 4,0% | 4,0% | - |
| 3A1b - Buffalo | 46,5% | 46,5% | - |
| 3A1c – Sheep | 33,0% | 33,0% | - |
| 3A1d - Goat | 35,2% | 35,2% | - |
| 3A1f - Horses | 24,3% | 24,3% | - |
| 3A1g - Mules and asses | 26,3% | 26,3% | - |
| 3A1h - Swine | 32,7% | 32,7% | - |
| **3A2 – Manure management** | **6,5%** | **7,6%** | **10,9%** |
| 3A2a - Total Cattle | 4,6% | 4,6% | 27,3% |
| 3A2b - Buffalo | 32,8% | 47,1% | 38,9% |
| 3A2c - Sheep | 28,2% | 35,7% | 34,5% |
| 3A2d - Goat | 26,4% | 46,5% | 31,5% |
| 3A2f - Horses | 29,9% | 42,6% | 39,0% |
| 3A2g - Mules and asses | 31,6% | 38,0% | 56,6% |
| 3A2h - Swine | 15,4% | 18,8% | 18,2% |
| 3A2j - Poultry | 16,6% | 27,3% | 17,9% |

#### 4.5.3.2 UNCERTAINTY ESTIMATE FOR CATEGORY 3B-LAND

An uncertainty level of 14,2% n gross emissions was estimated. The subcategories Land, 3B1-Forest Land, 3B2-Cropland, 3B3-Rangeland, 3B4-Wetlands, 3B5-Settlements, and 3B6-Other Land, define the estimate of net GHG emissions, with uncertainties in 2018 of 29,4%, 42,2%, 24,6%, 20,0%, 21,0% y 17,9% respectively.

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Uncertainty 3B1 - Forested land

The forest land category is estimated by considering $CO_2$ removals and emissions, both in those that cover remaining as such and those that are converted. The results showed that for 2018, in this category the uncertainty is equally sensitive to subcategories 3B1a and 3B1b, however, the calculation showed a lower level of uncertainty in 3B1b reaching for 2018 23,4%.

The level of $CO_2$ removals has an important impact on the overall uncertainty level of the subcategory, due to the variability generated when establishing net emissions.

Uncertainty 3B2 - Cropland

Net emissions present an uncertainty of 29,1%, however, the uncertainty in removals is 13,8% and 8,1% in gross emissions. When observing the subcategories with which the 3B2 category is estimated, it is possible to determine that 3B2a makes the greatest contribution to the overall uncertainty, since for this year, removals were estimated with uncertainties of 14,1%.

Uncertainty 3B3 - Grassland

A level of uncertainty of 24,6% was calculated for the category, where removals reach an uncertainty of 35,6% and emissions of 24,4%. In this case, it can be established that emissions present greater sensitivity in the uncertainty estimate. Category 3B3a has an uncertainty of 35,6%, while category 3B3 has an uncertainty of 24,4%.

Uncertainty 3B4 - Wetlands

GHGs from wetlands are calculated based on information from category 3B3b for the Orinoquia region. In this case only $CO_2$ emissions are considered, which for 2018, reached an uncertainty of 20,0%

Uncertainty 3B5 - Settlements

The settlements category estimates GHGs from $CO_2$ gas emissions and considers only the 3B5 category, which reaches an uncertainty level of 21,0% for 2018.

Uncertainty 3B6 - Other Land

The uncertainty assessment of other land (3B6), is established from $CO_2$ emission gases, which presented an uncertainty of 17,9% for 2018

Table 17. Uncertainty estimate for the category Land use and land use change in the Orinoquia 2018.

| **Category** | **All** | **Absorptions** | **Emissions** |
|---|---|---|---|
| | | **$CO_2$ (±)** | **$CO_2$ (±)** |
| **3B1 - Forest land** | **29,1%** | **13,8%** | **8,1%** |
| 3B1a - Forest land remaining forest land | 28,1% | 14,1% | 8,1% |
| 3B1b - Land converted to forest land | 23,4% | 23,4% | - |
| **3B2 - Cropland** | **47,3%** | **21,2%** | **34,9%** |
| 3B2a - Cropland remaining cropland | 35,3% | 21,2% | 47,2% |
| 3B2b - Land converted to cropland | 47,8% | - | 47,8% |
| **3B3 - Grassland** | **24,6%** | **35,6%** | **24,4%** |
| 3B3a - Grassland remaining Grassland | 35,6% | 35,6% | 49,3% |
| 3B3b - Land converted to grassland | 24,4% | - | 24,4% |

| | | | |
|---|---|---|---|
| **3B4 - Wetlands** | **20,0%** | | **20,0%** |
| 3B4a - Wetlands remaining grassland | | - | - |
| 3B4b - Land converted to wetlands | 20,0% | - | 20,0% |
| **3B5 - Settlements** | **21,0%** | | **21,0%** |
| 3B5a - Settlements remaining grassland | - | - | - |
| 3B5b - Land converted into settlements | 21,0% | - | 21,0% |
| **3B6 - Other land** | **17,9%** | | **17,9%** |
| 3B6a - Other land remaining grassland | - | - | - |
| 3B6b - Land converted into other land | 17,9% | - | 17,9% |

#### 4.5.3.3 UNCERTAINTY ESTIMATE FOR CATEGORY 3C-AGGREGATE SOURCES AND NON-$CO_2$ EMISSIONS FROM LAND

Category 3C, in 2018, corresponding to emissions from the agricultural sector, within which emissions associated with biomass burning are included, presented an uncertainty level of 14,7% in gross emissions. Subcategories 3C1, 3C2, 3C3, 3C4, 3C5, 3C6 and 3C7 define the estimate of net GHG emissions in Orinoquia, with uncertainties of 9,5%, 10,1%, 14,6%, 32,6%, 19,3%, 22,5% y 34,3% respectively.

Uncertainty 3C1 - Biomass burning emissions

The uncertainty estimate for category 3C1 in the Orinoquia region, is defined from categories 3C1a and 3C1b, evaluating the emission of $CH_4$ and $N_2O$ gases. In 2018, the uncertainty of this category was calculated at 9,5%, likewise, for $CH_4$ gases the uncertainty was 11,2% and for $N_2O$ gases 17,2%. In this category, the uncertainty could be more sensitive for category 3C1a.

$CO_2$ emissions from liming and 3C3 - $CO_2$ emissions from the use of urea

New category incorporated in the regional NGHGI, estimated uncertainty of 10,1% or the use of lime as a soil conditioner, where the uncertainty of the default emission factor suggested by the IPCC (2019) was contemplated and the activity data, estimated by expert consultation, for urea was calculated at 14,6% nd the same uncertainty values were imputed as those detailed for the use of lime. [

Uncertainty 3C4 - Direct $N_2O$ emissions from managed soils

The percentage uncertainty for the category of direct $N_2O$ emissions from managed soils reached 32,6% in 2018. However, categories 3C4b and 3C4c have uncertainties of 86,5% and 80,1% respectively.

Uncertainty 3C5 - Indirect $N_2O$ emissions from managed soils

The subcategory presented an associated uncertainty of 19,3% in 2018, with subcategories 3C5c and 3C5h presenting the lowest uncertainty.

Uncertainty 3C6 - Indirect $N_2O$ emissions from manure management

The uncertainty estimation for the Orinoquia region for everything related to Indirect $N_2O$ emissions from manure management resulted in an uncertainty level of 22,5%, where category 3C6j presented the lowest level, among all subcategories, reaching 32,4%, followed by category 3C6h, which was 34,7%.

Uncertainty 3C7 - Rice cultivation

In 2018, an uncertainty of 29,7% was calculated for category 3C7, where the subcategory of 3C7a presented 19,3% uncertainty and the subcategory 3C7b reached reaches 49,1%. In this case the overall uncertainty of 3c7 is largely influenced by category 3C7b.

Table 18. Uncertainty estimate for the category Land management- Aggregate sources and non-$CO_2$ emissions from land in the Orinoquia 2018.

| ***Category*** | ***All*** | ***Emissions*** | | |
|---|---|---|---|---|
| | | ***$CO_2$ (±)*** | ***$CH_4$ (±)*** | ***$N_2O$ (±)*** |
| ***3C1 - Emissions from biomass burning*** | ***9,5%*** | ***-*** | ***11,2%*** | ***17,2%*** |
| 3C1a - Emissions from biomass burning in forest lands | 9,6% | - | 11,2% | 17,3% |
| 3C1b - Emissions from biomass burning in cropland | 32,9% | - | 40,1% | 33,6% |
| 3C1c - Emissions from biomass burning in rangelands | - | - | - | - |
| 3C1d - Emissions from biomass burning on Other land | - | - | - | - |
| ***3C2 - Liming*** | ***10,4%*** | ***10,4%*** | ***-*** | ***-*** |
| ***3C3 - Urea application*** | ***13,7%*** | ***13,7%*** | ***-*** | ***-*** |
| ***3C4 - Direct $N_2O$ emissions from managed soils*** | ***32,6%*** | | | ***32,6%*** |
| 3C4a – Synthetic N fertilizers ($F_{SN}$) | 48,2% | - | - | 48,2% |
| 3C4b - Organic N applied as fertilizer ($F_{ON}$) | 86,5% | - | - | 86,5% |

| | | | | |
|---|---|---|---|---|
| 3C4c - Crop residues including nitrogen fixers and forage residues in grassland renewal ($F_{CR}$) | 80,1% | - | - | 80,1% |
| 3C4d - Mineralization N due to change in use or management in mineral soils ($F_{SOM}$) | 39,4% | - | - | 39,4% |
| 3C4e - Organic soil management ($F_{OS}$) | 68,8% | - | - | 68,8% |
| 3C4f - Urine and dung from grazing animals ($F_{PRP}$) | 49,2% | - | - | 49,2% |
| ***3C5 - Indirect emissions of $N_2O$ from managed soils*** | ***19,3%*** | **-** | **-** | ***19,3%*** |
| 3C5a - Volatilization - Synthetic N Fertilizers ($F_{SN}$) | 58,1% | - | - | 58,1% |
| 3C5b - Volatilization – Organic N applied as fertilizer ($F_{ON}$) | 69,9% | - | - | 69,9% |
| 3C5c - Volatilization - Urine and dung from grazing animals ($F_{PRP}$) | 30,2% | - | - | 30,2% |
| 3C5d - Leaching/runoff Synthetic N fertilizers ($F_{SN}$) | 41,4% | - | - | 41,4% |
| 3C5e - Leaching /Runoff Organic N applied as fertilizer ($F_{ON}$) | 68,0% | - | - | 68,0% |
| 3C5f - Leaching/runoff Crop residues including nitrogen fixers and forage residues in grassland renewal ($F_{CR}$) | 62,0% | - | - | 62,0% |
| 3C5g - Leaching/runoff Mineralization from change in use or management ($F_{SOM}$) | 44,4% | - | - | 44,4% |
| 3C5h - Leaching/runoff - urine and dung from grazing animals ($F_{PRP}$) | 35,5% | - | - | 35,5% |
| ***3C6 - Indirect $N_2O$ emissions from manure management*** | ***22,5%*** | **-** | **-** | ***22,5%*** |
| 3C6a - Total Cattle | 39,9% | - | - | 39,9% |
| 3C6b - Buffalo | 71,8% | - | - | 71,8% |
| 3C6c - Sheep | 59,5% | - | - | 59,5% |
| 3C6d - Goats | 67,9% | - | - | 67,9% |
| 3C6f - Horses | 54,5% | - | - | 54,5% |

| | | | | |
|---|---|---|---|---|
| 3C6g - Mules and asses | 59,8% | - | - | 59,8% |
| 3C6h - Swine | 34,7% | - | - | 34,7% |
| 3C6j - Poultry | 32,4% | - | - | 32,4% |
| ***3C7 - Rice cultivation*** | ***29,7%*** | **-** | ***29,7%*** | **-** |
| 3C7a - Irrigated rice | 29,6% | - | 29,6% | - |
| 3C7b - Rainfed rice cultivation | 35,3% | - | 35,3% | - |

#### 4.5.3.4 UNCERTAINTY ESTIMATION FOR CATEGORY 3D-PRODUCTS FROM HARVESTED WOOD

Category 3D, in 2018, is reported for the first time in the national GHG inventory, in this sense, emissions were calculated for the Orinoquia region, for which an uncertainty of 9,5% was reported as detailed in Table 19.

Table 19. Uncertainty estimate for category 3D-Wood products harvested in the Orinoquia 2018.

| Category | All | Absorptions $CO_2$ (+/-) |
|---|---|---|
| **3D1 - Harvested wood products** | **9,50%** | **9,50%** |

<u>General uncertainty estimation</u> [

According to the technical evaluation, it was considered that the categories associated with livestock and deforestation explain the highest percentage of GHGs in the region, therefore, the combination of these two can provide a clear approximation of the overall uncertainty, thus, an uncertainty level for net emissions of 26,4%, where 12,3% were removals and 10,3% were gross emissions.

The uncertainty estimate presented, which includes the subcategories associated with OWV, forest plantations and oil palm crops, was estimated based on the information currently available; however, its final estimate is part of the activities established and will be developed in the second half of this year.

The traceability of the uncertainty calculation can be consulted in the following folder: 4_5_3_Incertidumbre.

Regarding monitoring emissions and reducing uncertainty, these will be managed the in similar way as it was done for the interim baseline (e.g. Annex X describes protocols used for image processing and national forest inventory data collection for each category included in the interim baseline, detailing the QA/QC processes). Improvements will be incorporated and implemented as per the framework established by the improvement plan (Annex VIII)that is aimed among other things, at reducing the baseline uncertainty and deliver complete MRV compliance with ISFL requirements for all selected subcategories. Furthermore, field data collection protocols are being developed to develop QA/QC procedures for producing activity data at the parcel and/or specific intervention levels. This will lead to an improvement in emissions and removals monitoring as well as a reduction in uncertainty.

Activities aimed at reducing uncertainty include improving activity data, emission factors, and parameter transition to tier 2. This includes parameters used in agriculture, livestock, and forestry categories. These activities are being carried out through ongoing consulting services (for more details, refer to Annex VIII).

## 4.6 ESTIMATION OF THE EMISSION REDUCTIONS

Emission reductions were calculated from the NDC Sectoral Mitigation Measures included in Colombia's updated report submitted to the UNFCCC in December 2020 (Government of Colombia, 2020). The description of the measures can be found in the PORTFOLIO OF SECTORAL CLIMATE CHANGE MITIGATION MEASURES, a document annexed to the NDC (Government of Colombia, 2020)[149]. The methodology for modeling each of these measures at the national level can be found in the NDC mitigation scenario support document (VITO, University of Andes, U of Wageningen, CIAT, ESMIA, SEI, 2020)[150]. For each of these measures, a downscaling exercise was performed, from the national level to the Orinoquia level, estimating the corresponding mitigation targets for the region. These regional targets should not be taken as an official target of the ERP or as a regional target, but as an indication of the aspirational ambition for each mitigation measure for the Orinoquia region.

Once the downscaling exercise was completed, the emission reduction potentials were calculated, both for the NDC reference scenario simulated for the Orinoquia and as part of the ERP Baseline.

The detailed calculations to build the mitigation scenarios can be found in the following link 4_6_Escenario_BAU&Mitigación.xlsx, the information is associated with the compilation of calculated baseline emissions, mitigation scenarios and the reduction potential.

[149] Available in: https://www.minambiente.gov.co/wp-content/uploads/2021/10/portafolio-de-medidas-sectoriales-de-mitigacion-de-cambio-climatico-contribucion-determinada-Colombia-ndc-2020.pdf
[150] Available in: https://archivo.minambiente.gov.co/images/cambioclimatico/pdf/NDC_Colombia/PMR_reporte_escenario_de_mitigacion_20201209_1.pdf

## A. Livestock Sector - Enteric Fermentation Emissions Reduction

Emission reductions in the mitigation scenario for the Cattle Enteric Fermentation subcategories were estimated using an emissions intensity approach. The emissions intensity (EI) was calculated according to equation 1 (Eq 1)[151].

For the estimation of absolute emissions (Emissions) in the mitigation scenario, the projection of the trend in the growth of the number of animals through a linear regression applied to the base period 2009 to 2018 was used as activity data.[152]

The calculation of the enteric $CH_4$ emission factors in the mitigation scenario was performed under a Tier 2 methodology using the AFOLU 1 Colombia - IDEAM Model[153]. Assumptions associated with increases in milk production (2%) and meat production (7%) were used. Additionally, in order to achieve a reduction in emission factors, improvements in the animal diet were included, such as an increase in digestibility, fiber reduction, increase in protein and an improvement in the energy/protein ratio through the provision of better grassland (renovation), supplementation, the establishment of various silvopastoral arrangements and grazing management. The results of the calculation process show that, by applying the mitigation measures of the emission reduction program, the emission factors are reduced by about 15% on average for the subcategory Cattle Enteric Fermentation.

Generally, the calculation of absolute emissions (Emissions) for Cattle Enteric Fermentation is done by multiplying the emission factor for each animal subcategory by the activity data (number of animals). However, in a mitigation scenario it should be considered that the mitigation measures of the emission reduction program will initially have a low implementation for the first years and will gradually grow, for the case of livestock the annual growth rate of the implementation of mitigation measures on the cattle population is 3,75%. This means that the estimate of absolute emissions (Emissions) is calculated in a weighted way by multiplying the emission factor of the mitigation scenario by the number of animals over which the measures of the emission reduction program will be implemented, plus the result of multiplying the emission factors of the baseline over the remaining animal population or over which the mitigation measures have not been implemented. The growth rate of the implementation of mitigation measures is cumulative, so over the years the number of animals over which mitigation measures have been implemented will increase.

To calculate protein production, assumptions associated with 2% increases in milk production and a 7% increase in meat production (weight gains) were used. As in the baseline, it is calculated as the product of the average number of animal heads for the projected period 2019 to 2029 and the average production per animal head of protein for the period 2019 to 2029. The same baseline assumptions were used for meat and milk protein contents. As in the calculation of absolute emissions, total protein production (Production) was calculated in a weighted manner using the implementation rate of 3,75% over the cattle population.

On the other hand, the reduction in livestock emissions is calculated based on equation 2 (Eq 2),

[151] https://www.biocarbonfundisfl.org/sites/isfl/files/202301/ISFL%20ER%20Program%20Requirements_V1.3_2023.pdf
[152] 4_6_DA_Bovinos_Linea_base_2019 - 2029.xlsx
[153] 4_6_Modelo_AFOLU 1_Colombia_IPCC_IDEAM_FE_CH4.xlsx

reported in numeral 4.5.4 of the emission reduction program requirements version 1.3.

Equation for the calculation of emission reductions in livestock farming

$$ER_{ERP} = (EI_{ERP} - EI_{baseline}) * Average\ Annual\ Protein\ Production_{ERP} * N_{Years}$$
Eq 2.

Where:
$ER_{ERP}$ = emission reductions in an emission reduction program, t $CO_2$ eq year$^{-1}$.
$EI_{ERP}$ = Average annual emissions intensity during the implementation of an emissions reduction program, t $CO_2$ eq year$^{-1}$.
Average Annual Protein Production$_{ERP}$ = average annual protein production in an emission reduction program, t year $^{-1}$.
$\mathbf{N_{Years}}$ = duration of the emission reduction program in years.

Therefore, applying equation 2 (Eq 2), the emission reduction in the emission reduction program for the duration of the program (10 years) is 3.830.690 t $CO_2$ eq.

Figure 20 shows the emissions intensity of the baseline and the mitigation scenario for livestock (Cattle Enteric Fermentation). The baseline shows a growth rate of -0,22%, with a constant slope in the period 2009 to 2016, while there is an increase in the intensity of emissions, associated with the growth in the animal population due to the effect of increases in the price of beef for those years and phenomena such as social protests, which in 2016 exacerbated the reduction in the rate of cattle extraction and the consequent reduction in slaughter, causing an increase in the population of meat animals. For the mitigation scenario, there is evidence of a pronounced drop in emissions intensity, with a growth rate of -0,52%, in response to the implementation of the mitigation measures of the emissions reduction program. The calculation of baseline emissions intensity and mitigation can be found at the link: 4_4-4_6_ISFL_Methodology_Livestock.xlsx

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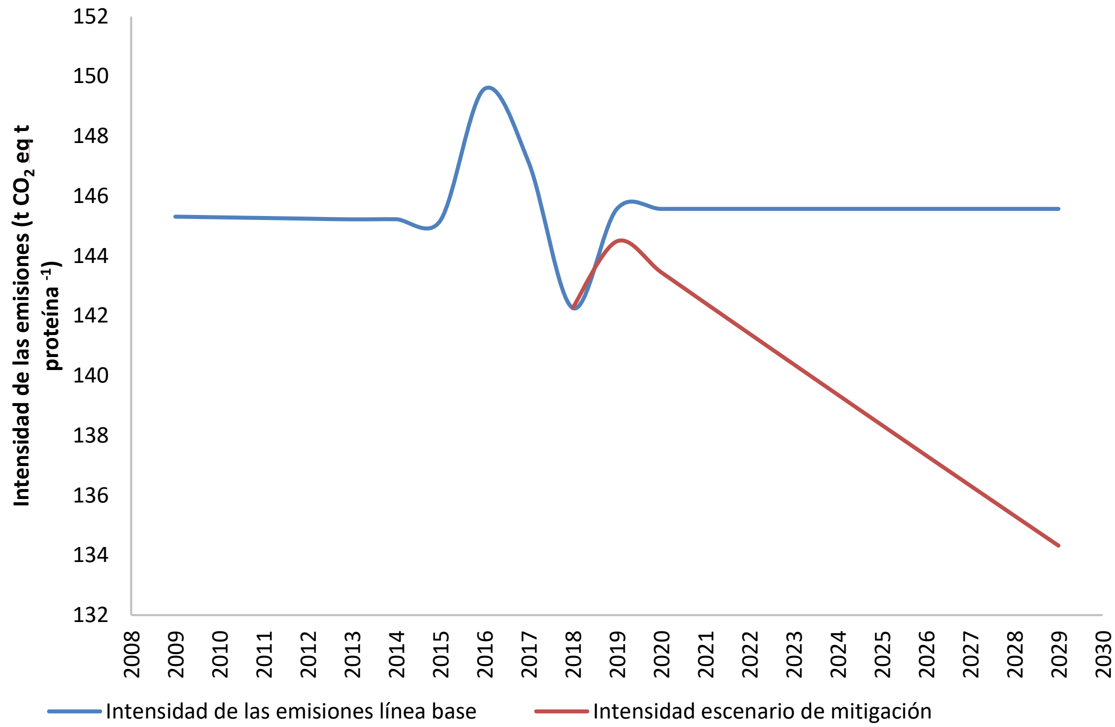


Figure 20. Emission intensities for the baseline and mitigation scenario of the ERP emission reduction program

B. Forestry and land use and land use change sector - Reduction of emissions and increase of removals by the implementation of mitigation measures

The following measures have been identified to mitigate emissions from land use and land use change: a) Development and consolidation of the production chain of commercial forestry plantations as a contribution to GHG capture; b) Intersectoral reduction of deforestation; c) Restoration processes in degraded areas and ecosystems; d) Low-emission cocoa crop production models; e) Renewal and rehabilitation of oil palm crops under a landscape approach; f) Increase in areas of OWV.

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GHG emission reductions from reduced deforestation

For the estimates of emissions from deforestation in the baseline scenario, data on natural forest areas converted to other land use from annual deforestation reports generated by the SMByC are taken as activity data for the period 2009-2018. For 2018, there was a total deforested area in the Orinoquia of 57.837 hectares, of which 24.832 hectares, correspond to category 3B1aii, 559 hectares to 3B2bi, 31.803 hectares to 3B3bi, 446 hectares to 3B4bi, 0 hectares to 3B5bi and 197 hectares to 3B6bi.

For the mitigation scenario, the NDC deforestation scenario (see file Escenario Deforestación.xlsx) presented in the cells highlighted in yellow in column F of the file, from 2019 to 2030, taking the

NDC target scenario and distributing the mitigation effort that should have the reduction of deforestation in the Orinoquia region, as a percentage that is close to 29%, this percentage is obtained from the representativeness of the deforested area in the Orinoquia region with respect to the national deforested area in 2018. Subsequently, the percentage distribution is made by type of change of use and the corresponding areas are established.

The emissions of the mitigation scenario are estimated from the deforestation data established in the NDC targets, and scaled according to the area of the Orinoquia region by deforestation subcategory for the period 2019-2030, and a factor corresponding to the ratio between emissions in 2018 and the activity data for the same year.

Figure 21 shows the baseline and deforestation mitigation scenario. The emissions trend in the baseline scenario shows an average annual growth rate of 15,31% (2009-2018). The estimated deforestation reduction target in the Orinoquia from the NDC scenarios is to reach an annual average deforestation reduction rate of 2881,77 ha. year-1 (2019-2029), reaching 17.796,96 ha of deforestation in 2029 compared to 2018, which corresponds to 57.837,24 ha. In terms of emissions, this represents an average annual decrease of -9,15% (2019-2029).

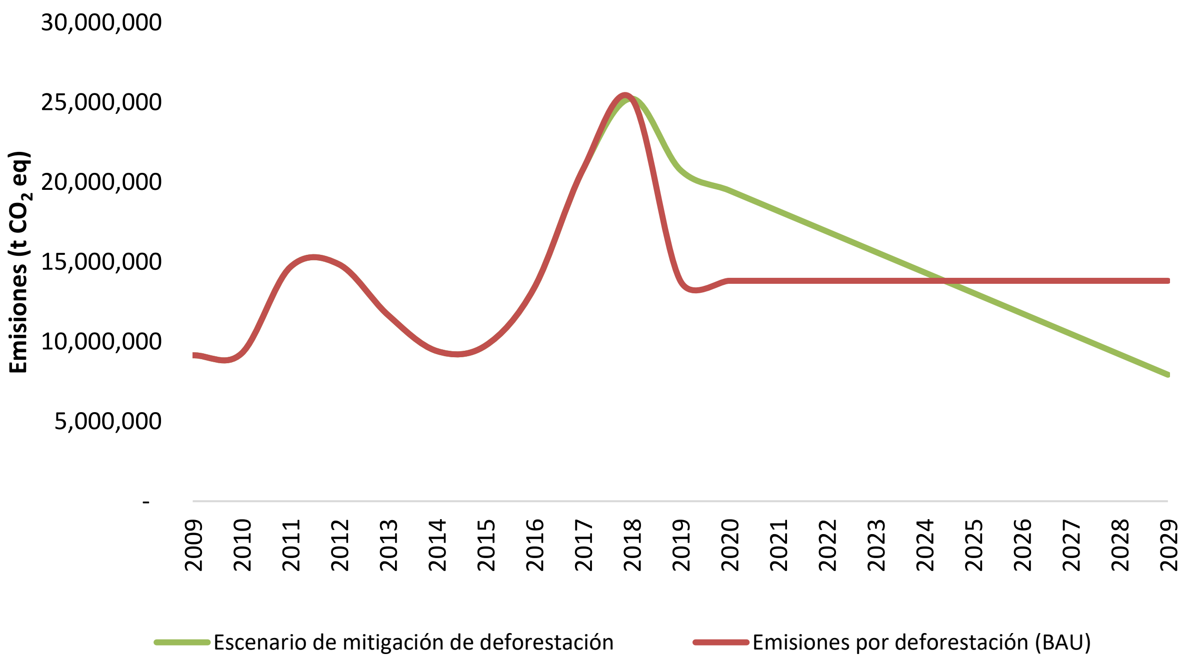


Figure 21. Emission intensities for the baseline and mitigation scenario of the ERP emission reduction program

## Increased removals due to implementation of ecological restoration activities

For the estimates of emissions from regeneration in the baseline scenario, the regeneration areas from the annual reports of Natural Forest change generated by the SMByC are taken as activity data for the 2009-2018 period. For the year 2018, there was a total regenerated area in the Orinoquia of 156 hectares.

The baseline emissions estimate for the 2019-2030 period is generated from the average of 2009-2018 emissions reported in the NGHGI, which, for the regeneration category (3B1bi land converted to forest), is -198.334 removals in t/$CO_2$.

The 2019-2029 mitigation scenario was constructed based on the ecological restoration goal formulated for the NDC, which indicates that by 2030 the restoration of 962.615 ha in the country will be achieved[154]. For the Orinoquia, as proposed in the NDC, an average annual restoration of 9.991 ha. year$^{-1}$ (2019-2029), is considered, reaching a total of 116.627 ha accumulated in 2029, corresponding to 13% (historical average of the percentage of regeneration area of the Orinoquia with respect to the national regeneration area in the period 2010-2018) of the accumulated area for the country's goal. In the fileEscenario Regeneración.xlsx, you can consult the information of the data taken into account for the projection of annual areas of the NDC, for the country and those projected for the Orinoquia region. The emissions of the mitigation scenario are estimated based on the regeneration data mentioned above for the period 2019-2030, and a factor corresponding to the ratio between removals in 2018 and the activity data for the same year.

Removal increases due to the implementaiton of new forestry and oil palm areas

The baseline scenario for the implementation of new areas of commercial forestry and oil palm plantations takes as a reference the increase and decrease of areas reported by the SMByC in the 2009-2018 period. The annual estimates in 2019-2029 are generated from the average of 2009-2018 emissions reported in the NGHGI, which, for the forest plantation category, is -483.309 removals in t/$CO_2$ and 35.098 emissions in t/$CO_2$ in oil palm cultivation this average corresponds to-479.374 removals is t/$CO_2$ and 149.057 emissions in t/$CO_2$. Finally, for the mitigation scenario, an annual implementation of new areas was projected based on the trend of increase and decrease in the areas of plantations and oil palm crops in the 2009-2018 period.

According to the projection of areas for the Orinoquia region, 2019 would start with a total of 73.666 hectares of increase in plantation areas and 529 hectares of decrease in plantation areas, ending in 2029 with 144.688 and 946 hectares of increase and decrease in commercial plantation areas, respectively. For oil palm cultivation in 2019, a total of 224.923 hectares of increased plantation areas and 4.341 hectares of decreased plantation areas would start, ending in 2029 with 269.831 and 5.208 hectares of increased and decreased commercial plantation areas, respectively. See file: 4_6_Escenario_BAU&Mitigación.xlsx.

The emissions/removals estimates of the mitigation scenario for the implementation of forestry plantations and oil palm cultivation are obtained from the projected activity data of both increase (removals) and decrease (emissions) of areas, by a factor that shows the ratio of removals/emissions

[154] For more information on Colombia's NDC mitigation measures related to ecological restoration activities, see the document "PORTAFOLIO DE MEDIDAS SECTORIALES DE MITIGACIÓN DEL CAMBIO CLIMÁTICO", page 59. Available at: https://www.minambiente.gov.co/wp-content/uploads/2021/10/portafolio-de-medidas-sectoriales-de-mitigacion-de-cambio-climatico-contribucion-determinada-Colombia-ndc-2020.pdf

of 2018 with the activity data of the same year, thus obtaining the results of emissions/removals estimates for each of the years of the mitigation scenario series (2019-2030).

Increased removals from increased areas of OWV

In the construction of the baseline for the estimation of emission reductions due to the increase in areas of OWV, the NGHGI emissions/absorptions information for category 3B1aii2 - Dynamic in OWV (OWV), generated by the SMByC, period 2009-2018, was taken; counting in 2018 with a total of absorptions due to the increase in areas of OWV of 5.187.104 t. $CO_2$nd emissions of 1.038.679 t.$CO_2$**.** For the period 2019-2030 the baseline is estimated from the average of 2009-2018 emissions reported in the NGHI, which corresponds to a total of -5.278.419 removals in t.$CO_2$ y 1.255.238 emissions in t.$CO_2$.

Given that the coverage of OWV taken into account for Colombia includes all types of woody vegetation that do not meet the criteria of the definition of forest[155], it is assumed that this coverage includes areas of permanent crops such as cocoa and silvopastoral systems, whose expansion of areas is considered as a mitigation measure within the Program.

According to the above, the mitigation scenario of the Dynamic category in OWV contemplates the implementation of several measures proposed in the Sustainable Livestock NAMA given its importance in terms of mitigation measures that the country should develop such as the release of livestock areas for use as recovery of natural vegetation areas, silvopastoral systems, live fences, fodder hedges, mixed forage banks and planting of scattered trees; additionally, the implementation of new areas of low emission cocoa cultivation is contemplated.

The mitigation scenario proposes that the annual released areas suggested in the Sustainable Livestock NAMA be transformed into areas of OWV. According to the NAMA, the measure of "*release of areas in livestock use for ecological restoration*" is derived from the productive intensification of the livestock system, where, to the extent that the same number of cattle can be kept in a smaller area and produce the same or even more, it frees up areas within the property, which can be used for other purposes, including ecological restoration. Therefore, it is a change in land use within the cattle ranch in areas where, instead of continuing to develop livestock activity, an isolation is carried out and an unassisted ecological restoration process takes place. It is expected that through this measure a total of 13.686 ha will be released in the Orinoquia by 2029. Thus, for the mitigation scenario for the period 2019-2030, the moderate scenario of the released areas proposed in the Livestock NAMA (see Table 20), was used as activity data for areas of OWV increase, which are accumulated to the area of increase in 2018. For the OWV decrease areas, it is proposed to maintain the average area decrease reported by the SMByC between 2011-2018, which corresponds to a value of 8.500 hectares.

GHG emissions in the period 2019-2030 correspond to the activity data of increase and decrease of areas, according to the scenarios mentioned above by a factor that is equal to the ratio between emissions/removals and the activity data of increase/decrease of area in 2018.

[155] See definition of forest for Colombia in the definitions chapter.

For the silvopastoral systems implementation scenarios[156] a historical line of emissions was elaborated based on the information of implementation of silvopastoral systems areas in the region for the period 2009-2018, provided by the Colombian Sustainable Livestock Project 2018 and the MADR and absorption factors proposed by TNC for the Orinoquia region, this information can be evidenced in the file: 4_6_Escenario_BAU&Mitigación.xlsx. The mitigation scenario is constructed from the accumulation of new areas to be implemented as part of the livestock NAMA to the area of OWV reported in 2018 according to the historical line.

Following the guidelines of the livestock NAMA[157], in a moderate scenario the program will initially have a low implementation rate for the first few years and will gradually increase. This information was established through working groups with FEDEGAN and CIPAV, in which the size of the areas for the development of the proposed mitigation actions was identified.
The estimated removals of the mitigation scenario for the implementation of silvopastoral systems are obtained from the activity data of accumulated annual areas (hectares) to be implemented by type of production system according to the goals of the livestock NAMA in a moderate scenario, multiplied by the emission factors proposed in the same NAMA (Table 21). These estimated emissions are accumulated to those estimated in the baseline for OWV for 2018.

Table 20. Annual implementation of productive systems areas according to the goals of the livestock NAMA in a moderate scenario for the Orinoquia region.

| System | Year 1 (ha) | Year 2 (ha) | Year 3 (ha) | Year 4 (ha) | Year 5 (ha) | Year 6 (ha) | Year 7 (ha) | Year 8 (ha) | Year 9 (ha) | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Release areas | 0 | 0 | 259 | 777 | 1.336 | 1.895 | 2.670 | 3.156 | 3.593 | 13.686 |
| Scattered trees in paddocks | 0 | 2.352 | 6.966 | 11.308 | 15.805 | 19.455 | 23.074 | 26.643 | 30.320 | 135.923 |
| Live fences | 0 | 2.612 | 7.834 | 12.831 | 17.846 | 22.010 | 26.092 | 30.134 | 33.999 | 153.359 |
| Forage Hedges | 0 | 23 | 254 | 620 | 1.056 | 1.595 | 2.212 | 2.742 | 3.152 | 11.654 |
| Mixed Fodder Banks | 0 | 0 | 9 | 28 | 44 | 61 | 86 | 98 | 111 | 437 |
| Intensive Silvopastoral Systems | 0 | 0 | 176 | 521 | 908 | 1.382 | 1.965 | 2.383 | 2.761 | 10.095 |

Table 21. Annual implementation of productive systems areas in accordance with the goals of the livestock NAMA in a moderate scenario for the Orinoquia region.

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| System | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 |
|---|---|---|---|---|---|---|---|---|---|---|

[156] For the estimation of removals from the implementation of silvopastoral systems in accordance with the goals of the NAMA for livestock, the areas of other productive systems such as dispersed tree planting, live fences, mixed forage banks and forage hedges are taken into account.
[157] World Bank, CIPAV, CIAT, FEDEGAN, TNC (2021). Nationally Appropriate Mitigation Action NAMA for sustainable cattle ranching in Colombia. Available at: https://documents1.worldbank.org/curated/en/229181642406542199/pdf/Acci%C3%B3n-de-Mitigaci%C3%B3n-Nacionalmente-Apropiada-NAMA-De-La-Ganader%C3%ADa-Bovina-Sostenible-en-Colombia.pdf

| | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|
| AD Scattered trees | 0 | -12.702 | -50.318 | -111.383 | -196.728 | -301.784 | -426.382 | -570.255 | -733.985 | -885.031 |
| CV -Live fences | 0 | -9.664 | -38.651 | -86.125 | -152.157 | -233.593 | -330.135 | -441.630 | -567.428 | -683.585 |
| SF - Forage Hedges | 0 | -205 | -2.515 | -8.158 | -17.768 | -32.286 | -52.413 | -77.365 | -106.049 | -134.523 |
| BMF - Banks | 0 | 0 | -36 | -143 | -314 | -550 | -882 | -1.263 | -1.694 | -2.124 |
| SSPi - Silvopastoralism | 0 | 0 | 0 | -1.451 | -5.745 | -13.235 | -24.631 | -40.835 | -60.483 | -83.252 |
| Total | 0 | -22.572 | -91.520 | -207.260 | -372.713 | -581.448 | -834.443 | -1.131.349 | -1.469.639 | -1.788.516 |

The mitigation scenario for the category of OWV also included the areas and increased removals from the implementation of new areas of cocoa cultivation and intensive silvopastoral systems, which were constructed as follows: for cocoa cultivation, there is historical reference information provided by FEDECACAO (2009-2018). Finally, for the mitigation scenario, an annual implementation of new areas was projected based on the trend of cocoa areas in the 2009-2018 period.

Figure 22 shows the baseline and net emissions mitigation scenario for the OWV subcategory. The trend of net emissions in the baseline scenario (2009-2018) shows an increase of -6.61 per year. The calculation implementing mitigation measures for this scenario estimates a percentage reduction of GHG emissions of -48,22% in 2029 with respect to the baseline, where the greatest decrease comes mainly from the efforts that the region will have to implement silvopastoral systems, low carbon cocoa areas and release of livestock areas.

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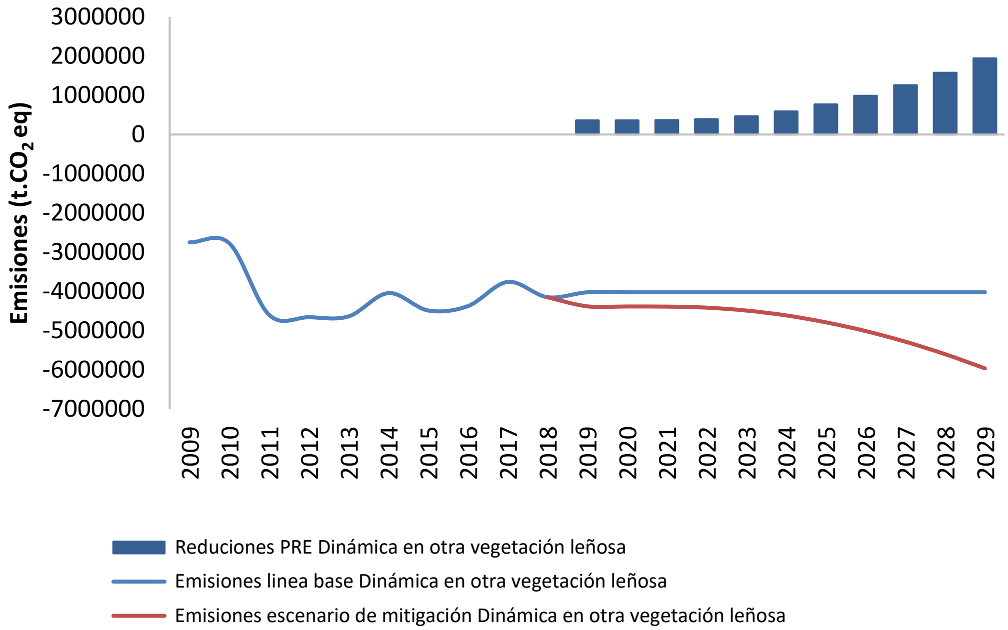


Figure 22. Mitigation scenario Dynamic in OWV

Figure 23 shows the baseline and mitigation scenarios for gross emissions, net emissions and removals for the land use and land use change sector. The trend of net emissions in the historical baseline scenario (2009-2018) shows an increase of 22,55% per year. The calculation implementing mitigation measures for this scenario estimates an emissions reduction of 148,33% with respect to the baseline in 2029, with the largest decrease coming mainly from the region's efforts to reduce deforestation.

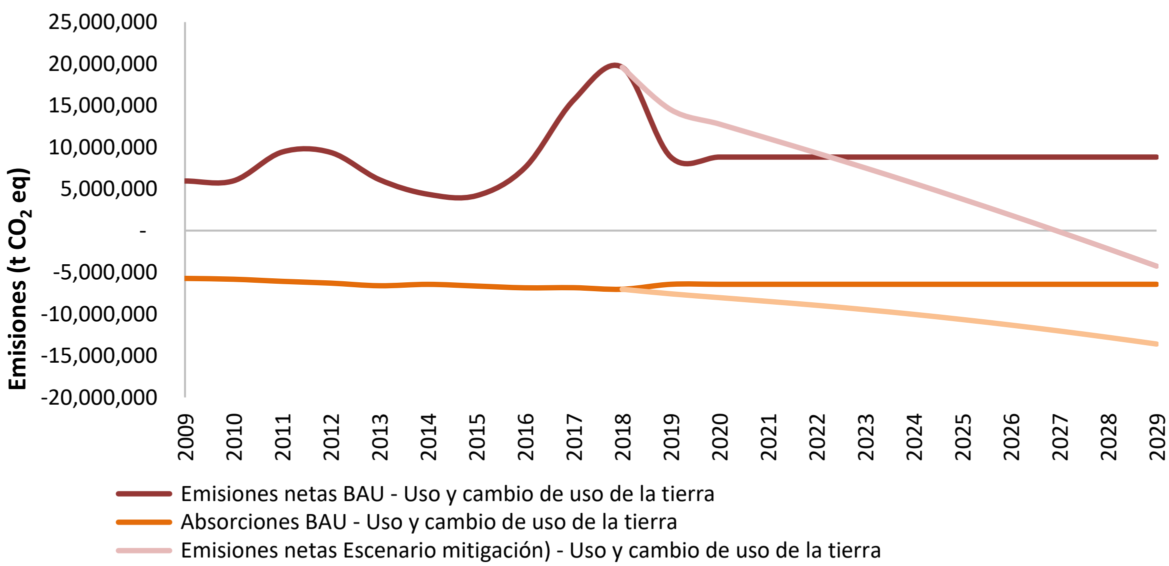

Figure 23. Baseline and mitigation scenarios for the land use and land use change sector

C. Reduction of GHG emissions in rice production through the massive adoption of low carbon technology packages in Colombia. - Led by MADR

For the 2019-2029 trajectory, the baseline scenario (BAU) takes as activity data the average of irrigated and rainfed rice areas of the 2009-2018 time series, proposing a daily emission factor of 3,55 kg $CH_4$ $ha^{-1}$ $day^{-1}$ for irrigated rice and 1,91 kg $CH_4$ $ha^{-1}$ $day^{-1}$ in rainfed rice, estimating $CH_4$ from 208.594 hectares harvested in 2009 to 207.574 hectares without carrying out emission reduction activities in 2029. The mitigation scenario quantifies intervened and non-intervened areas with mitigation actions, proposing a daily emission factor reduction of 0,43 kg $CH_4$ $ha^{-1}$ $day^{-1}$ or irrigated rice and 0,13 kg $CH_4$ $ha^{-1}$ $day^{-1}$ or rainfed rice. It is expected to achieve an intervention of 30% of the areas by 2029 (data provided by AGROSAVIA according to research in the region), starting in the first year of mitigation with 2,7% (5661 hectares intervened) and ending with 30% (annual cumulative value) equivalent to 62.272 hectares harvested with mitigation actions.

Figure 24 shows the behavior of the scenarios (baseline and mitigation) of $CH_4$ emissions from rice cultivation. The baseline emissions trend (2009-2018) shows a growth rate of 0,78%, due to the variability of the growth of harvested areas over the years. A reduction in $CH_4$ emissions is observed in the mitigation scenario corresponding to -2,95% due to the intervention of 30% of the harvested area by 2029 with low-carbon technological packages, mainly involving the implementation of good practices in rice cultivation[158]. The above will consider better practices for the control of the water sheet, which will allow the reduction of the scaling factors suggested by the IPCC 2019, mainly those to compensate for the differences in water regimes prior to the growing period, during the season prior to cultivation and factors for the type and amount of organic amendment applied. In a complementary manner, the reduction of nitrogen fertilizer, lime and urea application and the reduction of growing days due to the introduction of new varieties are proposed.

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[158] See file: 4_4-4_6_BAU-Mitig_Arroz_Orinoquia.xlsx

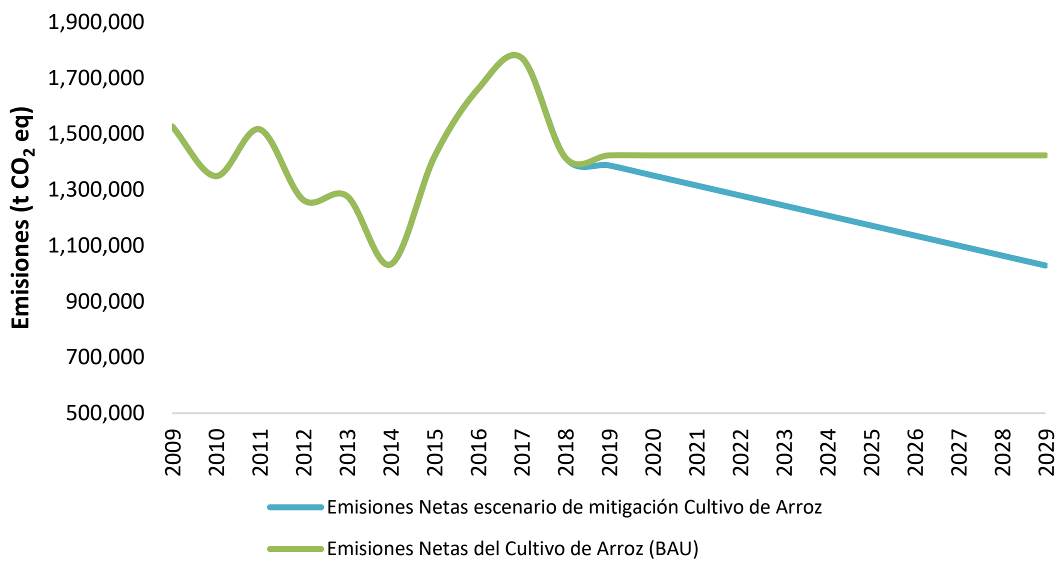


Figure 24. Baseline and mitigation scenario for rice cultivation in the Orinoquia region.

Figure 25 hows the aggregate estimate of the baseline net emissions and removals of the AFOLU sector and the corresponding mitigation scenarios to the year 2029, with an expected uncertainty deduction of 4%. The emissions in the mitigation scenario for the year 2029 estimates 13.557.775 t $CO_2$ eq, it is evident that the program will obtain results from the year 2024 given that the emissions of the last historical year (2018) are higher with respect to the average (2019-2029). It is worth mentioning that the mitigation scenario estimate without 4% is 14.122.682.

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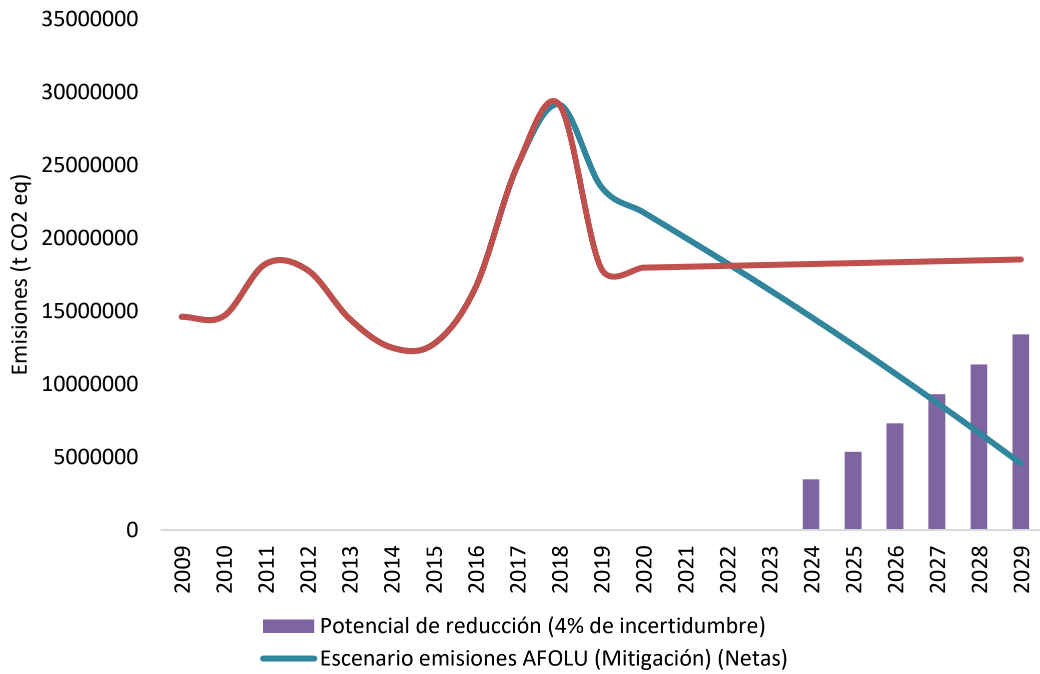


Figure 25. Aggregate mitigation scenario for the Orinoquia with the implementation of NDC mitigation measures.

Table 22 presents the numerical estimates of the baseline net emissions, the mitigation scenario, the reserve estimate (4% of total reductions) and the emissions reduction estimate considering the projected reserve. The reduction estimate is calculated as the sum of the reduction in cattle enteric fermentation emissions plus the reduction in emissions from the land use and rice categories. Cattle enteric fermentation emissions reductions are calculated based on the emissions intensity approach adapted from section 4.5.4 equation 2 of the ISFL Emission Reduction (ER) Program Requirements [159] where, the emissions reduction of an emission reduction program is calculated as the difference between the average annual emissions intensity of the baseline and the average annual emissions intensity of a program, during implementation (Mitigation Scenario); multiplied by the average annual protein production in an ER program. On the other hand, the estimated emission reductions for the land use and rice categories are calculated as the difference between the net GHG emissions of the baseline and the net GHG emissions of the mitigation scenario, calculation adapted from numeral 4.5.3. The traceability of the information can be consulted at the following link: 4_6_Escenario_BAU&Mitigación.xlsx. In general terms, the calculations show a reduction potential of 50.861.179 t $CO_2$ eq. $yr^{-1}$ for the years 2024 a 2029. Estimated value considering expected reserve due to uncertainty.

[159] https://www.biocarbonfund-isfl.org/sites/isfl/files/2023-01/ISFL%20ER%20Program%20Requirements_V1.3_2023.pdf

Table 22. Estimated emission reductions

| Year t of ERPA | Emissions baseline ($tCO_2$ eq/year) | Estimated emissions forecast in the ERP ($tCO_2$ eq/year) | Estimate of the expected reserve to reflect the level of uncertainty associated with the estimation of ER during the ERPA term ($tCO_2$ eq/year) | Estimated emission reductions ($tCO_2$ eq/year) |
|---|---|---|---|---|
| 2019 | 17.911.348 | 23.515.371 | | |
| 2020 | 17.973.597 | 21.775.877 | | |
| 2021 | 18.035.846 | 20.036.442 | | |
| 2022 | 18.098.096 | 18.274.383 | | |
| 2023 | 18.160.345 | 16.464.357 | | |
| 2024 | 18.222.594 | 14.604.420 | 147.854 | 3.548.485 |
| 2025 | 18.284.844 | 12.691.366 | 227.398 | 5.457.542 |
| 2026 | 18.347.093 | 10.729.337 | 308.909 | 7.413.805 |
| 2027 | 18.409.342 | 8.718.255 | 392.389 | 9.417.347 |
| 2028 | 18.471.592 | 6.660.142 | 477.759 | 11.466.226 |
| 2029 | 18.533.841 | 4.557.779 | 564.907 | 13.557.775 |
| Total | 200.448.537 | 158.027.730 | 2.119.216 | 50.861.179 |

The GHG emission reduction potential established and presented in this document is technical and is based on the GHG reduction ambition of the Orinoquia region associated with meeting the NDC target. For this reason, it cannot be understood as the volume of GHG emission reductions that the country will commit to the ISFL during the implementation period of the ERP. This volume of GHG reductions should be agreed upon in the framework of the negotiations for the elaboration of the ERPA that the country will carry out with donors and the World Bank.

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## 4.7 REVERSALS OF GHG EMISSIONS FROM THE ORINOQUIA BIOCARBON PROGRAM

### 4.7.1 NATURAL AND ANTHROPOGENIC RISK ASSESSMENT OF GHG EMISSIONS

The ISFL methodological framework states that a "reversal" occurs if one or more disturbance events result in the aggregate amount of measured and verified Reduced Emissions (RE) within the

ERP area for a Reporting Period being less than the aggregate amount of measured and verified Reduced Emissions (RE) within the ERP area for the previous Reporting Period(s). Colombia welcomes this general conceptual framework and proposes the following specific criteria to define the scope of the analysis of reversals in the framework of the Orinoquia ERP:

- Reversals from removals are calculated differently than reversals from emission reductions.

- For removals, the following definition of reversion applies to the ERP: *A reversion exists when areas of land that have generated removals measured and verified for the program (forest plantations, permanent crops, and restoration) are transformed as a result of a natural disturbance event or by an anthropogenic decision, causing their use to revert to another cover and consequently emit the carbon they had sequestered, with a magnitude such that in the net calculation the removals that had been registered become emissions for an ERPA accounting period*.

- Likewise, for reduced deforestation, the ERP will record a reversal if after a reporting period in which an emissions reduction below the historical average deforestation is calculated, emissions above the baseline are recorded during the next reporting period, which when aggregated cancel out the reduced emissions achieved in the first period for the total ERPA accounting period.

- Reversals are not calculated for category 3A and 3C emission reductions (IPCC, 2006).

- For the evaluation and calculation of the percentage of compensation of the risk of reversals for the ERP, the buffer calculation tool established by the ISFL [160] is used, which is developed by implementing the technical agreements reached by the country with the World Bank.

According to the ISFL methodological framework, there are two groups of risk factors that can cause reversals: natural and anthropogenic. The risk analysis is presented below, highlighting the behavior of the variables considered most important within each group. The results of the reversion buffer calculation are presented in the following section.

#### 4.7.1.1 NATURAL FACTORS

The analysis of the natural dynamics of the Orinoquia region made it possible to identify the two types of events considered most relevant for the calculation of the risk of ERP reversions due to natural factors: floods and fires. In general terms, it was identified that these events are due to the seasonal dynamics of the variables in the region. For the region as a whole, only 3,0% is considered

[160] ISFL Buffer Requirements versión 2.0 (2020). Available at: https://www.biocarbonfund-isfl.org/sites/isfl/files/2020-04/ISFL%20Buffer%20Requirements_2020_Final.pdf

susceptible to flooding, while in the departments of Arauca and Casanare more than half of their territory (51,7% y 53,3%, respectively) corresponds to periodically floodable areas. This indicates that flooding is typical of regional dynamics (Figure 26).

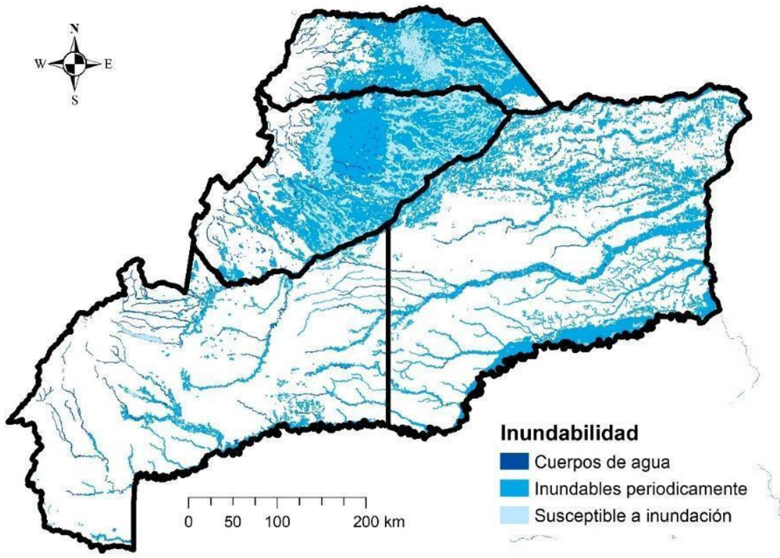


Figure 26. Floodability of the Orinoquia Scale 1:500.000 (2010). ERP Orinoquia Region
Data source: Areas susceptible to flooding. Colombia - IDEAM

Regarding the behavior of hot spots as a proxy for fires, the data show an average to low variability of 12,9% at the regional level and from 23,1% to 10,8% at the departmental level, with no atypical data within the ERP reference period (2009 - 2018). This indicates a low risk of events outside the trend that could generate reversals (Figure 27 y Figure 28). In conclusion, the behavior of the variables analyzed indicates that the level of risk associated with exposure and vulnerability to natural disturbances that could generate reversals for the Orinoquia ERP region is low. This is due to the fact that in both cases the dynamics are typical of the historical context of the region where atypical events have not been identified; in addition, the ecosystems of the Orinoquia are adapted to changes in natural factors, and there are risk management processes that seek to prevent and mitigate the effects and occurrence of disasters of this type.

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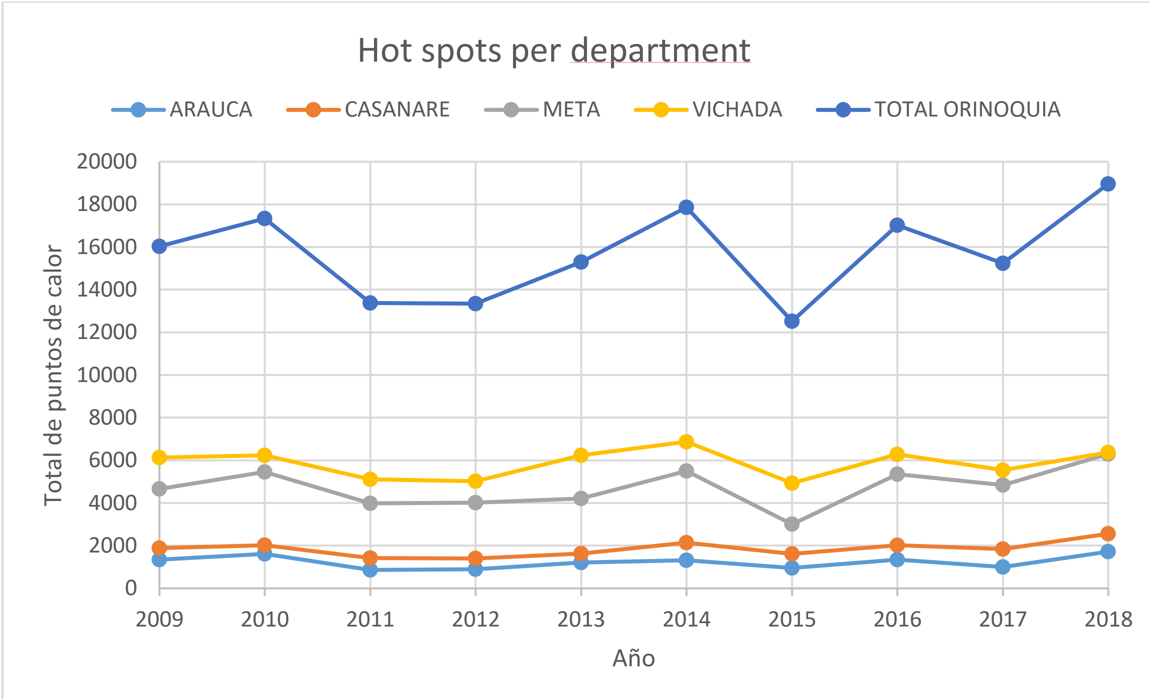


Figure 27. MODIS sensor hot spots trend. ERP Orinoquia region.
Data source: NASA

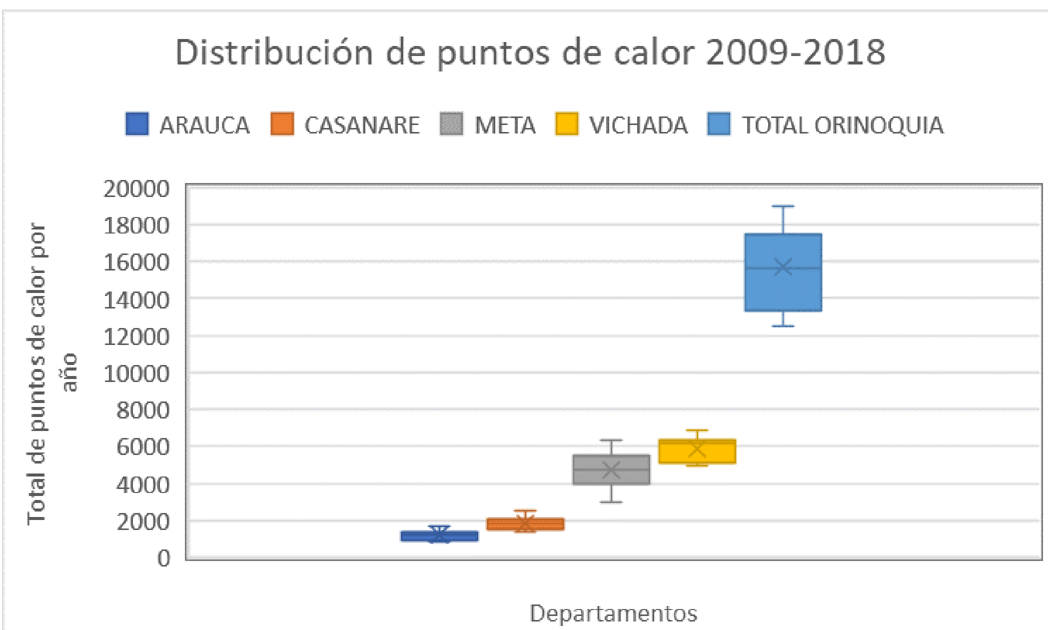


Figure 28. Distribution of MODIS sensor hot spots, period 2009-2018, Orinoquia ERP region.

Data source: NASA

### 4.7.1.2 ANTHROPIC FACTORS

The analysis of the socio-political and economic dynamics of the region made it possible to identify the main anthropic factor to be taken into account in the calculation of the risk of reversions: public order. For its analysis, the available information bases on the main variables related to public order disturbances that could affect the results of the program were used.

The number of events of forced disappearance, displacement, homicides, landmines, among other victimizing events (Figure 29), decreased in the region between 10,7%% and 99,9%% between 2009 and 2018. The exception was presented in the variable threats (increase of 326,4 which may imply a risk factor to community leadership processes. Other factors such as poverty and unemployment also decreased between 17,2% and 33,2% (Terridata, DNP). This indicates a reduction in the effects of the conflict and a general trend towards stabilization in the region. However, the recent presence of new illegal armed actors (after the signing of the peace agreement with Revolutionary Armed Forces of Colombia-FARC) that show interest in promoting activities that generate deforestation, especially in the southern part of the department of Meta, could represent a risk of reactivation of the conflict in some areas where there could be a reversal in the measured and verified GHG removals. In conclusion, given the current socio-political reality, the region presents a high potential risk of reversions due to anthropic factors related mainly to the public order situation; however, it is considered that this level of risk is focused mainly in areas with natural forest presence.

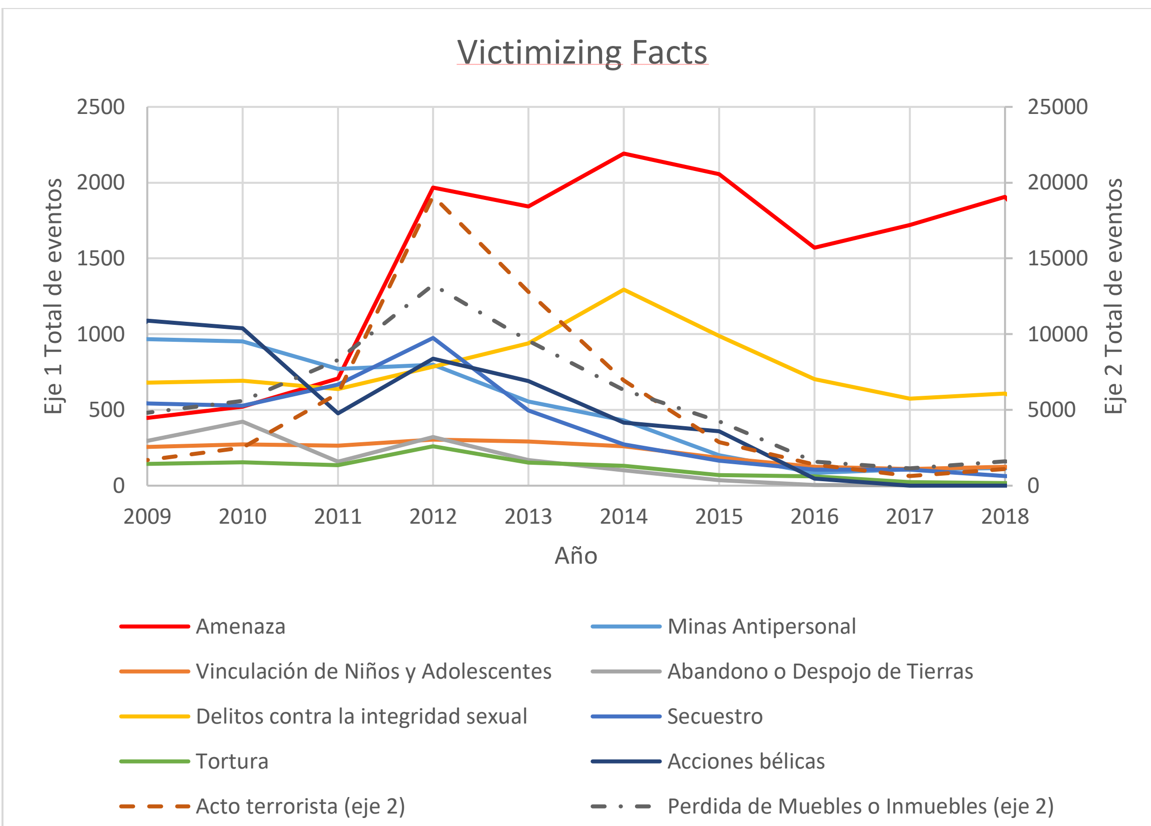

Figure 29. Trend of victimizing events. ERP Orinoquia region. Source of data: Historical Memory Center.

### 4.7.2 EVALUATION AND CALCULATION OF THE PERCENTAGE OF COMPENSATION OF THE RISK OF REVERSIONS FOR THE ORINOQUIA BIOCARBON PROGRAM

Table 23 presents the results of the implementation of the reversion risk assessment tool and determination of the compensation percentage for the program. The assessment took into account the main natural and anthropogenic factors identified in the previous section, as well as other relevant information inputs[161]. The result of the analysis indicates that the actual total percentage of reversion risk compensation for the program, resulting from adding the percentages for natural (5%) and anthropogenic (15%) risk, corresponds to 20%.

Table 23. Reversion risk assessment tool and determination of the compensation percentage for the program

| Risk Factors | Risk indicators | Risk level | Reversion compensation percentage |
|---|---|---|---|
| A.<br>Lack of long-term effectiveness in addressing key drivers of emissions and removals AFOLU | • Threats to social leaders and presence of illegal armed actors that can drive activities that increase deforestation and associated emissions (public order).<br>• Consolidation of new illegal armed groups in the southern part of the department of Meta, which are financed through deforestation-related activities (public order).<br>• Legal insecurity in land tenure and property rights, which may compromise the long-term sustainability of reductions.<br>• Expansion of road infrastructure (formal and informal) in the region, which may allow access to new areas of transformation.<br>• Encouragement of the expansion of unsustainable agricultural activities, which | Reversion risk is considered high for some eligible subcategories and low for others. The behavior of the variables, in general, is part of the region's own dynamics in terms of drivers. However, there is a high risk for the subcategories related to deforestation emissions, mainly due to the action of new illegal armed actors in the southern part of the department of Meta, which is the main deforestation and emissions center in the Orinoquia | 15% |

[161] The information obtained from the analysis of drivers (Annex I.docx) and land tenure (Annex III.docx), among others, was taken into account.

| Risk Factors | Risk indicators | Risk level | Reversion compensation percentage |
|---|---|---|---|
| | generate new fronts of transformation.<br>● Political and/or economic discontinuity in emission reduction actions and low capacity in territorial management.<br>● Migratory processes to the region, which generate new fronts of colonization and transformation. | | |
| B.<br>Exposure and vulnerability to natural disturbances | ● Large-scale burning processes result in forest fires that can affect different land covers, increasing emissions and/or reversing GHG removals.<br>● Natural flooding processes can affect different land covers, generating a decrease in natural forest and/or forest and agroforestry crops, which can lead to an increase in the sources of emissions and/or a reversal of removals.<br>● Occurrence of extreme drought and water deficit events that may affect reductions in interventions related to natural forest and/or forest and agroforestry crops. | Reversion risk is considered low for all eligible subcategories.<br>This is because the behavior of the natural variables analyzed indicates that this corresponds to the seasonal dynamics of the region, without the occurrence of atypical events that could lead to reversions. In addition, the region's ecosystems are adapted to changes in natural factors, and there are risk management processes aimed at preventing and mitigating the effects and occurrence of disasters of this type. | 5% |
| Actual reversion risk compensation percentage = Result A + Result B = 20% | | | |

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## Annex 1: Drivers of AFOLU Emissions and Removals

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ISBN



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# EXECUTIVE SUMMARY

This document was prepared in the framework of the Biocarbon ERP with a payment by results approach of the project "Low Carbon Sustainable Development in the Orinoco Region - Biocarbon Fund". Based on the review and analysis of different studies that incorporate information on causes and agents of deforestation and/or its associated emissions, national and regional greenhouse gas (GHG) inventories, and the analysis of other relevant information, the drivers (causes and agents) related to GHG emissions and removals were characterized for the agriculture, forestry and other land uses (AFOLU) sector in the Colombian Orinoco region, under a jurisdictional approach that responds to the territory of the departments of Arauca, Casanare, Meta and Vichada.

The methodology used for the characterization of the drivers of AFOLU emissions and removals was adapted from the conceptual and methodological framework developed by the Forest and Carbon Monitoring System (SMByC) of IDEAM, where the direct causes of AFOLU emissions/ removals are classified into four large groups: expansion of the agricultural frontier, timber extraction, mineral extraction and infrastructure expansion; underlying causes are social, economic, technological, political and biophysical factors or processes that reinforce the direct causes of AFOLU emissions/absorptions and influence the decisions made by agents or their motivations; and agents correspond to individuals, groups of individuals or institutions that, influenced by the underlying causes, make the decision to establish economic activities that transform land cover and generate GHG emissions or removals. The analyses developed for the characterization were based on the review of secondary information and on the coordinated work between the different technical teams and the regional actors that build the ERP of the region.

The Third Biennial Update Report for Colombia (IDEAM et al. 2021), indicates that the Orinoco (total area of Arauca, Casanare, Meta and Vichada departments) contributed 15.9% of the country's total emissions and 25.5% of removals for 2018. The department of Meta contributed 67.7% of total emissions and 70.8% of regional net emissions, which is highly related to deforestation in its southern zone. 78.7% of the total regional emissions in 2018 corresponded to the AFOLU component. The analysis of the regional GHG inventory indicates that the main sources of AFOLU emissions in the Orinoco are: 1) the change from natural forest to pasture (and to a lesser extent to crops), which basically corresponds to deforestation; 2) enteric fermentation of cattle, which depends directly on cattle inventory and its age structure; 3) nitrogen fertilization, mainly for crops and improved pastures; and 4) direct emissions from rice cultivation. On the one hand, there are direct emissions due to the increase in the size of the cattle herd and nitrogen fertilization processes for the establishment and maintenance of pastures, and on the other hand, indirect emissions caused by the change in natural cover (mainly forest) for the establishment of pastures.

The analysis of the available information and the participatory processes with different stakeholders in the framework of the ERP allowed to analyze the dynamics associated with the causes and agents of AFOLU emissions and removals on a regional scale. The conversion of forests to pasture (grazing land) and the expansion of cattle ranching are the main direct causes of regional emissions, especially when they occur synergistically, because in addition to the change in coverage they imply an increase in the cattle herd and its direct emissions. Agriculture is developed at different scales, with a greater contribution in emissions from agro-industrial crops, especially rice. According to ODC (2021), coca crops show a clear trend of reduction in the Orinoco region; however, they still stimulate important processes of natural cover conversion, mainly in the southern area of Meta. Apart from the direct causes related to the expansion of the agricultural frontier, timber extraction (deforestation and/or forest degradation due to selective logging for different purposes and scales of extraction) and the dynamizing effect of the expansion of transport infrastructure (formal and informal) are also relevant.

A high concentration of emission drivers was identified in the foothill areas of the departments of Arauca, Casanare and Meta, especially due to the expansion of the agricultural frontier through cattle ranching, cattle grazing and industrial crops. Coca crops are located in the southern part of Meta and Vichada departments, where, together with logging and extensive cattle ranching, they have generated significant deforestation, even affecting the interior of protected areas. In the high-plains and areas of natural savannah, characteristic of the Orinoco biome, a significant presence of the causes and their expansion towards the east was also identified. The axes of transformation (historical and current) are related to transportation infrastructure, for the expansion of land roads and the navigability in the main rivers of the region.

The underlying causes analyzed are mainly associated with the legal status and tenure of the land, the presence and effectiveness of protected areas and indigenous reserves, the vision of the region as the "agricultural and livestock pantry of the country" (current and potential), the technological and productive development of large-scale agricultural activities, the livestock culture of the region, the presence of illegal armed actors that promote transformation activities, among others. The following agents were identified as relevant through a characterization process: the livestock, agricultural and timber producers (who promote the large-scale conversion of natural land cover to pasture for land grabbing and/or livestock expansion), the builders of infrastructure transportation and timber extractors at different scales.

Regarding the drivers of GHG removals, the main direct causes identified and characterized, based on the AFOLU emissions/removals balance of the region and contrasted with available information sources, correspond to: 1) natural regeneration and forest restoration; 2) forest plantations in previously transformed areas; 3) permanent crops in previously transformed areas; 4) silvopastoral systems; and 5) sustainable soil and degraded pasture management practices. According to the regional GHG inventory, in the Orinoco region, removals are concentrated in the subcategories of other woody vegetation (not included in the country's definition of forest), commercial forestry plantations, and oil palm cultivation.

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# 1. INTRODUCTION

In the framework of the Biocarbon ERP with a payment by results approach of the project "Low Carbon Sustainable Development in the Orinoco Region - Biocarbon Fund", this document describes and analyzes the direct causes, underlying causes and agents related to GHG emissions and removals for the AFOLU module at the regional scale.

In a complementary manner, the document aims to generate information on the patterns and dynamics of economic activities that constitute sources of AFOLU emissions and removals in the Orinoco region, provide analysis and decision-making elements for the construction of the portfolio of measures and actions aimed at reducing emissions and/or increasing regional AFOLU removals, and support the construction of mitigation scenarios for these GHG emissions.

The background review on the characterization of the causes and agents of deforestation and its associated emissions in the Orinoco region, presented in Chapter 2, provided the basis for the conceptual and methodological approach of the analyses described in Chapter 3, in addition to generating relevant inputs for the characterization results.

The following chapters present the results obtained to conduct the driver analysis. First, there is a description of the regional context in terms of territorial, sociocultural, economic and historical aspects (Chapter 4). Chapter 5 synthesizes the profile and description of the main sources of regional GHG emissions and removals updated to 2018. Chapter 6 analyzes the main causes of natural forest loss and its relationship with some economic activities in the Orinoco region. Chapter 7 includes the characterization of the causes and agents of regional AFOLU emissions and, finally, Chapter 8 analyzes the same for GHG removals.

This characterization is harmonized with the key categories of the regional GHG inventory and with the construction of the portfolio of measures and actions, processes that are also developed in the framework of the Orinoco ERP.

# 1. BACKGROUND ON THE PROCESS OF CHARACTERIZATION OF CAUSES AND AGENTS OF GHG EMISSIONS AND REMOVALS IN THE AFOLU SECTOR IN THE ORINOQUIA REGION

Different analyses and studies carried out on economic activities in the Orinoquia region and their relationship with GHGs provide a baseline of knowledge for the identification of possible causes and agents of GHG emissions and removals in the region. This chapter presents a synthesis of the main results of some of these studies and the information used for decision making to identify the most relevant emission sources.

## 1.1. Deforestation causes and agents

The Forest and Carbon Monitoring System (SMByC) from IDEAM generates the country's official data on the state of the forest, deforestation and its associated causes. The characterization of causes and agents of deforestation has a solid conceptual and methodological basis, supported by the analysis of different sources and the adjustment to the conditions and particularities of the country (González et al. 2018a and 2018b). This process follows the sequence of identification and description of the underlying causes (factors that condition the decision to deforest), the agents (those who make the decision), the direct causes (productive or extractive activities that transform forest cover) and the chains of events that link these three components (Figure 11).

On this basis, the SMByC's team of causes and agents of forest transformation is constantly reporting at different temporal and spatial scales. According to the analysis of various sources of information, a base of reports is available at the departmental scale, including the four departments of the Orinoco region, which are discussed in the results section (Chapter 6).

The main cause of deforestation in the region is the expansion of the agricultural frontier, mainly due to the large-scale conversion of natural forests to pastures for extensive cattle ranching and/or land grabbing; agricultural production at different scales, including the expansion of illicit crops, generates lesser impacts in terms of deforestation. Other causes are related to the expansion of transportation infrastructure and timber extraction. Mineral extraction is considered a cause of deforestation with less relevance in the Orinoco (González et al. 2018b). This dynamic presents its highest concentration in the southwestern area of the department of Meta, which coincides with the evidence presented in the study about early implementation initiatives in REDD+ in the La Macarena Special Management Area - AMEM (Cormacarena, Patrimonio Natural and PNN 2015).

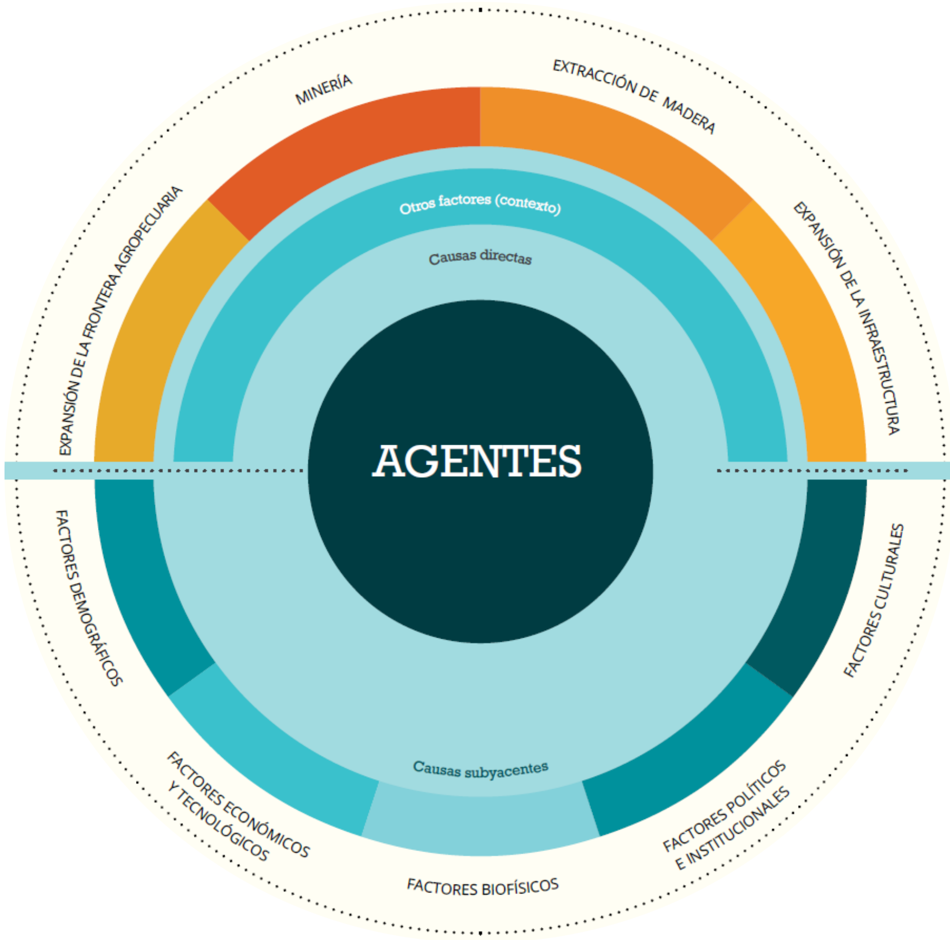


Figure 11. Components of characterization of causes and agents in the general structure of deforestation in Colombia (González et al. 2018a).

The AMEM is made up of four National Natural Parks, two of which, Sierra de La Macarena and Tinigua, have all of their territory in this area, while Sumapaz and Cordillera de Los Picachos only have part of their territory in this area. There are also three Integrated Management Districts (DMI in Spanish): North Macarena, South Macarena and Ariari-Guayabero. The study by Cormacarena, Patrimonio Natural and PNN (2015) identified and characterized the main causes and agents of deforestation. The results are summarized below.

### 1.1.1. **Deforestation agents**

Based on the analysis of the information and methodological development in the area, three groups of agents related to historical land-use change were identified: i) associated with coca, ii) associated with cattle ranching and iii) associated with agricultural production. The agents are temporally and spatially dynamic, they can expand their activity or alternate between the different groups, which can make it difficult to establish relationships with the direct and underlying causes of deforestation.

- **Group 1, associated with coca:** There are two types of actors in this group: former settlers and emerging coca growers who arrived in this subregion during recent migrations. The first case corresponds to small and medium-sized traditional coca growers, who cultivate fields ranging from 3,8 to 5,3 hectares. The large emerging coca growers, on the other hand, established plantations of up to 40 hectares in the flat areas and in the mountainous sector of Puerto Lleras, Vistahermosa and Puerto Rico. These three municipalities have the most persistent coca crop cultivation area in the AMEM.
- **Group 2, associated with cattle ranching:** There is a cattle ranching implementation model associated with an actor called "absentee rancher", which corresponds to those people who do not live in the region, but invest significant capital for cattle ranching, through agreements under the modality of "appraisal" that are established with rural settlers.
- **Group 3, associated with agricultural production:** This corresponds to people who have been established in the region, constituting settlements that refers to historical colonization processes, and who sustain the permanence of the productive and family unit through small-scale agricultural and livestock activities, for self-consumption and generation of overstocks for sale in local markets.

#### 1.1.2. Deforestation direct causes

According to the classification of agents, the direct causes of deforestation in the AMEM are related to the expansion of the agricultural frontier: agricultural crops of different scales, cattle ranching/grazing land expansion and coca cultivation.

- **Agricultural crops:** These are the activities of establishing and producing transitory or permanent crops for self-consumption or to generate surpluses for commercial purposes. Transient crops in the area include cereals (corn, wheat and rice), tubers (potatoes and cassava), plantains and most vegetables. Due to soil conditions, these crops require cultural practices such as preparation, slash and burn of stubble or wooded areas for new plantings. Permanent crops include African palm, citrus and several varieties of coffee.
- **Cattle ranching and grazing land:** The effect of the activity on deforestation is analyzed based on the change from natural forest cover to pasture or other covers that include pasture. Traditional extensive or improved extensive production systems predominate, which combine natural pastures with introduced pastures,

and where carrying capacities are generally low. This factor is related to the low productive quality of the soils and leads to the need to expand into new natural areas.

- **Coca cultivation:** This activity was introduced in the area because of the possibility of generating income in the short term, with high profitability and relatively assured commercialization. The coca cultivation model is associated with recurrent land occupation processes, particularly in areas considered as colonization fronts, where deforestation, grazing and subsistence crops are combined with the planting of illicit crops.

### 1.1.3. Determining or predisposing factors

These factors refer to physical or tangible decision elements that can influence the behavior of deforestation agents in the area. These include the water network for forest access, road network, proximity to human settlements/populated centers, proximity to markets and service infrastructure, land tenure structure and management categories (National Parks, indigenous reserves, among others).

- **Water Network:** In the Guaviare-Inírida-Meta hydrographic zone there are seven subzones associated with the Ariari, Upper and Middle Guaviare, Güejar, Guape, Guayabero and Losada rivers. These rivers are permanently navigable by small boats (canoes, motorboats) and at certain times of the year by larger boats. In the northern part of the AMEM, the proximity to the rivers is mainly associated with illicit crops, and in the southern sector it is related to cattle ranching.
- **Road network:** In the northern sector there are the following roads: San José del Guaviare-Granada-Villavicencio (approximately 285 km long), Uribe-Mesetas-San Juan de Arama-Granada-Villavicencio (191 km), Vistahermosa-San Juan de Arama-Granada-Villavicencio (113 km), Puerto Lleras-Granada-Villavicencio (137 km) and Puerto Rico-Ganada-Villavicencio (202 km). In the southern zone is the La Macarena-San Vicente del Caguán-Florencia-Neiva road axis, with a length of approximately 589 km. The secondary and tertiary networks are made up of roads that connect the municipalities with the primary network. There is a proximity relationship (mainly in the range of 0 to 2 km) between the change in land use associated with deforestation and the subsequent establishment of agricultural and livestock activities and the tertiary road network in the area.
- **Proximity to human settlements/populated centers:** The concentration of population provides the necessary elements for the direct causes of deforestation to be greatly expanded. In this sense, the population centers in the study area are distributed in the zones of greatest intervention, especially in relation to the processes of forest clearing and coca cultivation.
- **Proximity to markets and service infrastructure:** The following development axes have been identified: Villavicencio-Granada, Puerto Concordia-San José del

Guaviare, La Macarena-San Vicente del Caguán, Uribe-Colombia and San Vicente del Caguán-Neiva. The main vocation is the primary sector, with agricultural production systems as the basis of the regional economy.

- **Land tenure structure:** As a result of the colonization dynamics in the AMEM, there are occupation processes in the Amazon Forest reserve zones, in the National Natural Parks and in the DMI, a situation that, due to its illegality, limits public and private investment that contributes to improving the living conditions of the local communities.
- **Land management categories:** The management categories condition the definition of the AMEM, but they are not uniform entities; they cover a wide range of objectives and are administered by a considerable number of diverse institutional and social actors. The vacant lands in the areas of recovery for production are occupied and the areas closest to the municipal capitals have a high concentration of land, with an ever-expanding agricultural frontier.

#### 1.1.4. Underlying causes of deforestation

The underlying causes identified were sectoral policy, agrarian policy, land use planning, land policy, eradication of illicit crops, and forest use and exploitation policies.

- **Sectoral policy:** Includes policies related to blocks and titles for hydrocarbon exploitation; the relationship between this activity and deforestation in the zone is related to accessibility (road construction and improvement) and the arrival of new populations that can transform the territory. In terms of mining blocks and titles, this activity is of lesser importance in the area in relation to oil. There are two main projects underway: the La Macarena transverse corridor (San Juan de Arama-Uribe-Colombia, Huila-Baraya section) and the marginal jungle corridor (San José del Fragua-Florencia-Puerto Rico section and design of the San Vicente de Caguán-San José del Guaviare section), with several secondary and tertiary points and connections over which deforestation continues to expand.
- **Agrarian policy:** Despite the country's current agrarian policies (Law 160 of 1994 and its subsequent developments), the processes of occupation, appropriation and land use have historically transformed the area's natural cover. There is a permanent conflict between the existence and maintenance of the legal conditions of the territory and the demand for land for the development of economic, sectoral and social models, which has ultimately promoted deforestation.
- **Land management figures:** Of particular importance are the ZRF of the Amazon (created in Law 2 of 1959), the AMEM (Decree Law 1989 of 1989), the District of Water and Soil Conservation of Caquetá (Agreement 020 of 1974 of the Institute for the Development of Renewable Natural Resources - INDERENA), and the indigenous reserves of La Julia (municipality of Uribe) and La Sal (Puerto

Concordia). Each of these areas is subject to anthropic pressures with varying degrees of impact, especially due to the expansion of the agricultural frontier.

- **Land policy:** The distribution of property in rural areas, the clarification of ownership (public and private areas), the definition of criteria for efficient land use, land markets, the ecological and social function of property, land restitution processes, the definition of rights of use and delimitation of the agricultural frontier, among others, are factors that widely influence the occupation, use and transformation of forest lands.
- **Eradication of illicit crops:** Forced eradication actions may motivate the sale of lands because of economic uncertainty generated in the inhabitants, causing them to abandon their lands or to open new areas to establish their economy and, in this way, expand the agricultural frontier over the forest cover.
- **Forest use and harvesting policies:** This underlying cause considers policy issues related to the use of forest resources, forest management, forest fire control, ecological restoration, payment for environmental services and other conservation incentives, which have failed in the consolidation of a comprehensive forest policy and a vision of sustainable forest management.

The relationship between direct causes, predisposing factors and underlying causes of deforestation analyzed for the AMEM is summarized in Figure 12.

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Figure 12. Relationship between direct causes, predisposing factors and underlying causes analyzed for the Macarena Special Management Area – AMEM (Cormacarena, Patrimonio Natural y PNN 2015).

### 1.1.5. Chains of events in deforestation

Based on the analyses developed, it was possible to identify the existing relationships between the agents and direct causes of deforestation, as well as some predisposing factors and underlying causes to have an approximation of the chain of events that promoted the deforestation in the AMEM (Figure 13).

The expansion of the agricultural frontier has been the central axis of the area's development and transformation, since the time of the first settlers, this region has based its economy on extensive cattle ranching, agriculture on different scales and illicit crops (especially coca). For reasons of cost and accessibility, these practices have occurred in forest areas close to population centers, which may be a factor that explains the loss of forest in a large part of the southern part of the AMEM.

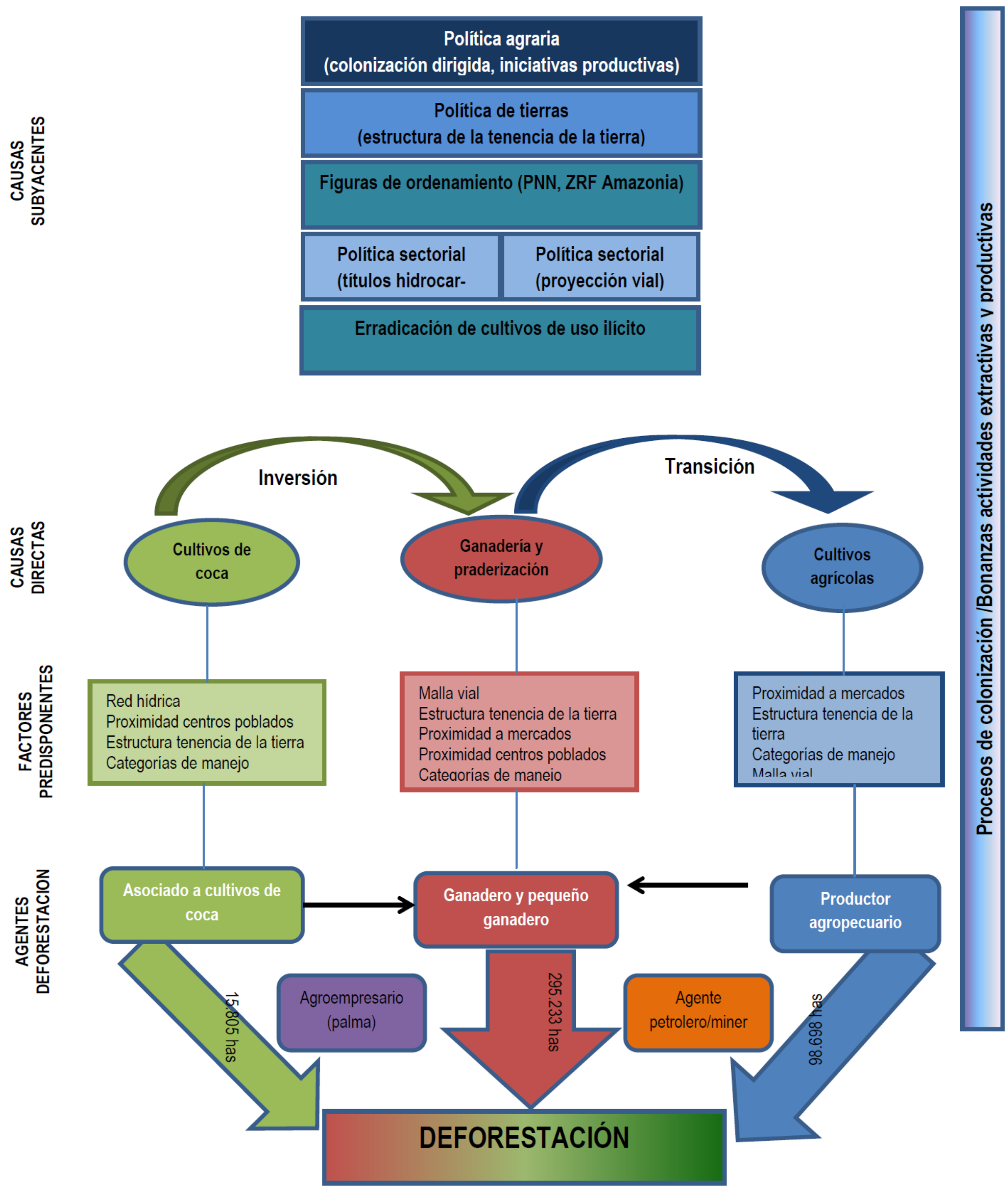


Figure 13. Synthesis of the chains of events leading to deforestation in La Macarena Special Management Area – AMEM (Cormacarena, Patrimonio Natural y PNN 2015).

It is evident that there are particular deforestation dynamics for each direct cause, establishing that cattle ranching and extensive cattle ranching occupy an increasing percentage of the area without forest in the zone. In the analysis of the main causes (agricultural crops, cattle ranching and logging, and coca crops), it is found that the decrease of one (e.g. coca crops) is significantly proportional to the increase of another (e.g. logging) (Cormacarena, Patrimonio Natural and PNN 2015). These dynamics and their characterization present a conceptual, methodological and results harmonization with the analyses developed by the SMByC of IDEAM (González et al. 2018a and 2018b).

## 1.2. Causes and agents of GHG emissions and removals – AFOLU

The document of the Regional Comprehensive Climate Change Plan for the Orinoco (PRICCO) synthesizes the results of an articulated work for the collective construction of adaptation and mitigation measures for the effects of climate change in the departments of Arauca, Casanare, Meta and Vichada. In the chapters describing the region and the regional GHG inventory, some factors that may represent general causes for emissions and removals in the AFOLU sector are identified (CIAT and Cormacarena 2017).

- **Demographics:** The region has a total population of 1.507.683 inhabitants, 70% in urban areas and 30% in rural areas, with a population density of 5,9 inhabitants/$km^2$. Despite the colonization that has occurred in recent decades, it is still considered a sparsely populated territory. Of the total population of the Orinoco, it is estimated that 51.098 inhabitants are indigenous, located mainly in the departments of Vichada and Meta.
- **Biophysical aspects:** Most of the region has a tropical climate and the predominant topography is slightly undulating or flat (high-plain). There are also mountainous areas in the western region (foothill), which are part of the eastern mountain range and some elevations in the Serranía de La Macarena. Therefore, there is a diversity of climates generated by the altitudinal gradient. In most of the region, the climate is monomodal, with a marked rainy and dry season; however, in the foothill zone, the climate becomes bimodal.
- **Land use:** Traditionally, the principal land uses in the Orinoquia have been cattle ranching, oil extraction, agricultural production, and conservation soils. 55% of the area is used for grazing, 5% for agricultural production, 1,3% for water bodies, 0,04% for forestry production and the remaining 38,6% for other uses.
- **Cattle ranching tradition:** Cattle ranching is one of the most important economic and cultural activities in the region, but it is also one of the main sources of greenhouse gases. Directly, the cattle digestion process, which converts fodder into animal protein, generates waste that is a source of methane gas and nitrous oxide. Indirectly, the expansion of areas dedicated to pasture

and extensive cattle ranching are the main cause of deforestation, a process that generates large $CO_2$ emissions.

- **Regional economy:** Until the 1980s, the agricultural sector contributed 41% of the region's GDP. Since the early 1990s, oil activity began to make a greater contribution, mainly in the departments of Arauca, Casanare, and Meta. This trend has continued to increase since 2000, making the regional economy's dependence on this sector a determining factor.
- **Transportation infrastructure:** Roads have been a determining factor in the economic development of the Orinoco region. Much of this expansion has taken place in the foothill, with the improvement of roads connecting the capitals of Meta and Casanare with the interior of the country (Villavicencio-Bogotá and Aquitania-Aguazul), and the La Soberanía highway between La Lejía and Saravena (Arauca). The department of Meta has had recent road growth, which has allowed agricultural and agro-industrial developments, mainly towards the municipalities of Puerto López and Puerto Gaitán, and the increase of agricultural areas in the central-south zone, associated with the Las Palmeras corridor and the La Macarena transversal. The rest of the region (with special reference to the department of Vichada) has very low road connectivity. In many of these areas, connectivity is through river corridors, by the Orinoco's rich water resources.
- **Water resources:** The region is part of the large Orinoco River basin. This region contains 31,7% of the country's floodable surface area, 1,5 million $m^2$ of swamps, and 22,4% of Colombia's total bog. In addition, it has 32,4% of the national water reserves, with 36% of rivers with a flow of more than 10 $m^3/s$. The main rivers are: Meta, Arauca, Casanare, Casanare, Vichada, Guaviare, Tomo, Bita, Tuparro and Caño Matavén.
- **Ecosystem richness:** The diversity of ecosystems includes natural savannahs, gallery forests, moriche palm crops, foothills, flooded forests, estuaries, rainforests, among others. The region has 156 types of natural ecosystems and 49 transformed ecosystems. It has 23% of the total area of the National Natural Park system (33.260 $km^2$); however, there are at least seven priority areas for conservation in order to protect the biodiversity present in this territory.
- **Vision as an agricultural pantry:** The Orinoco is seen as the country's future agricultural development pole; therefore, the Orinoco Master Plan is being formulated to coordinate the policies, programs and projects that are and will be developed in the region. The challenge will be to align economic growth goals with the protection and conservation of the water, biological and cultural wealth present.
- **Fires and burning:** Fires are common in the region in order to have better forage for livestock. The abuse of this practice causes soils to lose the few accumulated carbon reserves and other slowly recovering vegetation to be reduced by the flames.

Based on the literature review on the direct and indirect determinants of GHG emissions and removals, the CIAT study "Low-carbon agricultural growth in landscapes of the Colombian Orinoco: an assessment of opportunities"[162] proposed the classification of factors presented in Figure 14, highlighting that many of these determinants are related to others, which makes it difficult to describe them (Tapasco et al. 2018). The results of the study are synthesized below.

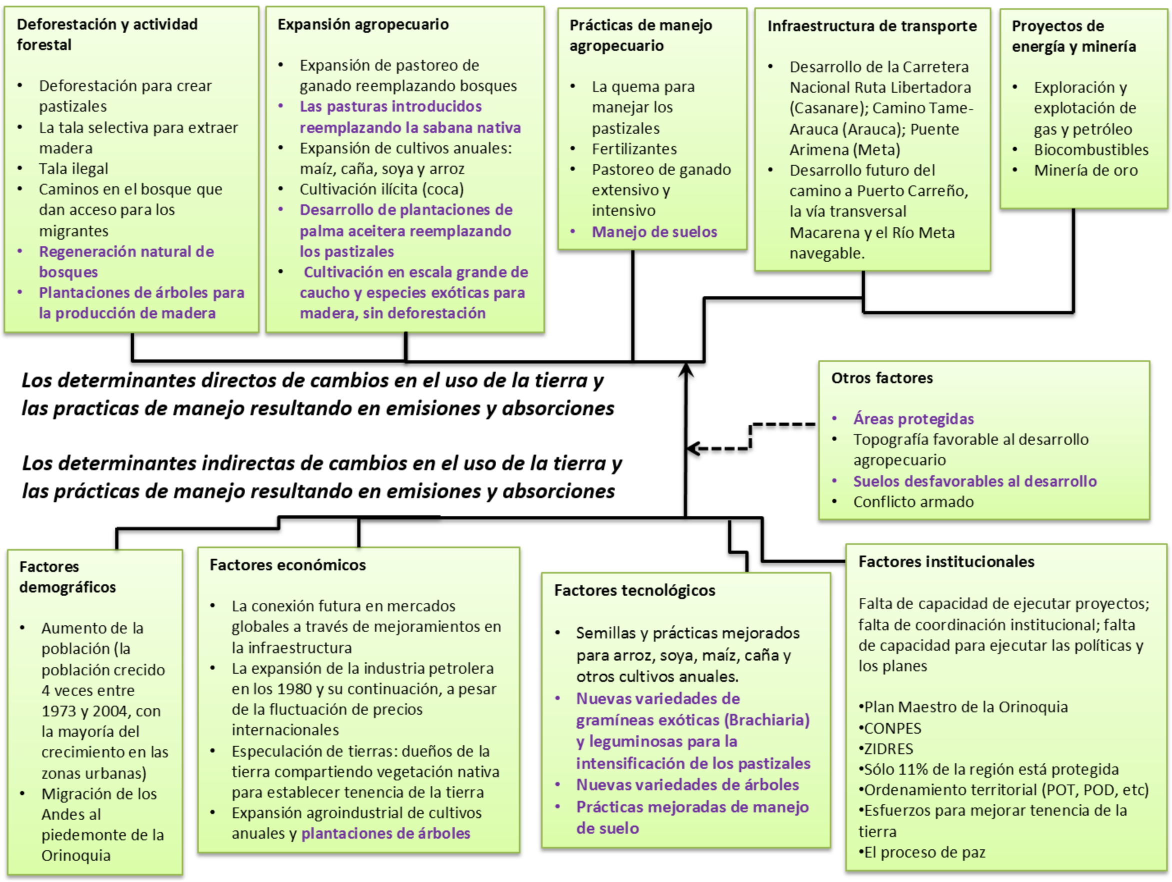


Figure 14. Determinants of GHG emissions and removals in the Colombian Orinoco region.[163] (Tapasco et al. 2018).

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## 1.2.1. Direct determinants

[162] The World Bank contracted with the International Center for Tropical Agriculture (CIAT) for the consultancy "Low carbon agricultural growth in the Orinoquia Landscape: An assessment of opportunities", the overall objective of which was to support the Government of Colombia in assessing opportunities for a low carbon agricultural growth pathway in the Orinoquia landscape, taking into account current development plans and stakeholder perspectives.

[163] The factors highlighted in purple are generally related to GHG removals processes.

Tapasco et al. (2018) define direct determinants as those productive and/or extractive activities that change land use and management practices, resulting in GHG emissions or removals.

- **Deforestation:** This is the main determinant of emissions in the Orinoco region. Several of the factors classified as determinants contribute to deforestation. According to the study, this phenomenon contributes almost 60% of regional emissions, mainly in the department of Meta. Most emissions in the four departments are the result of deforestation to establish pastures in areas adjacent to the Amazon biome, but also affect gallery forests. Deforestation processes, beyond the establishment of pastures, include colonization by small farmers, development of illicit crops, annual crops, agro-industrial crops (palm oil plantations), firewood collection and selective timber extraction. The literature reviewed showed the importance of deforestation as a determinant of emissions, but the processes that lead to this result are not always clear. Given the diversity of actors acting as agents of land use change, the development of policies and programs to halt deforestation is a major challenge.
- **Forestry activities:** Forestry activities that can generate emissions or removals include logging road development, selective timber extraction, tree plantation development, and natural or assisted regeneration of forest land. The information gaps and the high percentage of illegality represent great difficulties in understanding the importance of these activities as determinants of GHG emissions or removals. Besides, in most cases it is difficult to differentiate between timber extraction for these purposes and logging for pasture or crop establishment in the Orinoco region (with special reference to the southwest of the department of Meta). $CO_2$ removals from the atmosphere are due to the natural regeneration of forests or the establishment of tree plantations. Based on the national GHG inventory, it has been estimated that natural regeneration accounts for approximately 90% of all GHG removals in the Colombian Orinoquia.
- **Agricultural expansion:** This includes the replacement of native vegetation (gallery forests or savannahs) with annual crops, introduced pastures or tree crops. Pastoralism in the Orinoquia is linked to the history and development of the region through cattle ranching. The conversion of native savannah to introduced pastures allows producers to increase the stocking rate per unit area. The effects on emissions are due to increased methane emissions from the increased number of animals and nitrogen emissions from the fertilizers used to establish and maintain the introduced pastures. Coca cultivation is also recognized as a determinant of deforestation and expansion of the agricultural frontier; however, there are difficulties in obtaining a reliable estimate of the impact of illicit crops on emissions. Most of the coca cultivation in the Orinoco region occurs near the border of the departments of Meta and Guaviare, with a secondary focus in Vichada.
- **Agricultural management practices:** Beyond land use change, agricultural management practices can influence GHG emissions and removals. These

practices include improved grassland management, fertilizer application, tillage practices, soil management techniques to improve topsoil (crop rotation), and the use of burning to control vegetation. Burning is a common and widespread practice in the Orinoco region; the national GHG inventory estimates that it generates approximately 1% of regional emissions, which can be quickly offset by subsequent regrowth. Information on other management practices and their relationship with the GHG balance in the Orinoco is scarce.

- **Transportation infrastructure:** Roads and navigable rivers are important direct determinants of changes affecting GHGs. In the Orinoco the main transport corridors are the Guaviare and Meta rivers, the road network in the western part (adjacent to the Andes) and the stretches of road between Villavicencio and Puerto Carreño. The scarce road infrastructure is recognized in several sectors as an obstacle to the economic development of the region, but paradoxically has prevented higher emissions in several areas. Roads can allow new settlers and agricultural producers to reach areas that were previously inaccessible. It is clear that the development of regional transportation infrastructure, especially in the southern part, has led to higher GHG emissions from deforestation; in non-forested areas, road development is likely to lead to the conversion of native savannah to annual crops and introduced grasses.
- **Mining and energy projects:** The development of mining and energy projects is a determining factor in GHG emissions because of its relationship with the expansion of road infrastructure. Roads built for hydrocarbon exploration and exploitation have opened up the Orinoquia region to other economic sectors, mainly agriculture in the foothills. Biofuel production also drives emissions through land-use change for the cultivation of African palm and sugarcane. In the case of mineral extraction, mainly gold, the activity is present in some rivers, but there is not much evidence of the level of impact on the region's forests. In conclusion, there is a lack of literature on the impacts of mining and energy activities on land use and practices that affect GHG emissions and removals in the Orinoco region.

### 1.2.2. Indirect determinants

Tapasco et al. (2018) define indirect determinants as those political, social, economic, and technological factors that drive the direct determinants of GHG emissions or removals.

- **Demographic factors:** Population growth and migration are factors that drive changes in land use or management that could affect GHG emissions and removals. The four departments of the Orinoco region account for 22% of Colombia's land area, but only 3% of its population (1,7 million people). The rural population growth rate exceeded 3% between 1973 and 1993, but was -1,8% between 1993 and 2005, which may reflect rural-urban migration associated with the armed conflict in the region. This reduction in rural population probably reduced pressures on ecosystems and associated emissions. However, with the reduction in armed conflict since 2010 and the peace agreement with the FARC, signed in 2016, it is possible that further migration to the region has occurred and the rural population has increased.

- **Economic factors:** The most important drivers of economic growth in the Orinoco region have been the boom in the oil industry since 1980 and the subsequent development of livestock and agro-industry, which has been strongly related to the expansion of road infrastructure in the region. Land grabbing for speculative purposes is an economic phenomenon present in the territory, but its impact on land use changes and management practices is not well documented. Land speculation can reduce the adoption of technology, since the main interest of the land grabber is the accumulation and subsequent sale of land, not agricultural productivity.
- **Technological factors:** Technological factors that can drive GHG emissions and removals in the Orinoco are new methods for oil and gas extraction, improvements in timber extraction capacity, and technological advances in the agricultural sector, including acid soil management practices. Most of these improvements are not well documented, except for improvements in tropical forages (grasses and legumes), crops (annuals and perennials), and their adoption in the region.
- **Institutional factors:** Institutional performance and public policies have had diverse influences on the direct determinants of GHG emissions and removals in the region. However, weaknesses in this aspect (excessive planning but insufficient implementation) have limited the changes that could affect these emissions and removals. An example of this is the scarce development of regional infrastructure, despite the existence of plans for this purpose for several decades. If long-term road development is analyzed, the effect that could be generated by the improvement of the road connection between Villavicencio and Puerto Carreño, and the connection of the Orinoco with the Pacific, should be considered. Other institutional issues to consider are the development of the Orinoco Master Plan, the Zones of Rural, Economic and Social Development Interest (known as Zidres), the promotion of biofuels (which could lead to a continued increase in industrial monoculture areas), and the implementation of the agreements with the FARC.
- **Other factors:** It is important to consider the effects that aspects such as the armed conflict and its relationship with illicit crops or illegal logging, the development of future protected areas, and the biophysical particularities of the territory (for example, the flat topography of the Orinoco is favorable for agricultural development compared to other areas where the slope is a constraint) may have on the direct determinants of emissions and removals in the region.

# 2. CONCEPTUAL AND METHODOLOGICAL APPROACH TO THE CHARACTERIZATION OF CAUSES AND AGENTS

The characterization of the causes and agents of AFOLU emissions and removals in the Orinoco region is based on the conceptual and methodological approach developed and validated by the SMByC of IDEAM for the characterization of causes and agents of deforestation in Colombia[164], which was expanded and adapted to incorporate the analysis of the main drivers of GHG emissions and removals documented for the Biocarbon ERP area "Low carbon sustainable development in the Orinoco region - Biocarbon Fund".

## 2.1. Conceptual and methodological approach

The characterization of the process of land cover change that generates emissions or removals in the AFOLU sector is based on the identification and integration of three basic categories of analysis: direct causes, underlying causes and agents of the process.

### 2.1.1. AFOLU emissions/removals direct causes

Direct causes (also called drivers) are related to agricultural, forestry or other land use activities that lead to the generation of GHG emissions or removals. They generally involve the change of natural land cover to a productive use (which can generate GHG emissions), its permanence or its regeneration (which can increase GHG removals).

The direct causes of deforestation are classified into four main groups: expansion of the agricultural frontier, timber extraction, mineral extraction and infrastructure expansion. This classification can be adapted for the analysis of AFOLU emissions and removals. Based on this classification, the direct causes are subdivided into three levels according to the following criteria: i) coverage/associated use, ii) formality (or legality), iii) destination of production, iv) technological aspects, and v) permanence of the activity (Figure 15, Figure 16, Figure 17 and Figure 18). The increase in the level of classification implies a greater level of detail in the characterization.

[164] The detailed description of this approach can be found in the SMByC-IDEAM publications on the subject (González et al. 2018a and 2018b).

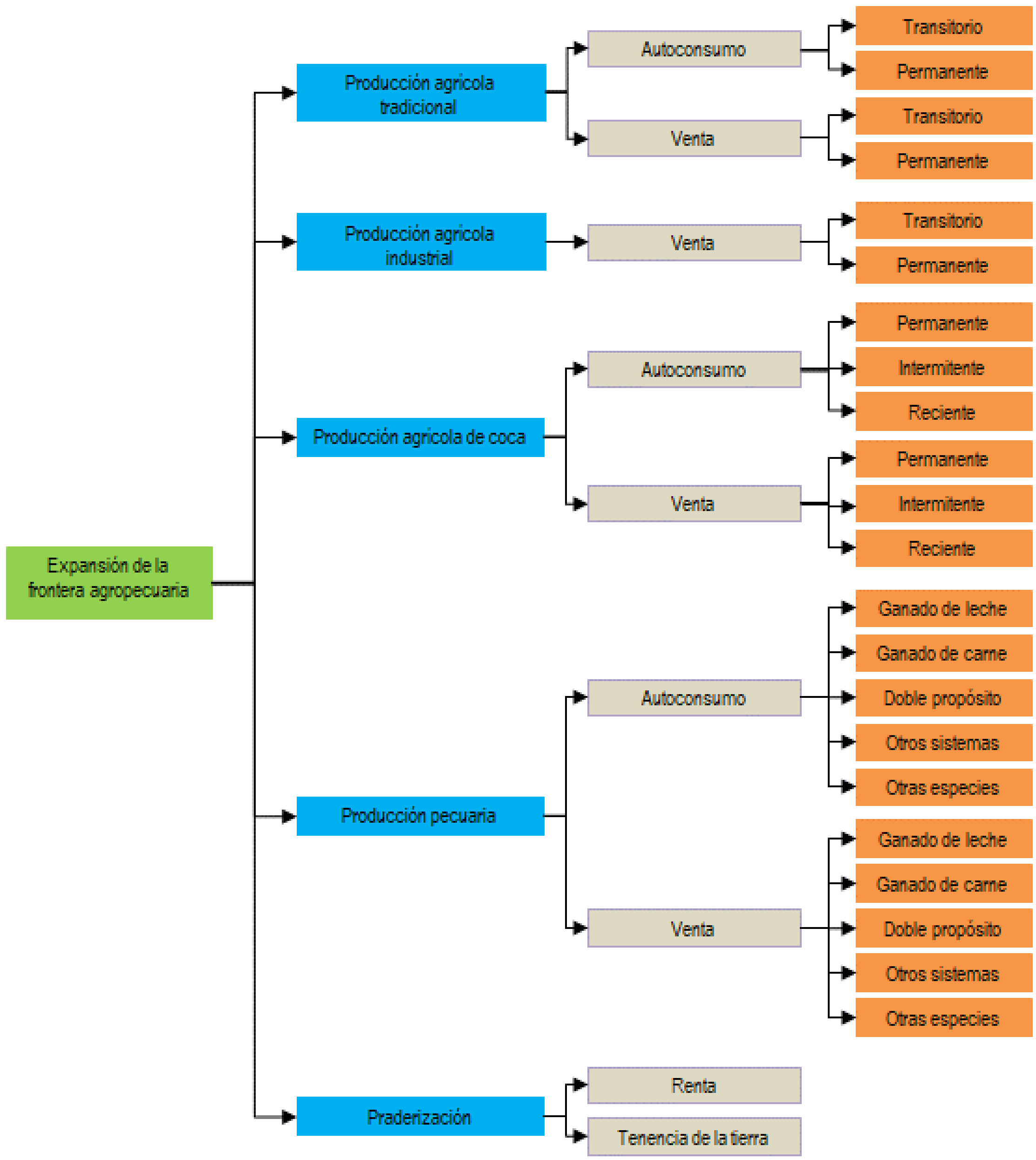


Figure 15. Classification levels for the direct causes in the AFOLU emissions and removals related to the expansion of agricultural frontier (adopted from González et al. 2018a).

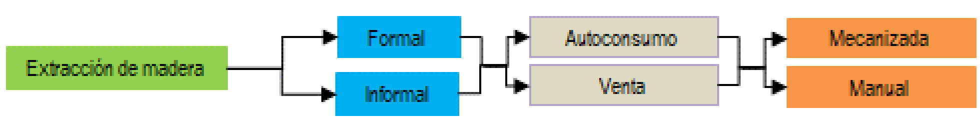


Figure 16. Classification levels for the direct causes in the AFOLU emissions and removals related to the timber extraction (adopted from González et al. 2018a).

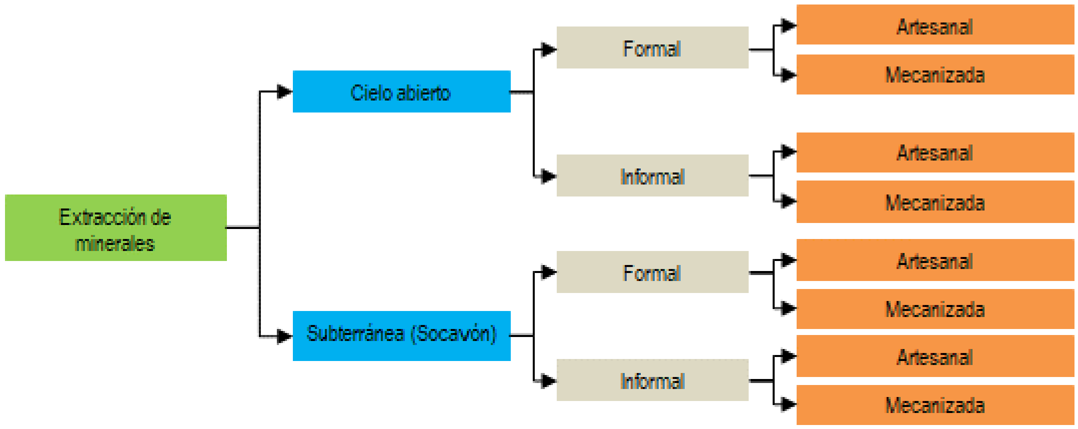


Figure 17. Classification levels for the direct causes in the AFOLU emissions and removals related to the minerals extraction (adopted from González et al. 2018a).

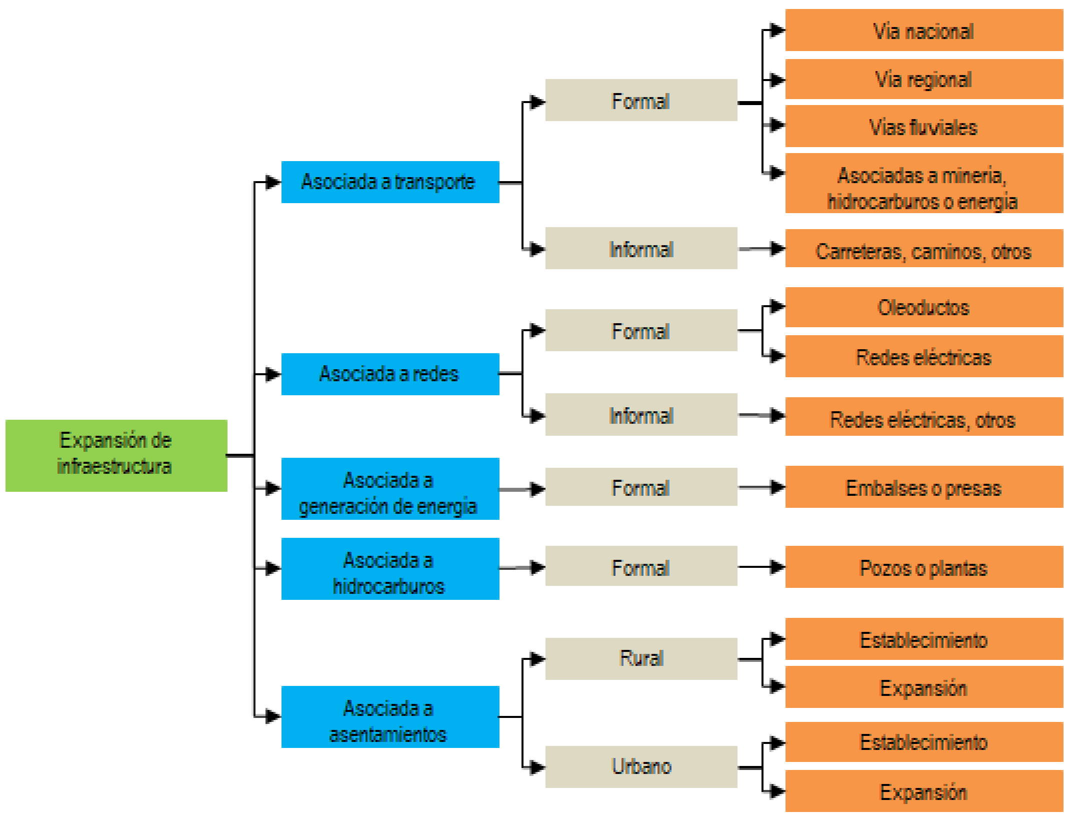


Figure 18. Classification levels for the direct causes in the AFOLU emissions and removals related to the infrastructure expansion (adopted from González et al. 2018a).

### 2.1.2. AFOLU emissions/removals indirect causes

Underlying causes are social, economic, technological, political and biophysical factors or processes that reinforce the direct causes of AFOLU emissions/removals and influence the decisions made by the agents or their motivations. The description and classification of the underlying causes, according to the mentioned factors, is presented in Table 11.

Table 11. Classification of the underlying causes for AFOLU GHG emission and removals

| Factors group | Description | Indirect General causes |
|---|---|---|
| **Technological and economic** | Economic factors and their related policies comprise a set of different processes, where taxes and subsidies are important causes of land use dynamics. Complementarily, other factors such as commercialization and access to technology are relevant in this change. | - Local, national and international markets.<br>- Illegal economies.<br>- State incentives.<br>- Technologies (mainly in agricultural production).<br>- Production costs.<br>- Consumption. |
| **Demographics** | The composition and distribution of the population (rather than the total number of inhabitants), as well as the context in which the population interacts with other factors, are the most important demographic aspects for understanding the pressure on land use and land cover changes. | - Population growth.<br>- Migration dynamics. |
| **Political-Institutional** | Government policies are relevant to land cover transformations, mediating and interacting with demographic, economic and biophysical factors, among others. For example, access to land, capital, technology and information is structured and often limited by national policies and institutions. Likewise, the definition and enforcement of property or land use rights is managed by the state. | - Sectoral and territorial policies.<br>- Institutional presence.<br>- Social conditions.<br>- Land use, distribution and property rights.<br>[ Protected areas (management figures).<br>- Armed conflict and post-conflict (implementation of the Peace Agreement). |
| **Cultural** | Multiple cultural factors influence decision-making related to land use and land cover change in a region, and these factors cannot be separated from the political and economic conditions experienced by the agents of | - Vision about the ecosystem or nature.<br>- Sense of belongingness<br>- Ancestral practices.<br>- Education. |

| Factors group | Description | Indirect General causes |
|---|---|---|
| | change. Personal and collective motivations, histories, attitudes, values, perceptions and beliefs affect decision making, and differ according to the actor being considered. | |
| **Biophysics** | Biophysical factors define the natural capacity or predisposition for changes in use, particularly through a set of variables such as climate, soils, topography, relief, hydrology and vegetation, which show spatial-temporal variation. This variability interacts with human causes of land cover change. | - Slope.<br>- Climate.<br>- Soils.<br>- Water supply.<br>- Mineral and hydrocarbon deposits.<br>- Presence of fine woods.<br>- Accessibility. |

Source: Adopted from González et al. (2018a y 2018b)

### 2.1.3. **AFOLU emissions/removals agents**

These stakeholders correspond to individuals, groups of people or institutions that, influenced by the underlying causes, make the decision to establish productive activities that transform natural land cover and generate greenhouse gas emissions or removals. The agents are generally autonomous, e.g, they have control over their actions and have certain strategies to achieve their objectives.

Each agent of transformation is a multidimensional entity in which social, economic and cultural aspects converge and shape their perception of reality and determine their decisions. These dimensions are transversal and establish structures of social organization, rules of behavior, interests, motivations, among others, that allow the agents to be classified into different groups. In this sense, there are three dimensions considered key in the analysis: i) social organization, ii) vision of the ecosystem, and iii) economic interests. The convergence of these three dimensions defines the intervention logic of the agents on natural land cover, as well as the emissions or removals associated with their decisions.

- **Social organization:** This dimension provides an understanding of the organizational level and the social role of the agents. There are four main categories that cover the agents involved in the transformation of land cover: i) civil society (local or regional organizations, NGOs, associations, etc.), ii) private (unions, investors, etc.), iii) state (national public entities, governments, mayors' offices, regional autonomous corporations, armed forces, etc.), and iv) other agents that are not included in the previous groups (e.g. illegal armed groups).

- **Ecosystem vision:** This dimension captures the perception that a particular agent may have of ecosystems, which may be influenced by a series of socioeconomic, political, technological and cultural factors that determine the magnitude and form of intervention of natural areas in order to execute the activity of interest. The predominant vision may be: i) strategic (valuation of the importance of the ecosystem for a particular interest or activity), ii) source of ecosystem goods and services (value of the ecosystem as a provider of resources or for its socio-cultural importance), and 3) conflictive/competitive (the agent sees a conflict between the maintenance of the ecosystem, to which he assigns little value, and the new land use he wishes to establish).
- **Economic interests:** shows the immediate economic objective or need for which the agent makes the decision to transform the natural cover. The decision may be aimed at: i) self-consumption (immediate needs for survival), ii) subsistence (income generation to satisfy basic needs and improve the quality of life, iii) accumulation of wealth in regulated markets (income generation that allows accumulation within the framework of markets governed by norms or rules that regulate economic activities), and iv) accumulation of wealth in unregulated markets (predatory vision of natural resources to obtain high profits in the shortest possible time).

The denomination of the agent depends on the direct cause to which its intervention on natural cover is related (Table 12).

Table 12. Agents denomination of AFOLU GHG emissions/removals according to direct causes.

| **Associated direct cause** | **Principal agents' denomination** |
|---|---|
| **Agricultural and livestock frontier expansion** | Traditional crops agricultural producer |
| | Industrial crops agricultural producer |
| | Coca agricultural producer |
| | Livestock Producer |
| | Grassland Producer |
| **Mineral's extraction** | Mineral informal extractor |
| | Mineral formal extractor |
| **Wood extraction** | Informal wood extractor for self-consumption |
| | Formal wood extractor for selling |
| **Infrastructure expansion** | Road infrastructure formal constructor |
| | Road infrastructure informal constructor |

Source: Adapted from González et al. (2018a y 2018b)

### 2.1.4. **Chains of events leading to transformation**

Event chains correspond to the descriptive and analytical integration of the underlying causes, agents and direct causes of natural cover transformation leading to the generation of GHG emissions or removals. Underlying causes indicate **why** it is transformed; agents correspond to **who** makes the decision to transform, and direct causes are **how** the cover is changed. The chain represents the visual description of these relationships between factors, which are dynamic (change) in time and space, involve significant levels of interdependence and complexity, and occur in a particular territorial, socio-cultural, economic and historical context (adapted from González et al. 2018a).

## 2.2. Key elements for characterization

In the development of studies for the characterization of causes and agents, it is necessary to consider some key aspects, such as those described below, in order to obtain more useful and robust results.

- **Spatial and temporal dimensions:** In spatial terms, it is relevant to know and analyze the location and extent of the natural land cover change phenomenon and its associated GHG emissions/removals. Understanding its temporal dimension allows understanding the phenomenon in terms of its historical background, its current dynamics and probable future behavior. The spatial and temporal dimensions are transversal to the other key elements that enable characterization.
- **Context:** No transformation process occurs in isolation from a territorial, socio-cultural, economic or historical context. An adequate characterization of the causes and agents of natural cover change in a particular area implies recognizing and understanding the socio-environmental setting of the phenomenon, as well as analyzing its influence on the dynamics of this transformation. [
- **Key actors, interests and motivations:** The transformation process involves multiple official actors, non-governmental and civil society organizations, among others. In this group are the direct agents and those actors that indirectly promote the processes of ecosystem change. It is essential to characterize the interests or motivations that determine their decisions and the relationships that they establish with other key actors.
- **Relationships and synergies:** The complexity of the phenomenon of ecosystem transformation requires the identification and analysis of interactions and synergies among all elements. This process complements the classification and description of individual causes and agents, and makes it possible to design

and implement more effective measures and actions for climate change mitigation and adaptation.

## 2.3. Criteria to guide the approach of characterization

The following is a list of criteria that guide the process of characterizing the causes and agents of emissions and removals for the AFOLU sector in the Orinoco region.

- Identification and description of the relevant sources of GHG emissions and sinks of removals for the AFOLU component at the regional scale (Orinoco), in each of the four departments, and in municipalities or zones considered key during the characterization process. This information represents the basis for the definition of the problem and its expression through the drivers' analysis.
- Relation of these sources with the direct and underlying causes of natural cover transformation, according to the classification described, and considering their temporal and spatial dynamics. Establishing the dynamics of the drivers makes it possible to design interventions that respond more precisely to the problem and prioritize specific areas for their implementation.
- Characterization of relevant actors and their possible role as agents of transformation in GHG emissions and removals for the AFOLU component in the region. Characterizing the actors allows identifying negotiation or coordination needs to achieve a more effective process of design and implementation of measures and actions.
- Generation of baseline information for the definition of the portfolio of measures and actions aimed at achieving effective emission reductions and increased GHG removals at a regional scale. To the extent that the interventions proposed for the program respond directly to the problems defined through the driver characterization process, better GHG mitigation results will be achieved for the AFOLU component.

## 2.4. Information generation and validation with regional stakeholders

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As part of the development process of the ERP, periodic work meetings were held with the different technical teams of the project "Low Carbon Sustainable Development in the Orinoco Region - Biocarbon Fund", including the regional team. The specific information on the progress of the analysis of causes and agents of AFOLU emissions and removals in the Orinoco region was validated and complemented in a workshop with regional and local stakeholders, where a preliminary exercise of spatialization of the direct causes of GHG emissions in prioritized municipalities was also conducted.

The spatialization of the causes for the entire region was developed in four departmental workshops, using participatory social mapping exercises with regional thematic experts, the direct causes of emissions in each department were spatially located, as well as the general description of the dynamics of the causes identified at this scale.

The systematization of the information consisted of georeferencing the maps obtained in the social mapping exercises with regional experts and subsequent digitalization of the points of each direct cause located on the respective map. Geographic databases were structured with point geometry, adding as attributes the type of cause, the level of importance according to the participants (high, medium, low), as well as spatial data related to the geographic names of department, municipality and village. This information was also structured in an alphanumeric database and a control board was built as a tool for visualization, consultation and decision making.

# 3. REGIONAL CONTEXT DESCRIPTION

In the framework of the project "Low Carbon Sustainable Development in the Orinoco Region - Biocarbon Fund", this region corresponds to the political-administrative aggregation of the four departments that comprise it: Arauca, Casanare, Meta and Vichada. The description of the regional context, in its territorial, economic, socio-cultural and historical aspects, represents the baseline result of the process of characterization of causes and agents.

## 3.1. Territorial context

The Orinoquia region has a total area of 254.335 $km^2$, distributed in four departments and 59 municipalities, which are equivalent to approximately 22% of the continental area of the country (CIAT and Cormacarena 2017) (Figure 19). It extends between the eastern mountain range and the border with Venezuela, passing from areas with mountainous relief to the characteristic plain areas. It is bordered to the south by the departments of Guainía, Guaviare and Caquetá; to the west by the departments of Boyacá, Cundinamarca and Huila; and to the northeast by Venezuela. There are areas with strongly broken relief such as the Serranía de La Macarena, the highest areas in the paramount massifs of Sumapaz and Chingaza, the Cuchilla de Los Picachos (where the elevation exceeds 3.000

meters above sea level), and the Sierra Nevada de El Cocuy on the border with Boyacá (Viloria 2009).

The departments that make up the region include foothills, alluvial fans and high plateaus (Rangel et al. 1995). Most of the territory corresponds to natural savannahs; however, there are also extensive areas of forest located mainly in the southern transition zone towards the Amazon rainforest and the Andean forests to the west (Riveros 1983).

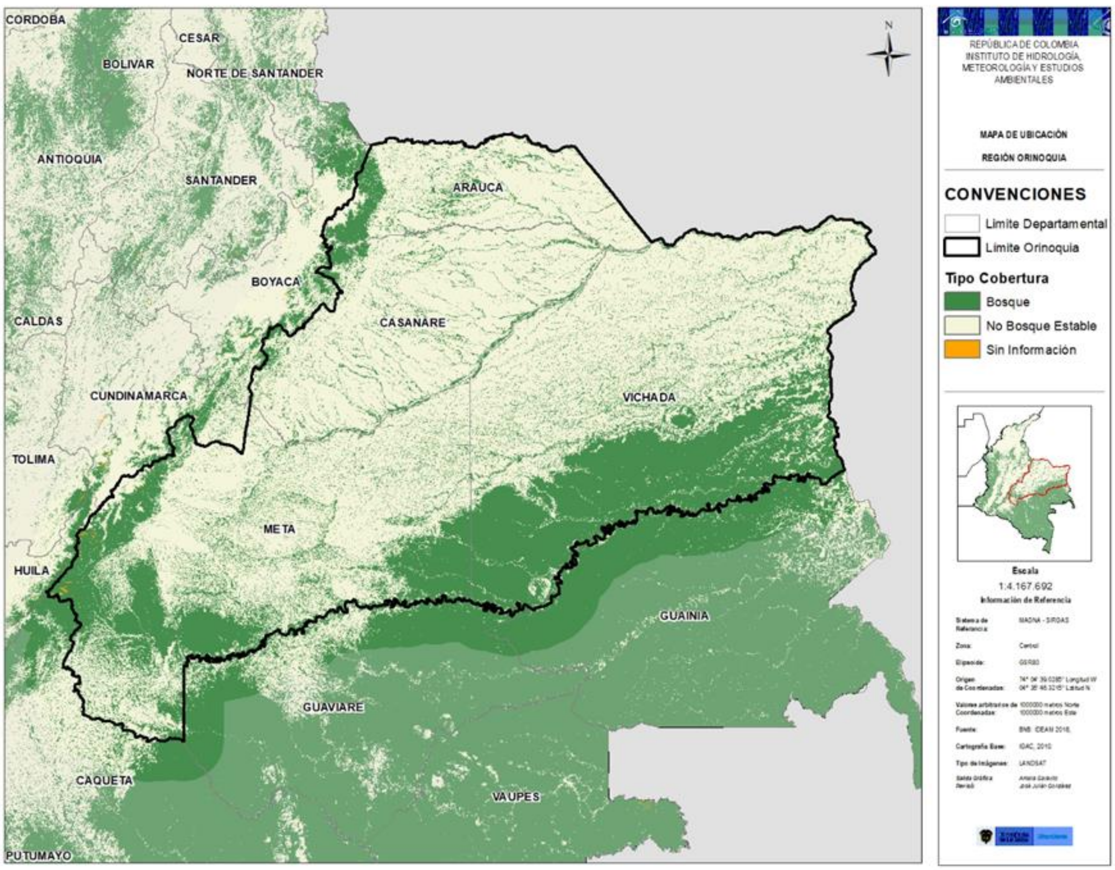


Figure 19. Orinoquia region and its departments (Own elaboration according to IDEAM, 2020)

### 3.1.1. **Climatic characteristics**

In general terms, temperatures in the region range between 18°C and 36°C, with an average temperature of 28°C (Lasso et al. 2010). However, some areas have temperatures below 4°C (Correa et al. 2005). The rainfall regime is monomodal, with a rainy period between April and November; however, the distribution of rainfall is not uniform, with average annual rainfall values between 1.000 mm and

1.500 mm in the southern part of Arauca and Vichada, and more than 4.500 mm in the eastern part of Meta (Viloria 2009).

One of the most globally recognized climate classifications is that associated with the Caldas-Lang system, which uses two classification variables: i) the altitudinal variation of temperature, indicating thermal floors, and ii) the effectiveness of precipitation showing humidity (Medina and Aldana 2019). The region is dominated by warm humid and warm semi-humid climates; however, in the western zone, on the eastern mountain range, there is a variety of climates ranging from super-humid snowy in the Sierra Nevada de El Cocuy, to warm super-humid in the north of the department of Meta (Figure 20). The departments of Arauca, Casanare and Vichada have a more uniform climatic distribution, while Meta presents greater climatic diversity (IDEAM 2015).

### 3.1.2. **Hydrographic zoning**

Colombia is made up of hydrographic units that constitute the framework for the formulation, adjustment, and/or execution of the different environmental policy, planning, management and monitoring instruments. Hydrographic zoning in Colombia was defined by IDEAM (2013), which classifies the national territory into hydrographic areas, zones, and subzones.

Most of the rivers distributed in the four Orinoco departments flow into the Orinoco River; for this reason, most of the region's surface area is located in the hydrographic area of the Orinoco. Only a small sector in the south of the department of Meta is part of the Amazon hydrographic area (Figure 21 and Table 13). The territory is divided into eight hydrographic zones (Apaporis, Arauca, Casanare, Guaviare, Meta, Orinoco Direct, Tomo and Vichada) and 63 subzones. The Meta and Guaviare hydrographic zones are the most representative, with 26% and 27% of the region's total area, respectively; between the two zones they cover 60% of the hydrographic subzones and cross the territory from the slopes of the eastern cordillera to the Venezuelan border. The hydrographic zone with the smallest area is the Apaporis, located in the municipality of La Macarena (Meta), with only 1% of the region's area (Figure 22).

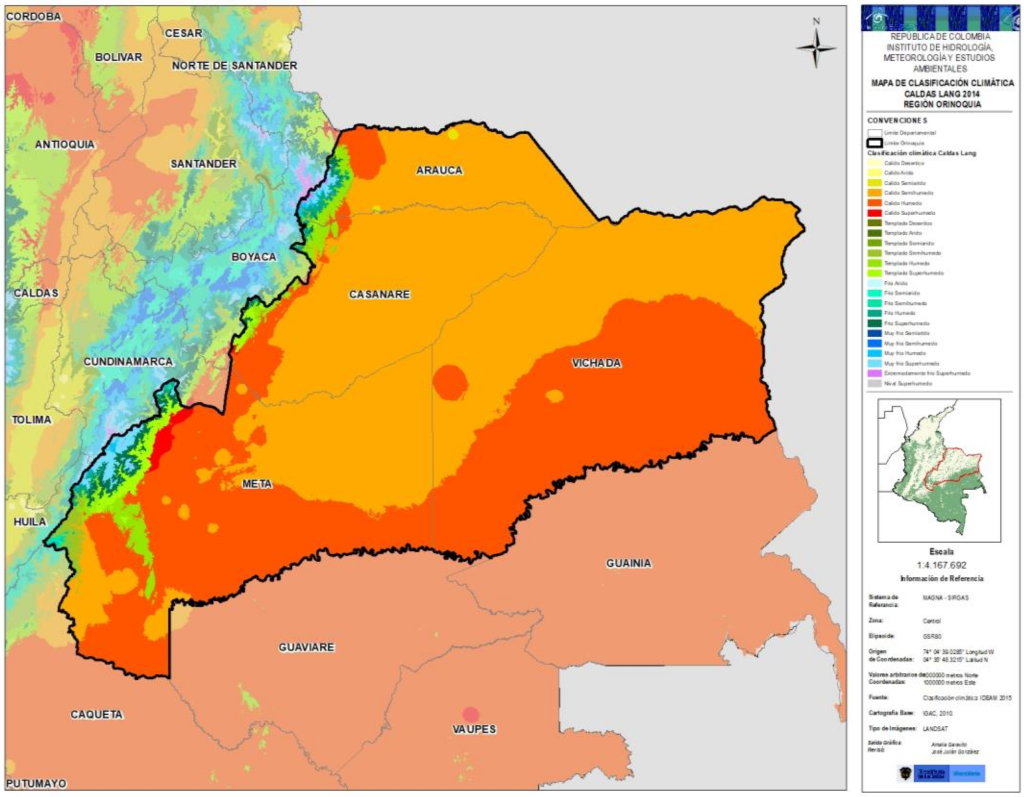


Figure 20. Climate classification Caldas-Lang for the Orinoquia region (Own elaboration according to IDEAM, 2015)

Table 13. Hydrographic zonification for the Orinoquia region

| Hydrographic area | Hydrographic zone | Area (ha) | Area (%) | No. Hydrographic subzones | Hydrographic subzones (%) |
|---|---|---|---|---|---|
| Amazon | Apaporis | 353.951 | 1% | [ 2 | 3% |
| Orinoco | Arauca | 518.507 | 2% | 3 | 5% |
| | Casanare | 2.410.671 | 10% | 5 | 8% |
| | Guaviare | 6.813.859 | 27% | 14 | 22% |
| | Meta | 6.717.567 | 26% | 24 | 38% |
| | Direct Orinoco | 3.907.837 | 15% | 6 | 10% |
| | Tomo | 2.029.556 | 8% | 4 | 6% |

| | | | | | |
|---|---|---|---|---|---|
| | Vichada | 2.621.194 | 10% | 5 | 8% |
| **Total** | | **25.373.145** | **100%** | **63** | **100%** |

Source: Own elaboration according to IDEAM (2013)

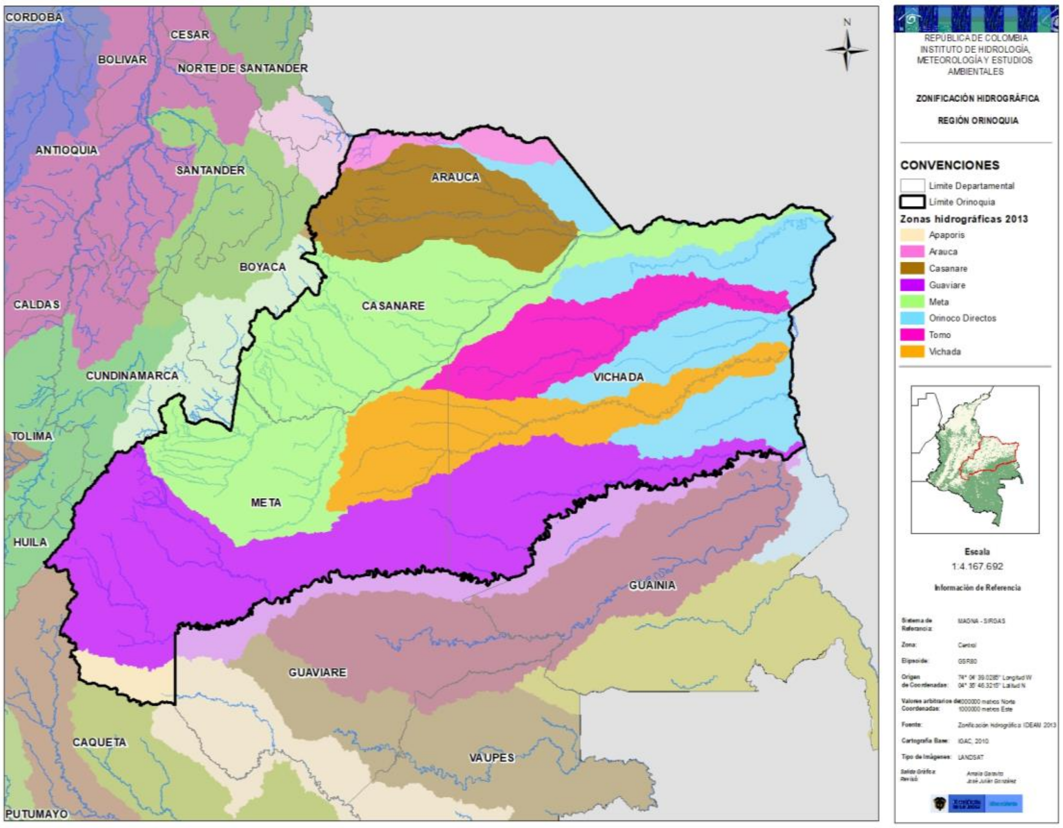


Figure 21. Hydrographic zonification for the Orinoquia region (Own elaboration according to IDEAM, 2013)

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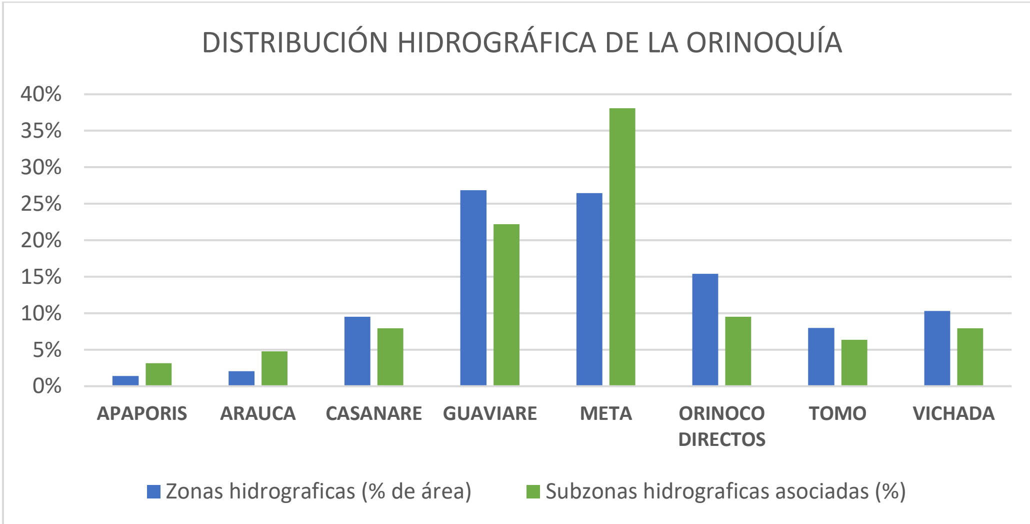


Figure 22. Hydrographic zones distribution in Orinoquia (Own elaboration according to IDEAM, 2013)

### 3.1.3. **Ecosystems**

According to the map of continental, coastal and marine ecosystems of Colombia (IDEAM 2017), the Orinoco region is dominated in extension by seasonal savannah and floodable savannah ecosystems; the former distributed mainly in Vichada and Meta, and the latter in Arauca and Casanare (Figure 23). Gallery and/or riparian forests (associated with watercourses) are widely distributed throughout the territory in the four departments, given the region's water supply. In the foothill zone, agro-ecosystems stand out, and dense forests are concentrated mainly in the south of Vichada and Meta, as well as on the borders with the Andean region.

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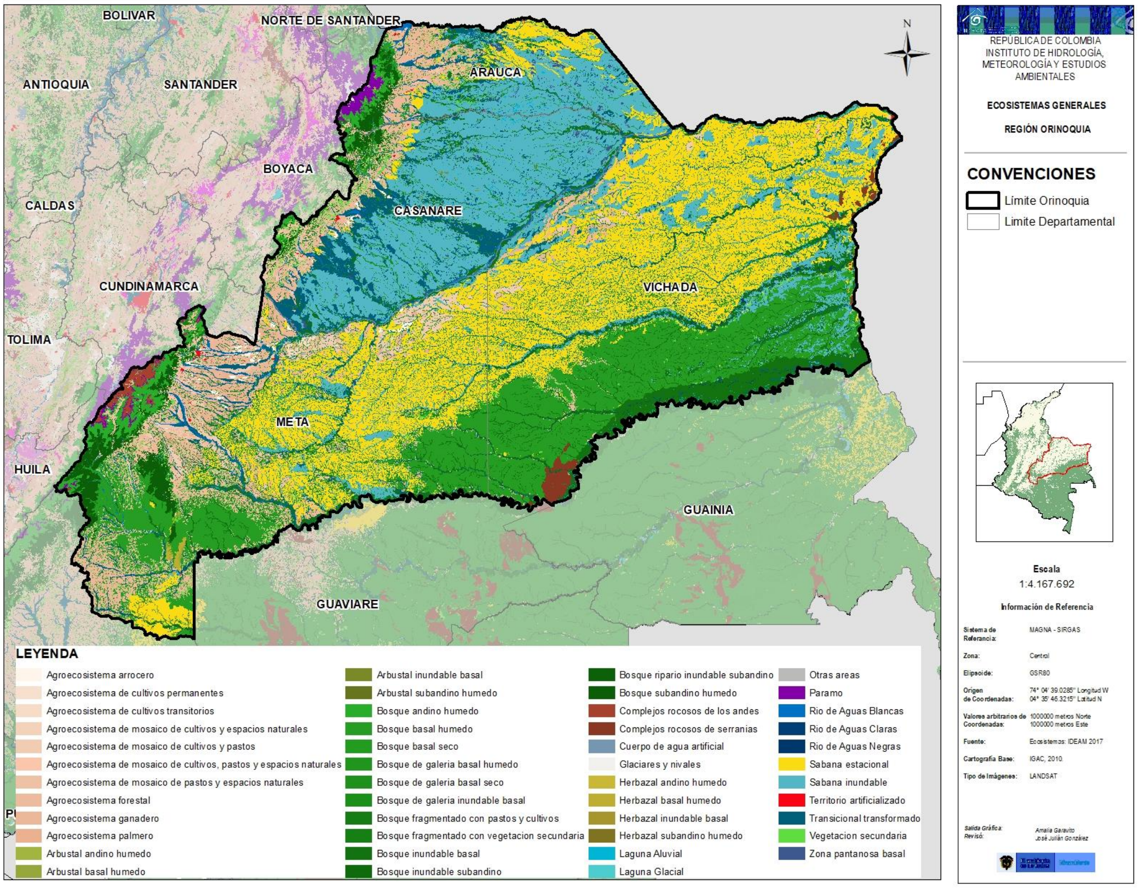


Figure 23. Orinoquia region ecosystems, 2017 (Own elaboration according to IDEAM, 2017)

Table 14 shows the percentage of the area associated with the main types of ecosystems in the Orinoco departments. Natural savannahs (both seasonal and flooded) correspond to the largest ecosystems, covering more than one fifth of the region (22,3%). Seven of the 20 largest ecosystems correspond to various types of forest, which together account for 16,7% of the total area. The livestock agroecosystem is in fifth place with 3,5% of the region's area, and the transformed transitional ecosystem represents 2,3% of the total area. [

Table 14. Ecosystems with high representativity in Orinoquia region

| Ecosystems | Arauca | Casanare | Meta | Vichada | Total Orinoquia |
|---|---|---|---|---|---|
| Seasonal savannah | 14,31% | 0,73% | 25,78% | 38,86% | 12,76% |
| Flooded savannah | 38,16% | 56,47% | 4,33% | 10,66% | 9,55% |
| Humid basal forest | 2,82% | 0,84% | 18,01% | 21,86% | 7,56% |

| | | | | | |
|---|---|---|---|---|---|
| Basal flooded forest | 4,87% | 5,26% | 4,04% | 12,31% | 3,80% |
| Livestock agroecosystem | 12,28% | 6,07% | 12,57% | 1,44% | 3,50% |
| Basal flooded gallery forest | 1,37% | 3,73% | 7,89% | 7,72% | 3,25% |
| Transitional transformed | 6,36% | 13,71% | 3,59% | 1,20% | 2,34% |
| Humid sub-Andean forest | 3,16% | 1,59% | 4,03% | 0,00% | 0,96% |
| Crop and pasture mosaic agroecosystem | 0,41% | 0,27% | 3,67% | 0,68% | 0,79% |
| White water river | 2,31% | 2,30% | 1,27% | 1,09% | 0,74% |
| Agroecosystem mosaic of pastures and natural spaces | 1,42% | 1,58% | 2,54% | 0,30% | 0,69% |
| Humid Andean forest | 2,15% | 0,63% | 2,36% | 0,00% | 0,55% |
| Secondary vegetation | 1,78% | 1,71% | 1,27% | 0,50% | 0,55% |
| Fragmented forest with secondary vegetation | 1,25% | 0,97% | 0,87% | 0,16% | 0,32% |
| Fragmented forest with pasture and crops | 0,21% | 0,97% | 0,93% | 0,15% | 0,28% |
| Agroecosystem of mosaic of crops, pastures and natural spaces | 0,57% | 0,98% | 1,06% | 0,03% | 0,30% |
| Rocky complexes of highlands | 0,00% | 0,00% | 0,00% | 1,40% | 0,28% |
| Palm agroecosystem | 0,00% | 0,02% | 1,50% | 0,00% | 0,25% |
| Paramo | 2,55% | 0,15% | 0,44% | 0,00% | 0,21% |
| Clear water river | 0,00% | 0,00% | 0,23% | 0,96% | 0,23% |

Source: Own elaboration according to IDEAM (2017)

According to information from the Forest and Carbon Monitoring System of IDEAM (2020), it was identified that for the year 2010 about 33% of the total area of the Orinoco corresponded to natural forests. By 2019, the percentage of forest reached a value of 31,49%. The difference in forest area in the data analysis period is equivalent to 332.760 ha, which represents a total variation of 1,34% (Figure 24). The total area of natural forest in the region for 2019 was estimated at 7.996.427 ha, of which 4.118.227 ha are located in Vichada, 2.964.498 ha in Meta, 533.066 ha in Casanare and 380.636 ha in Arauca (IDEAM 2020).

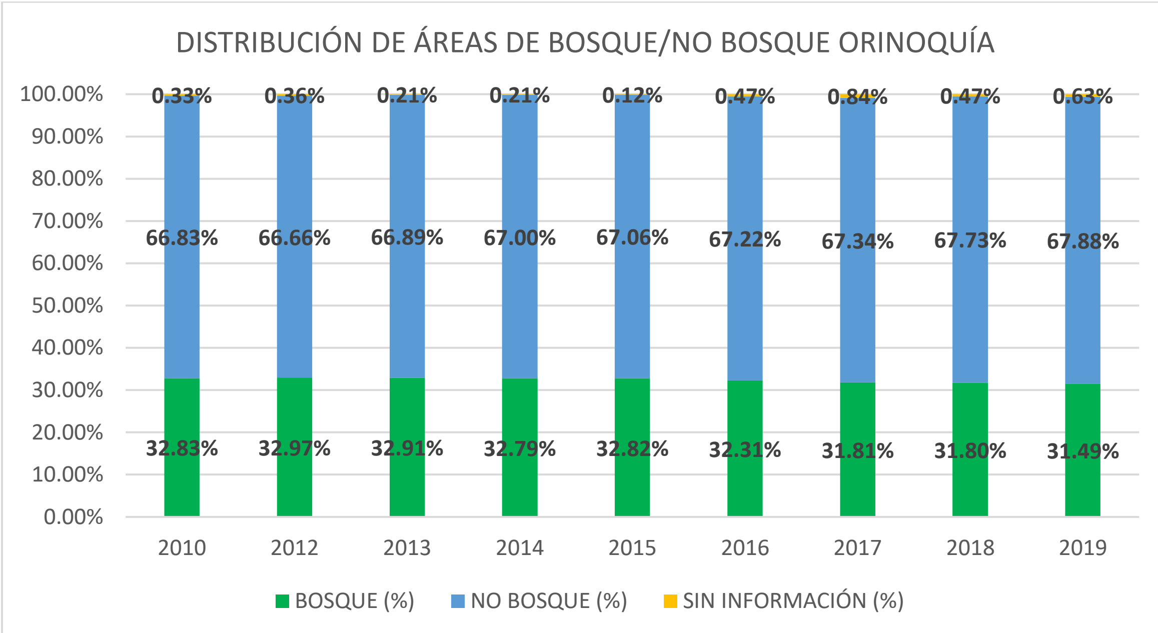


Figure 24. Forest and no forest area distribution in Orinoquia (2010-2019) (Own elaboration according to IDEAM, 2020)

### 3.1.4. Protected areas

According to the Single National Registry of Protected Areas (RUNAP 2020), 2.501.116 ha in the Orinoco are under one of the protection categories defined in the National System of Protected Areas (SINAP). Of this area, 77,9% corresponds to National Natural Parks (1.949.278 ha), while National Integrated Management Districts account for 13,3% (333.245 ha), followed by Civil Society Natural Reserves with 5,2% (129.291 ha). The categories of Regional Integrated Management Districts, Regional Natural Parks, National Protected Forest Reserves, Soil Conservation Districts and Recreation Areas together represent less than 4% of the protected areas identified in the region (Table 15).

Each of the defined categories responds to certain conservation and management objectives, the most important category being the National Natural Parks (NNP). The area of the NNP is distributed as follows (percentage equivalent to the area of each park in relation to the total NNP area within the region): Sierra de La Macarena 31,82%, El Tuparro 28,74%, Tinigua 11,0% (these three parks are entirely located withing the region), Cordillera de Los Pichachos 10,53%, El Cocuy

8,97%, Sumapaz 7,87%, Chingaza 1,04% and Pisba 0,02% (Figure 25)[165]. Figure 26 shows the location of the NNP in the Orinoco region.

Table 15. Distribution by categories of protected areas in Orinoquia region

| RUNAP Category | Area (ha) | Participation (%) |
|---|---|---|
| Recreation Areas | 278 | 0,01 |
| Soil Conservation Districts | 294 | 0,01 |
| National Integrated Management Districts | 333.245 | 13,32 |
| Regional Integrated Management Districts | 50.393 | 2,01 |
| National Natural Parks | 1.949.278 | 77,94 |
| Regional Natural Parks | 27.815 | 1,11 |
| Civil Society Natural Reserves | 129.291 | 5,17 |
| National Protective Forest Reserves | 10.521 | 0,42 |
| **Total** | **2.501.116** | **100** |

Source: Own elaboration according to RUNAP (2020)

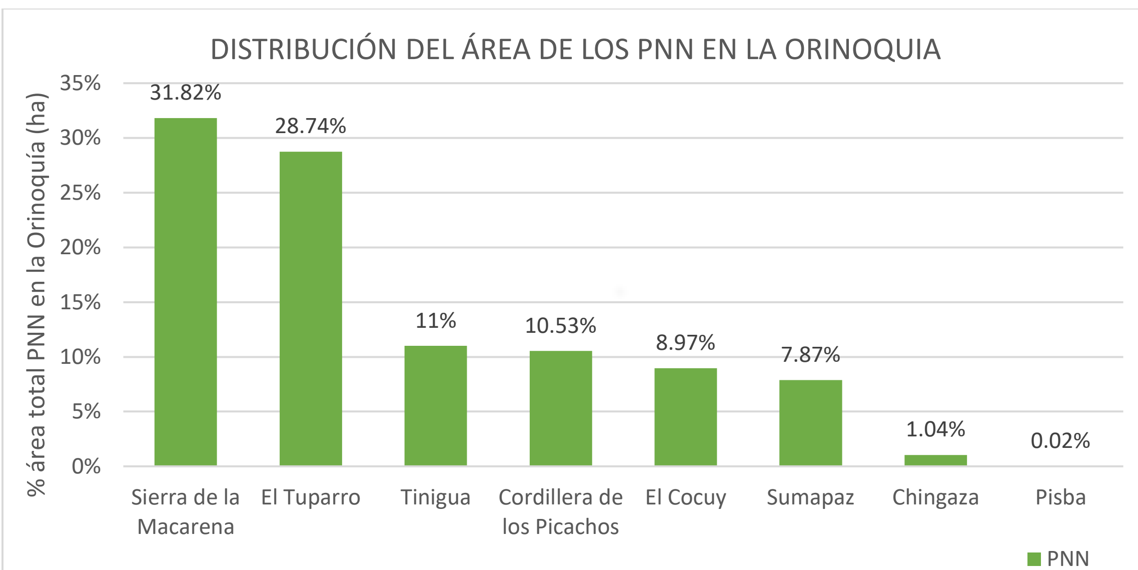


Figure 25. Distribution of NNP areas in Orinoquia (Own elaboration according to RUNAP 2020)

[165] By crossing available official information, 129 ha of Serranía de Chiribiquete NNP were identified within the municipality of La Macarena, Meta; however, according to resolution 1256 of 2018 of the Ministry of Environment and Sustainable Development, the Park's boundaries do not extend to that department. It is possible that the detected overlap is due to methodological differences in the elaboration of the official cartography.

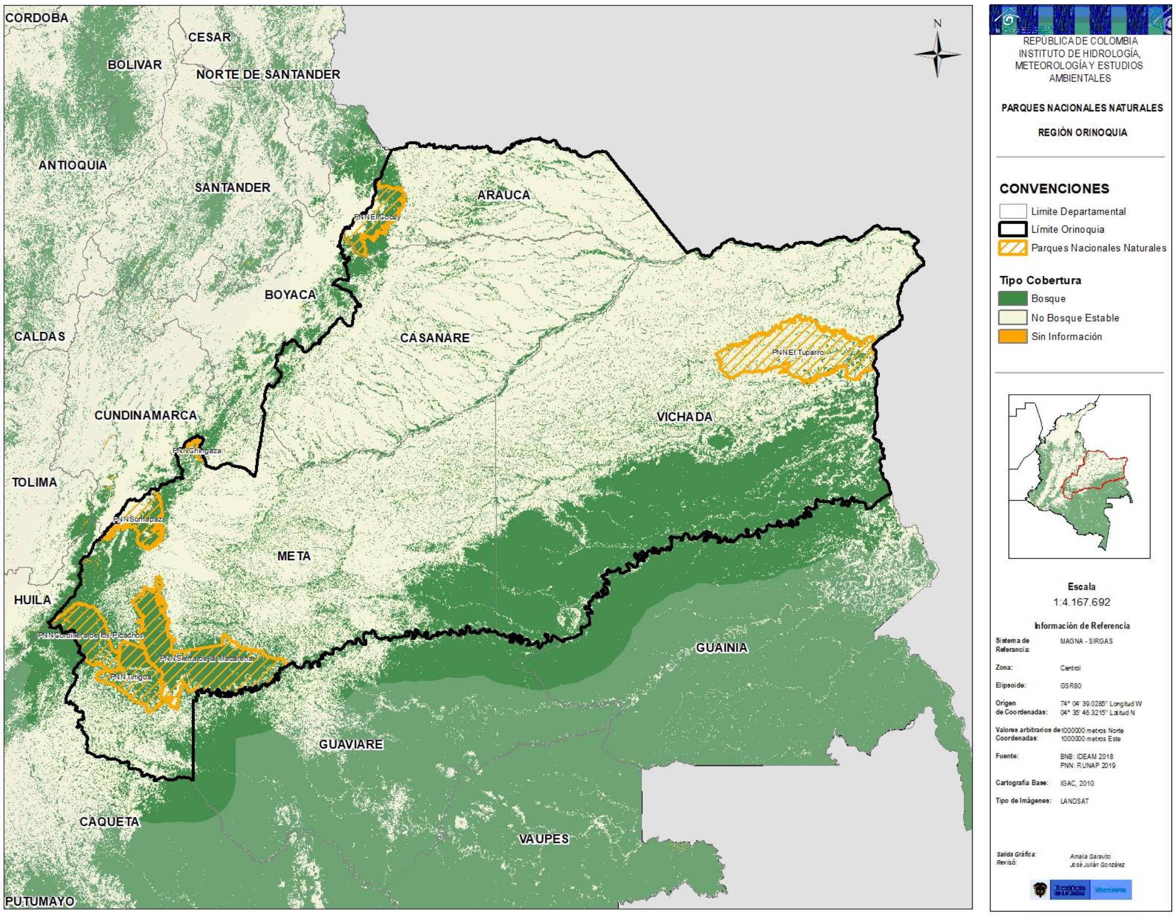


Figure 26. NNP in Orinoquia (Own elaboration according to RUNAP 2020)

## 3.2. Economic Context

### 3.2.1. Gross domestic product

For the year 2019, the Gross Domestic Product (GDP) of the Orinoquia region represented 5% of the national GDP. The department of Meta contributed the most to the region's GDP, while Vichada was the department with the lowest participation (DANE 2020). Figure 27 shows the annual behavior of GDP in the period 2005-2019 for each of the departments that make up the region; a marked increase trend is evident between 2009 and 2015, with a general decrease in 2016 and a subsequent tendency to increase from 2016 in Meta, Casanare and Arauca.

### 3.2.2. Economic activities

Table 16 shows the groups of economic activities in the four departments that make up the region and the percentage contribution of each to the departmental

GDP during the 2005-2019 period. In general terms, the activities with the highest participation in the regional GDP correspond to "mining and quarrying" (including hydrocarbon exploration and exploitation activities), "agriculture, livestock, hunting, forestry and fishing", trade, transportation and tourism, and the group related to public service and social investment, called "public administration and defense; mandatory social security plans; education; human health care and social services activities" (DANE 2020).

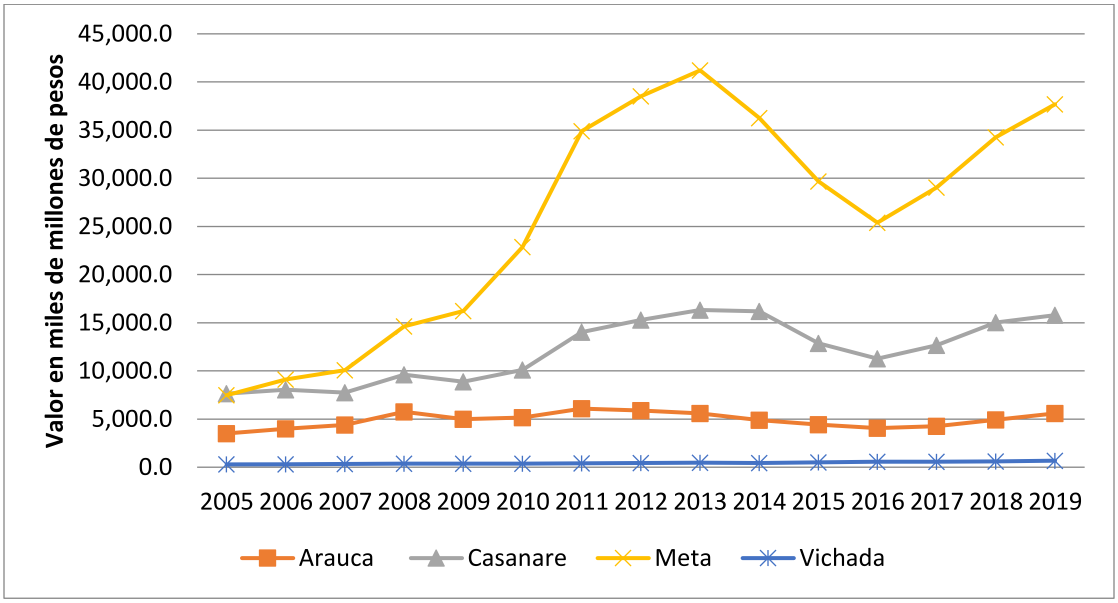


Figure 27. GDP in Orinoquia Departments, during 2005-2019 (Own elaboration according to DANE 2020)

The economic development of the Colombian Orinoquia region has historically been linked to primary activities such as cattle ranching, agriculture, and mining and energy projects. Due to the high acidity and low fertility characteristics of the soils in many areas of the region, the most traditional productive option for land use has been extensive cattle ranching, mainly cattle breeding and rearing systems, with little or no incorporation of technology, very low carrying capacities and developed in large extensions of native savannahs or with introduced pastures (Viloria 2009). According to the livestock suitability zoning implemented by UPRA (2019a and 2019b), the region has large extensions with medium-high suitability for cattle grazing in the four departments, mainly in the areas of natural savannahs.

Hydrocarbon extraction has an important weight in the region's economy, with the presence of extraction wells in the four departments. Figure 18 shows that the department with the highest concentration of wells is Meta, followed by Casanare, Arauca and Vichada (ANH 2018). Although the vast majority of these wells are located in areas with a certain degree of transformation, in the southeastern part of Meta it is possible to identify some of them located near extensive forest areas. Hydrocarbon extractive activity is spatially related to the distribution of the official road network (IGAC 2019).

Table 16. GDP by economic activities in Orinoquia departments (Average value for 2005-2019)

| Economic Activities | Arauca (%) | Casanare (%) | Meta (%) | Vichada (%) |
|---|---|---|---|---|
| Agriculture, livestock, hunting, forestry and fishing. | 13,73 | 8,69 | 8,50 | **35,10** |
| Mining and quarrying. | **56,35** | **58,20** | **57,73** | 0,36 |
| Manufacturing industries. | 2,16 | 2,22 | 2,57 | 0,80 |
| Electricity, gas, steam and air conditioning supply; water distribution; sewage disposal and treatment, waste management and sanitation. | 0,58 | 1,33 | 0,94 | 0,71 |
| Construction. | 4,39 | 3,62 | 5,61 | 8,50 |
| Wholesale and retail trade; repair of motor vehicles and motorcycles; transportation and storage; accommodation and food services. | 7,65 | 14,76 | 10,23 | 10,45 |
| Information and communications. | 0,59 | 0,57 | 1,12 | 0,81 |
| Financial and insurance activities. | 1,02 | 1,05 | 1,21 | 1,78 |
| Real estate activities. | 2,52 | 2,40 | 2,46 | 4,64 |
| Professional, scientific and technical activities; administrative and support service activities. | 0,31 | 0,88 | 2,02 | 0,63 |
| Public administration and defense; compulsory social security schemes; education; human health care and social work activities. | 10,34 | 5,95 | 6,96 | 35,32 |
| Arts, entertainment, recreation and other service activities; activities of individual households. | 0,36 | 0,33 | 0,66 | 0,91 |
| **Total** | **100%** | **100%** | **100%** | **100%** |

Source: Own elaboration according to DANE (2020)

On the other hand, mining activity boomed in the region between 1990 and 2000, mainly in the departments of Casanare and Arauca; however, the trend has changed in recent years and, although this sector still makes a large contribution to the regional economy, its participation has decreased (Viloria 2009). The National Mining Agency reports active mining titles mainly in the departments of Meta and Vichada (ANM 2019) (Figure 28).

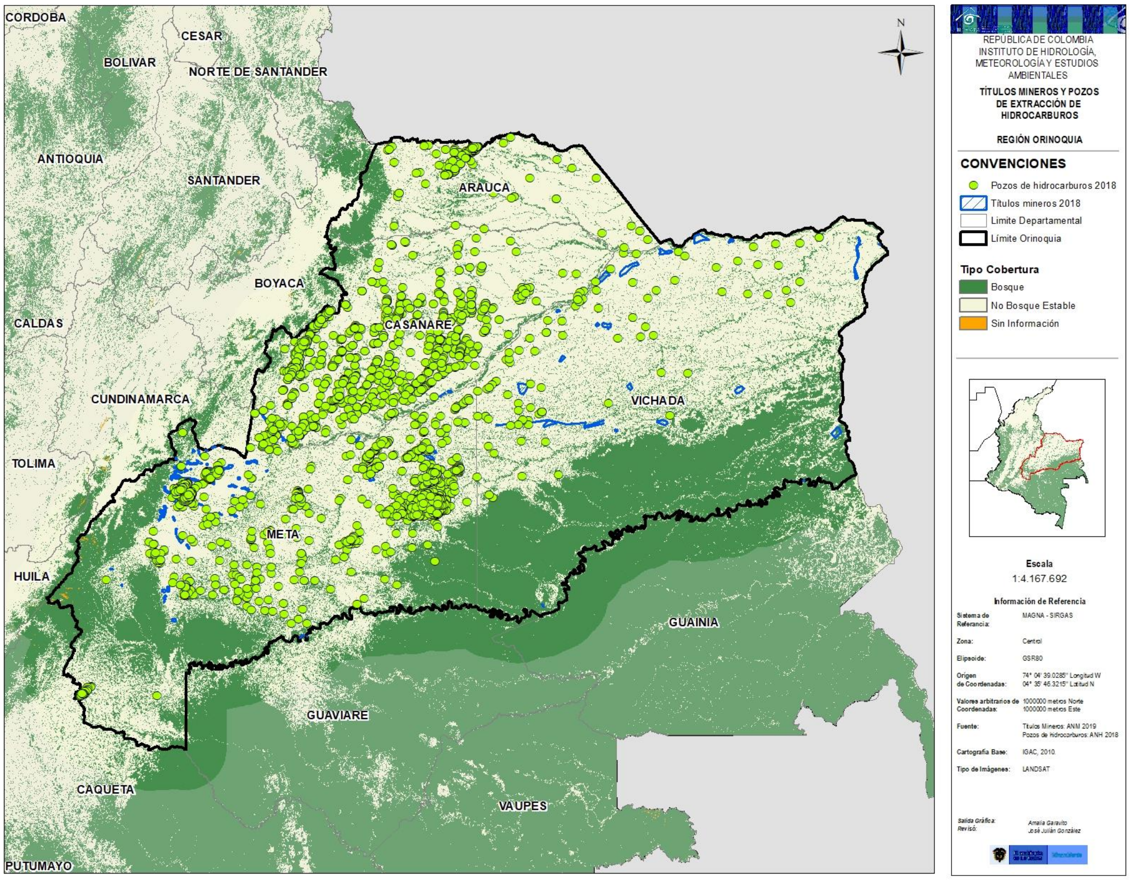


Figure 28. Wells for hydrocarbon extraction and mining tittles in Orinoquia (Own elaboration according to ANH 20218 and ANM 2019)

### 3.2.3. **Road infrastructure**

The economic growth and development of a region is driven, among other factors, by transportation infrastructure (García 2007). The quantity and quality of roads, especially at the rural scale, generates greater participation of local actors in the country's economy, because it has effects on construction, reduction of travel times, reduction of productive costs, accessibility to markets, among others (Durango et al. 2016). In the Orinoco, road infrastructure is mainly concentrated in the western part of the region, with higher density in the highly transformed areas of the foothills, while in the southern zone (where dense forests are located) and in the far east road accesses are very reduced (Figure 29).

Although the growth of road infrastructure is considered fundamental to generate economic growth and greater competitiveness, in recent years indicators such as GDP, developed an increased interest in the activity in terms of its environmental impacts, which has driven the coordination between the different actors for the construction of roads that mitigate these impacts (Bager 2018).

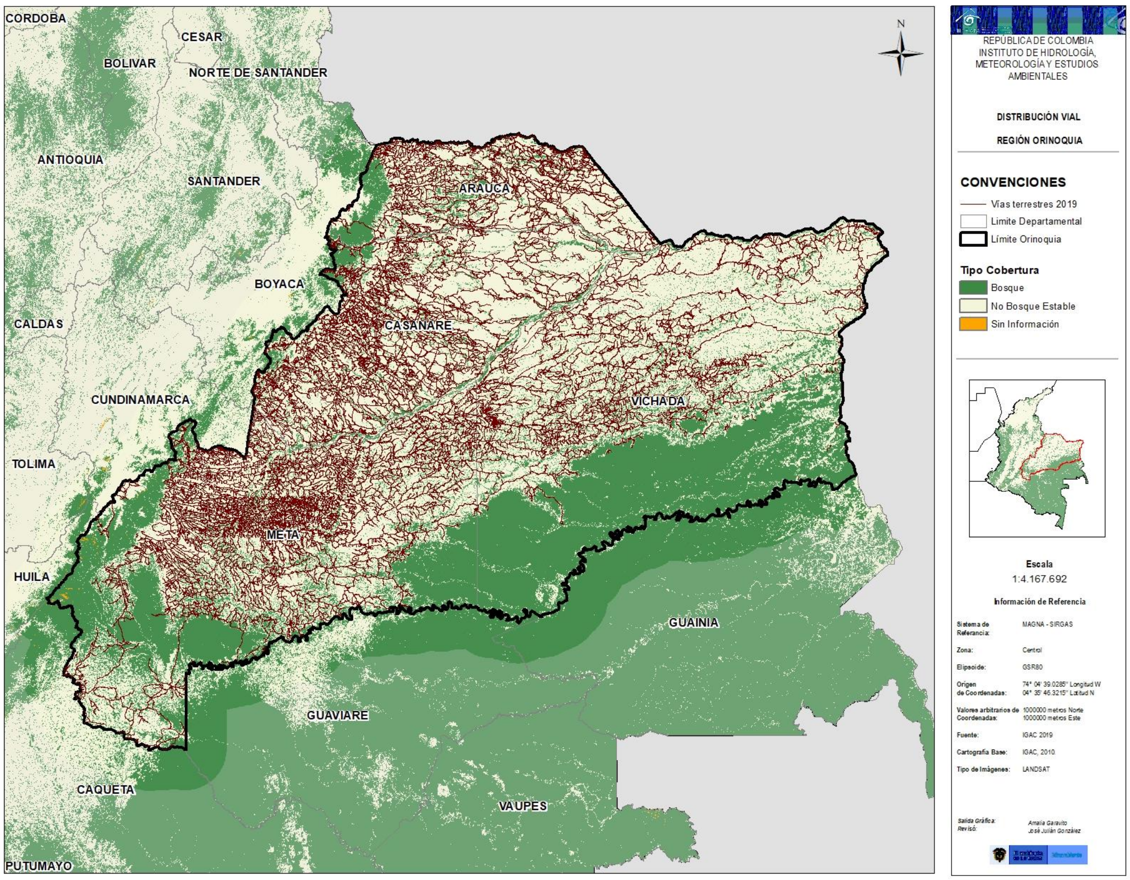


Figure 29. Road distribution in Orinoquia region (Own elaboration according to IGAC 2019)

## 3.3. Sociocultural context

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### 3.3.1. Social indicators

The human development index (HDI) is constructed from indicators such as life expectancy at birth (LEB), higher education coverage (HEC), labor informality (LI) and real GDP per capita (RGDP). The HDI value ranges from zero (0) to one (1); the closer the value is to one (1), the greater the human development achieved by the country, region, department or municipality (Ramírez et al. 2015). For the year 2019, according to Global Data Lab (2019), the HDI for each of the departments in the region was: Arauca 0,740, Casanare 0,750, Meta 0,778 and Vichada 0,754, while the national average was 0,767. In all cases, this value corresponds to the highest in the records for the last twenty years.

The unsatisfied basic needs index (UBN), as an approximation to the level of poverty, is calculated based on indicators such as inadequate housing, with critical overcrowding, inadequate services, high economic dependence and school-age children not attending school. For 2018, it was identified that the department of Vichada has the highest value of UBN in the region with 67,76%, followed by Arauca with 32,45%, Casanare 16,08% and Meta 13,45% (DANE 2018). Regarding the information corresponding to occupation and unemployment, the region presents information gaps for the departments of Arauca, Casanare and Vichada; however, for 2018, a participation rate of 62,6%, occupation of 55,2% and unemployment of 11,9% was recorded in the department of Meta (DANE 2018).

### 3.3.2. **Population dynamics**

According to information from the National Population and Housing Census (CNPV in Spanish) conducted by DANE, the Orinoco recorded a total population of 1.615.166 people for 2018, distributed in 796.486 women and 818.680 men. Of this population, 54% corresponds to children and youth (0-29 years), 37% to adults (30-60 years) and the remaining 10% to adults over 60 years (DANE 2018). The department of Meta concentrates most of the region's population with 56,91%, followed by Casanare with 23,5%, Arauca 14,83% and, finally, Vichada with 4,75% (Figure 30).

For 2018, 629.665 units with residential housing use were identified in the region, 26.366 units of mixed use, 7.431 correspond to traditional indigenous housing and 288 to traditional ethnic housing (Afro-Colombian and others); on the other hand, 183.959 units of non-residential use were registered (DANE 2018). Some of the main uses that registered non-residential units are presented in Figure 31, where those dedicated to commerce (31.874 establishments) and agricultural, agro-industrial and forestry uses (18.559 units) stand out. Mining-energy activity was only reported by 194 establishments in the four departments, while industrial activity was reported in 1.855 non-residential units in the region.

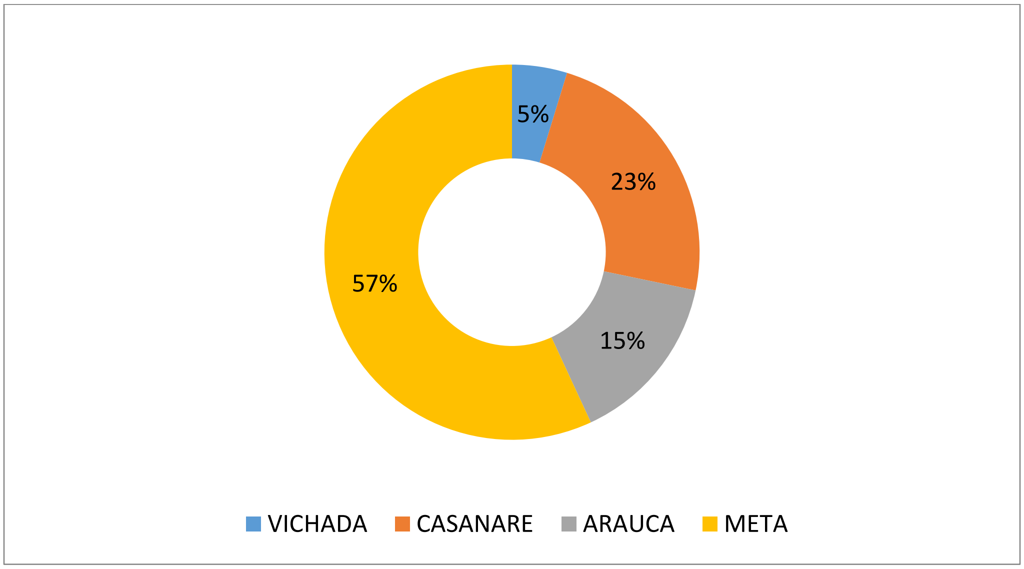


Figure 30. Population distribution in Orinoquia departments (Own elaboration according to DANE 2018)

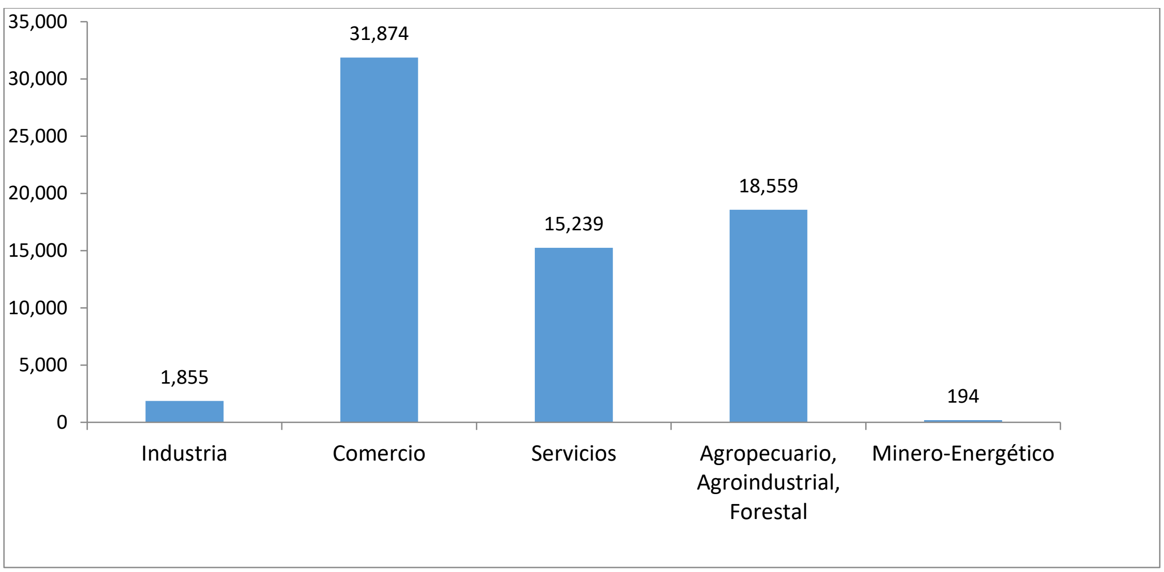


Figure 31. Classification of non-residential units in Orinoquia (Own elaboration according to DANE 2018)

Analyzing the information related to the population's access to basic services in their homes (DANE 2018), it can be observed that they mostly have availability of electric power (90,74%), aqueduct (76,85%), sewerage (71,55%) and natural gas (57,66%). However, in terms of connectivity, more than 70% of households lack internet connection (Figure 22).

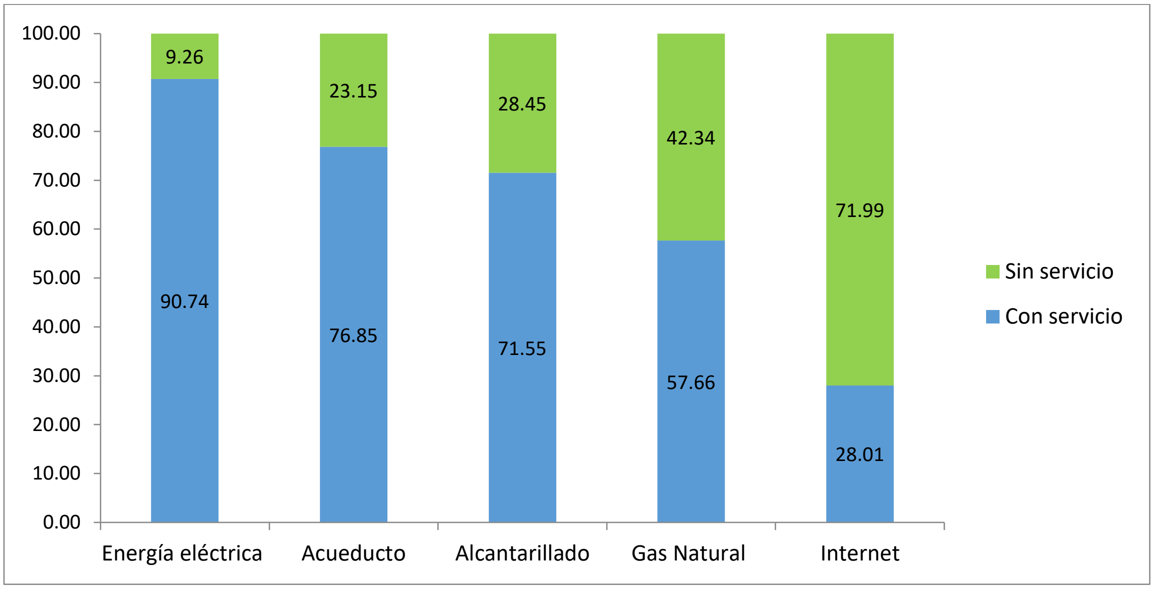


Figure 32. Access to basic services in Orinoquia (Own elaboration according to DANE 2018)

Finally, DANE (2018) reported that of the 814.482 CNPV surveys conducted in the Orinoco departments, 1,6% (12.997) were applied in indigenous collective territories, 0,85% (6.896) in protected areas and none in areas defined as collective territories of black communities. Regarding the spatial location of the indigenous shelters in the region, the wide extension of these territorial management figures in the department of Vichada is highlighted (Figure 33).

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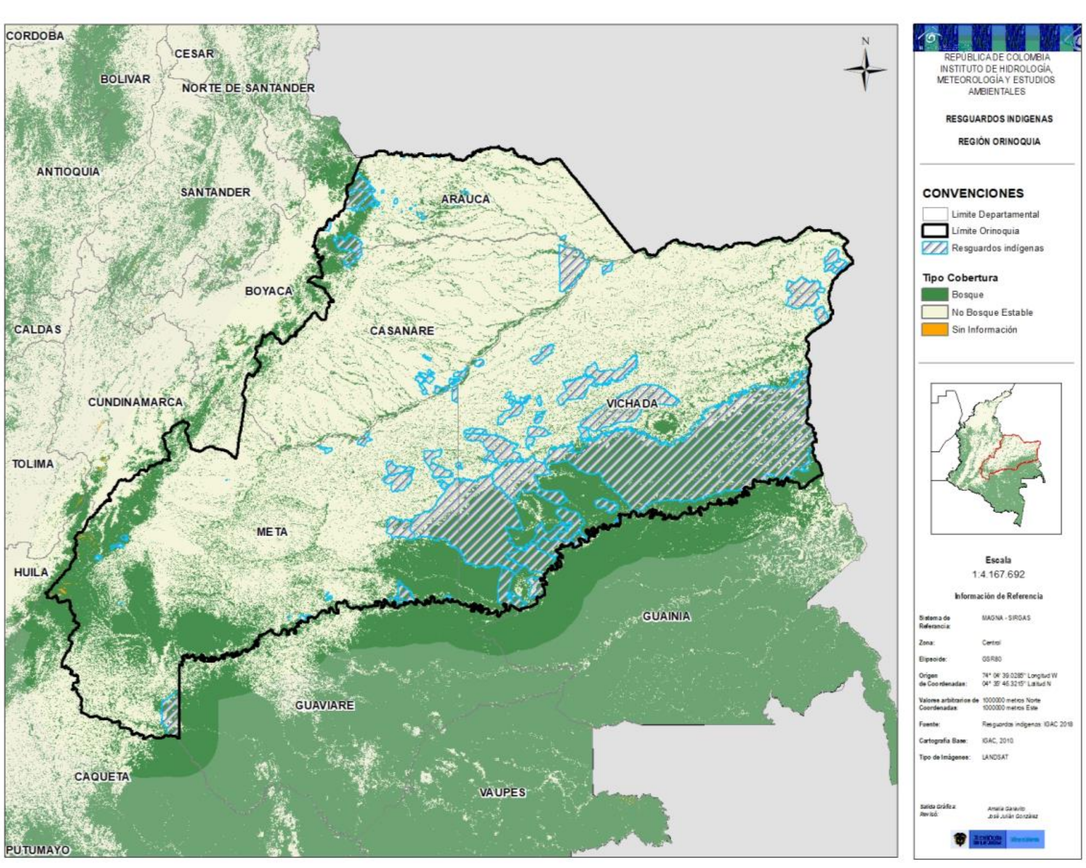


Figure 33. Indigenous shelter areas in Orinoquia (Own elaboration according to IGAC 2018)

## 3.4. Historic Context

The Orinoquia region has undergone an intense process of occupation and transformation throughout its history, especially in the foothill areas (Viloria, 2009). After the Conquest, the main factors in the transformation of the landscape in the Colombian Orinoquia went from the Jesuit missions to the violence of the mid-20th century and the intensification of colonization processes aimed at establishing large areas with extensive cattle ranching, as well as the boom in oil exploration and exploitation in Arauca, Casanare and Meta in the 1980s (Moncayo, 2017).

### 3.4.1. XX Century time line

Figure 34 shows a summary of the historical milestones identified as relevant in the transformation of natural land cover in the region, with emphasis on forest cover, during the 20th century.

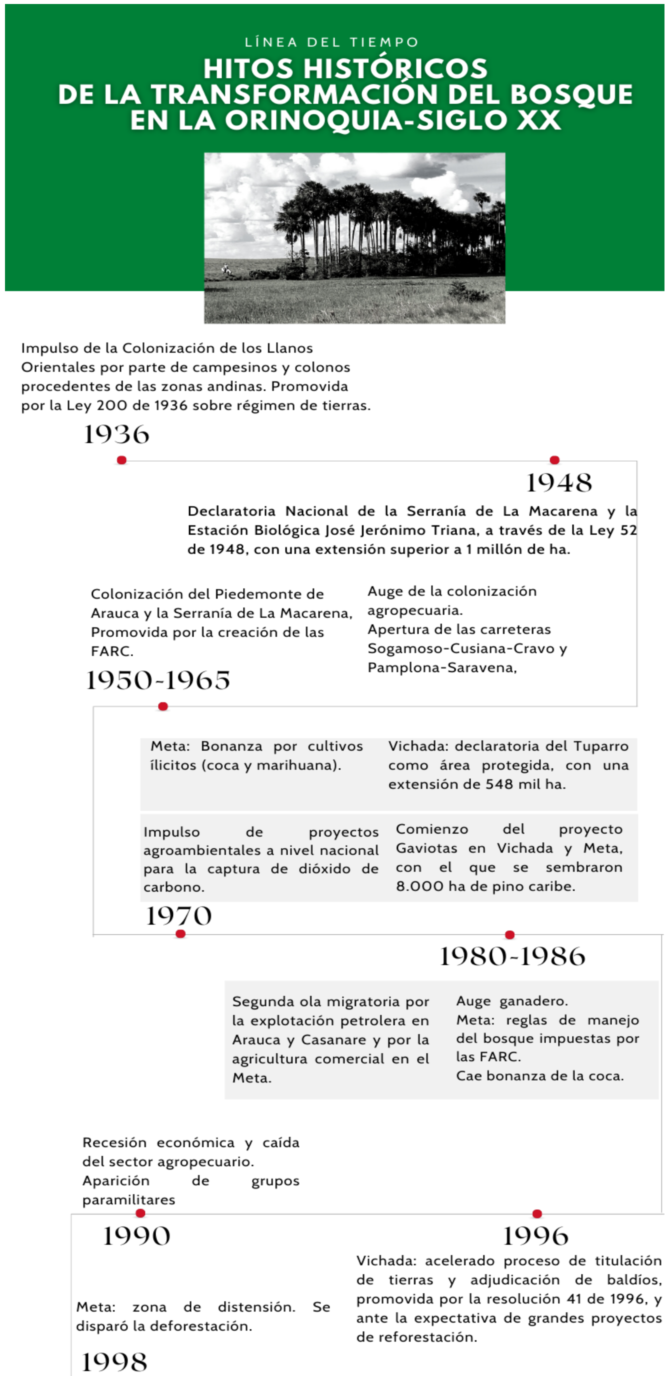


Figure 34. Line time of forest transformation in Orinoquia (XX century) (Own elaboration)

Milestones related to the colonization directed from the center of the country towards the Orinoco and the Amazon were identified as relevant in this period, driven by Law 200 of 1936, which was later consolidated with the beginning of the expansion of road infrastructure in the foothill. The declaration of the main protected areas and the dynamics of the armed conflict generated different effects on the dynamics of transformation in the mid-20th century, allowing the conservation of large areas, but also promoting the growth of illicit crops and the consolidation of extensive cattle ranching to the point of occupying large areas of natural savannahhs. Between 1980 and 1990, the deforestation fronts were consolidated as a result of colonization and the coca boom, in addition to the exploitation of high-value timber species such as cedar. Towards the end of the period (1990-2000), there was a boom in the oil industry, which was linked to a more accelerated expansion of road infrastructure, extensive cattle ranching and the extraction of timber from natural forests and forestry plantations.

### 3.4.2. **XXI Century time line**

Regarding the transformation of natural cover in this period and according to data from the Forest and Carbon Monitoring System of IDEAM (2020), in 2000, 34,5% of the total area of the Orinoco region corresponded to natural forests. By 2019 the percentage of forest was reduced to 31,5%. During the period 2000-2019 the total loss of natural forest in the Orinoco region was estimated at 651.407 ha, equivalent to 3% of the territory (Figure 35).

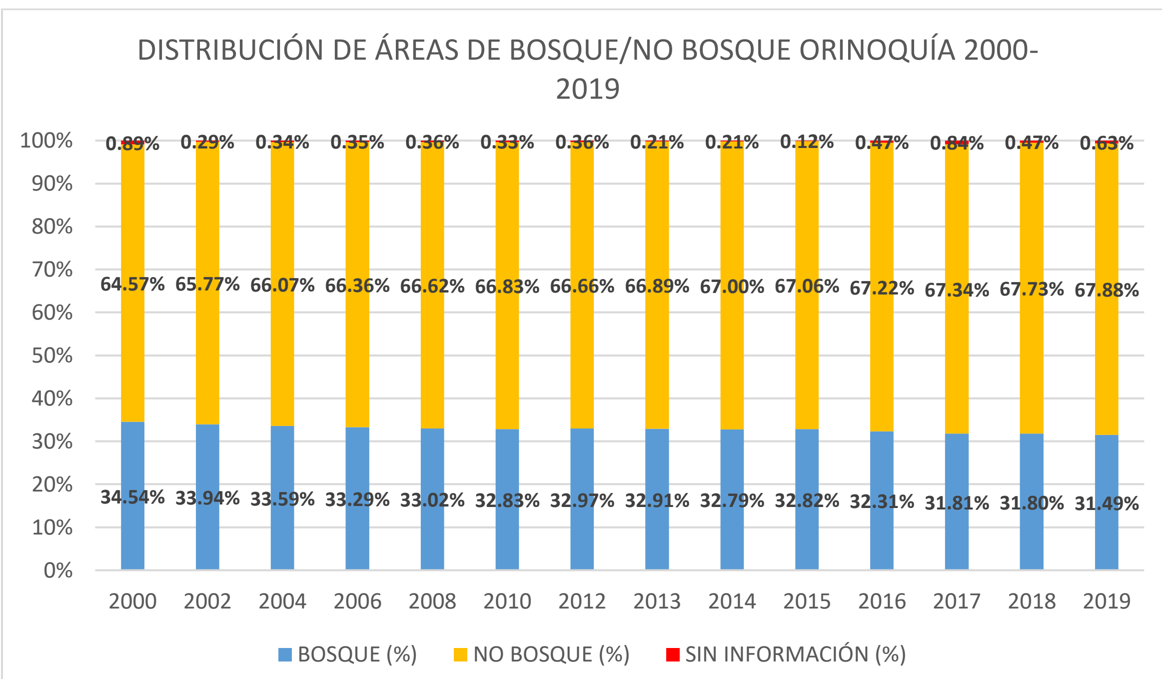


Figure 35. Forest/non-forest areas in Orinoquia region (2000-2019) (Own elaboration according to IDEAM 2020)

Figure 36 summarizes the historical milestones identified as relevant in the transformation of natural land cover in the region, with emphasis on forest cover, during the 21st century.

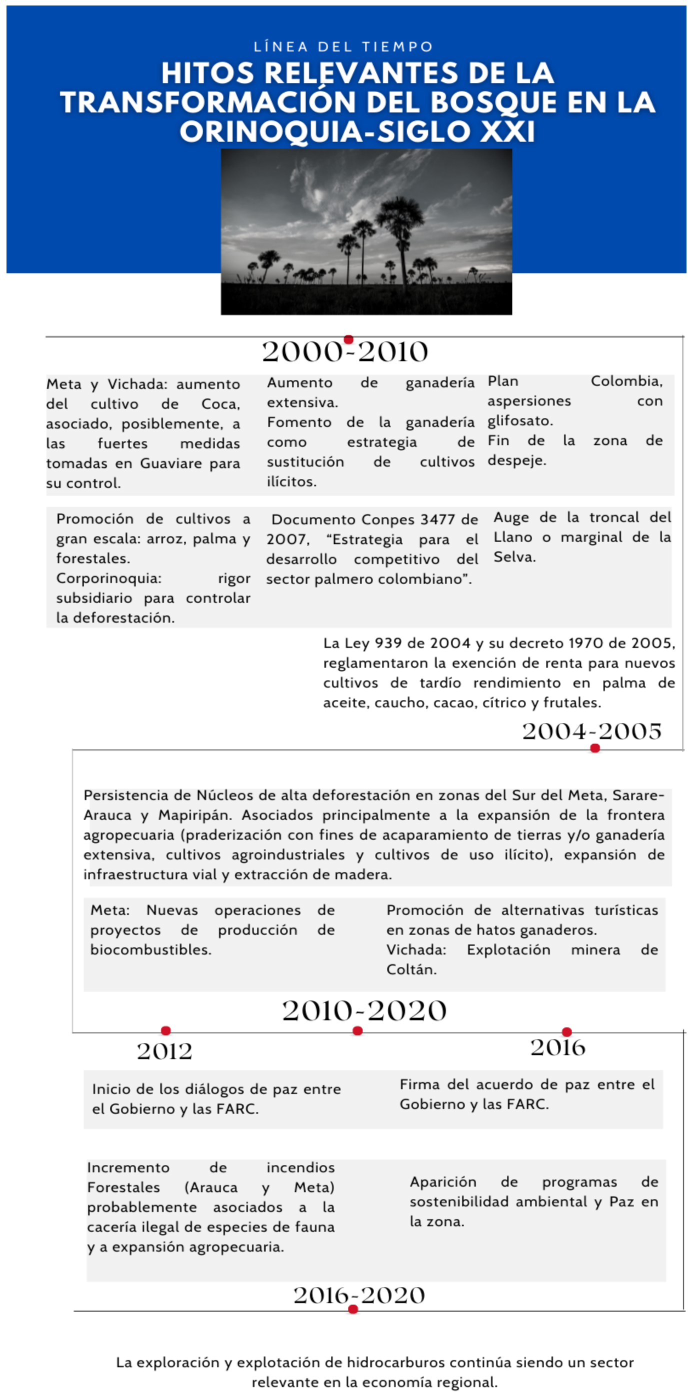


Figure 36. Line time of forest transformation in Orinoquia (XXI century) (Own elaboration)

In the 2000-2010 decade, the expansion of livestock production and coca crops continued, and the growth of industrial agriculture was promoted in the region (mainly palm oil, rice and forestry plantations), generating some control actions to the growing phenomenon of deforestation by regional environmental authorities (Autonomous Corporations and National Natural Parks), especially related to restrictions on productive and extractive activities in non-permitted areas. For the entire period, the implementation of national policies for the control of coca crops and the promotion of substitution strategies related to food security and livestock production were highlighted.

After 2010, deforestation in the region was concentrated in the southwestern area of the department of Meta, in municipalities such as Uribe, Mesetas, San Juan de Arama, Puerto Lleras, Puerto Rico, Puerto Concordia and La Macarena, threatening the PNN Sierra de La Macarena, Cordillera de Los Picachos and Tinigua; these protected areas are of high ecological importance as they function as a connectivity corridor between the Andean, Orinoco and Amazonian ecosystems. For this period, a significant concentration of deforested areas associated with the road axis known as "Marginal de la selva" was evidenced, where the Amazon Forest presents a high risk of intervention due to the effect that this corridor exerts by connecting the deforestation fronts coming from the south of Meta and northwest of Guaviare (González et al. 2018b).

In the 2010-2020 decade, grazing for land grabbing purposes was highlighted as the main cause of forest loss; extensive cattle ranching continued to be an important cause, but processes of productive reconversion and integration to economic activities such as tourism were initiated. Other causes were identified, such as industrial agricultural production, illicit crops and timber extraction. Mineral extraction was identified as a possible cause of deforestation during this period; however, its impact on natural vegetation cover in the region has been much less than that generated by other activities. The high deforestation area of southern Meta, Sarare (Arauca) and Mapiripán (Meta) were consolidated in this decade.

Towards the end of the period, with the signing of the peace agreements with the FARC and their demobilization (2016-2017), new colonization processes occurred and deforestation in the area increased significantly. This increase was mainly associated with large-scale conversion of forests to pastureland for land grabbing and/or expansion of extensive cattle ranching. The transformations were generally strongly fueled by burning, which usually resulted in forest fires. The presence of illegal armed groups, which have directly promoted the occupation of protected areas and deforestation activities, made the implementation and effectiveness of measures and actions to address the phenomenon difficult.

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# 4. GHG EMISSIONS AND REMOVALS PROFILE FOR THE AFOLU SECTOR IN ORINOQUIA REGION

## 4.1. National profile

According to Colombia's Third Biennial Update Report to the UNFCCC (IDEAM et al. 2021), total estimated direct GHG emissions in Colombia for 2018 were 302.974 Gg $CO_2$eq, of which 70.2% corresponded to $CO_2$, 24,3% to $CH_4$, 4,4% to $N_2O$, 1,1% to HFC-PFCs and 0,1% to SF6. Estimated $CO_2$ removals were -23.776 Gg of $CO_2$eq, which generated a net emissions balance of 279.198 Gg of $CO_2$eq in that year.

In terms of participation by module and subcategory, 59,1% of GHG emissions corresponded to those estimated under the AFOLU category and, together with those of the energy module, accounted for approximately 90% of the country's emissions (Figure 37). For removals, 60,7% corresponded to those estimated within the forest land group, 28,2% to cropland growth, 8,6% to those calculated for the grassland subcategory (removals in silvopastoral systems) and 2,5% to harvested wood products (Figure 38).

On average, Colombia's annual historical emissions from the AFOLU module for the period 1990-2018 were 155.431 Gg $CO_2$eq. The estimations were 163.725 Gg $CO_2$eq for 1990 and 179.066 Gg $CO_2$eq for 2018. Average removals, over the same period, were -12.293 Gg $CO_2$eq. A total of -4.696 Gg of $CO_2$ was calculated for 1990 and -23.776 Gg of CO2eq for 2018 (IDEAM et al. 2021).

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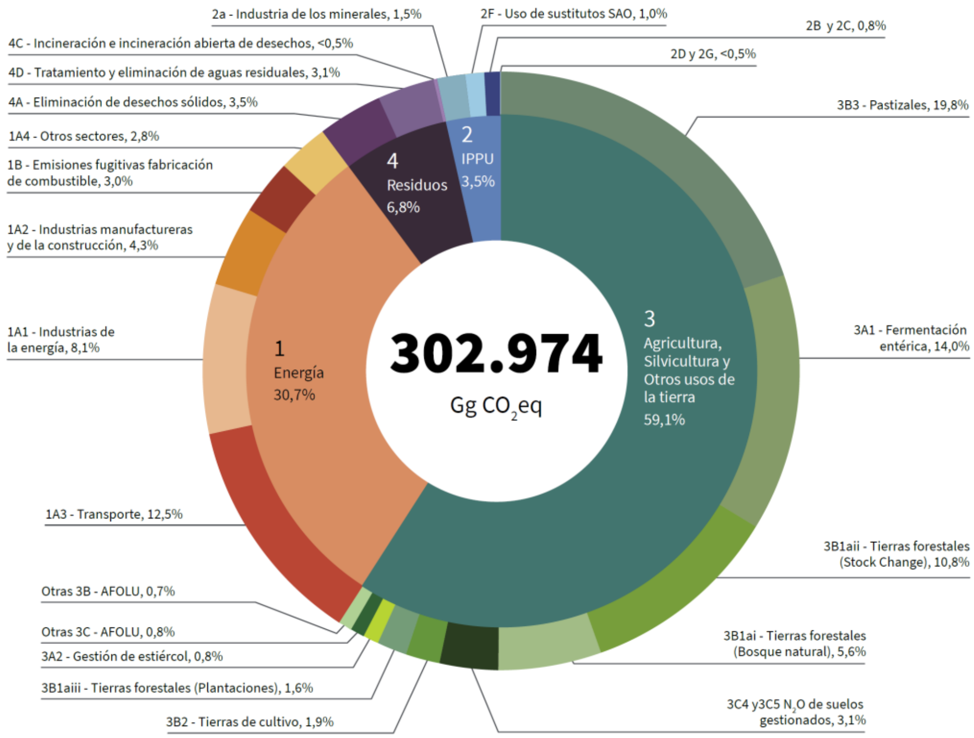


Figure 37. Participation by module in GHG emissions in 2018, national scale (IDEAM et al. 2021)

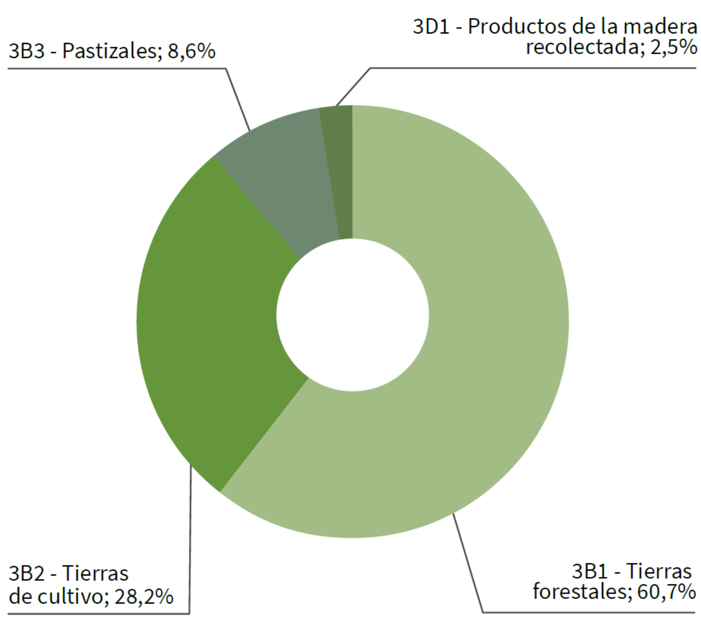


Figure 38. Participation by sub-category in GHG removals in 2018, national scale (IDEAM et al. 2021)

## 4.2. Total emissions and removals regional profile[166]

In the framework of the ERP, the Orinoco region corresponds to the political-administrative aggregation of the four departments that comprise it: Arauca, Casanare, Meta and Vichada. Total estimated GHG emissions for the region in 2018 were 48.301 Gg $CO_2$eq, and estimated $CO_2$ removals were -6.068 Gg $CO_2$eq, generating a net emissions balance of 42.233 Gg $CO_2$eq in the same year (Table 17). In reference with the national results presented in BUR 3 (2018 data), the Orinoco contributed 15,9% of total emissions, 25,5% of removals and 15,1% of net emissions.

As shown in Table 17, the department of Meta contributed 67,7% of total emissions and 70,8% of regional net emissions; followed in emissions (total and net) by the departments of Casanare and Arauca; the lowest emissions corresponded to the department of Vichada. Regarding GHG removals in 2018, between Vichada and Meta contributed 94% of total removals in the Orinoco region (Figure 39).

Table 17.GHG total emissions, removals, net emissions in Orinoquia departments (2018)

| Department | GHG Total Emissions | | GHG Total removals | | Net GHG Emissions | |
|---|---|---|---|---|---|---|
| | Gg $CO_2$eq | Region Percentage | Gg $CO_2$eq | Region Percentage | Gg $CO_2$eq | Region Percentage |
| Arauca | 3.774 | 7,8% | 60 | 1,0% | 3.713 | 8,8% |
| Casanare | 8.089 | 16,7% | 316 | 5,2% | 7.774 | 18,4% |
| Meta | 32.694 | 67,7% | 2.773 | 45,7% | 29.921 | 70,8% |
| Vichada | 3.744 | 7,8% | 2.919 | 48,1% | 826 | 2,0% |
| **Total Orinoquia** | **48.301** | **100%** | **6.068** | **100%** | **42.233** | **100%** |

Source: Own elaboration according to GHG Departmental Inventory in 2018 (IDEAM et al. 2021)

[166] The information presented in this numeral was constructed based on the results of the 2018 departmental greenhouse gas inventory, which includes the disaggregation of the national data published in the Third Biennial Update Report of Colombia to the UNFCCC (IDEAM et al. 2021).

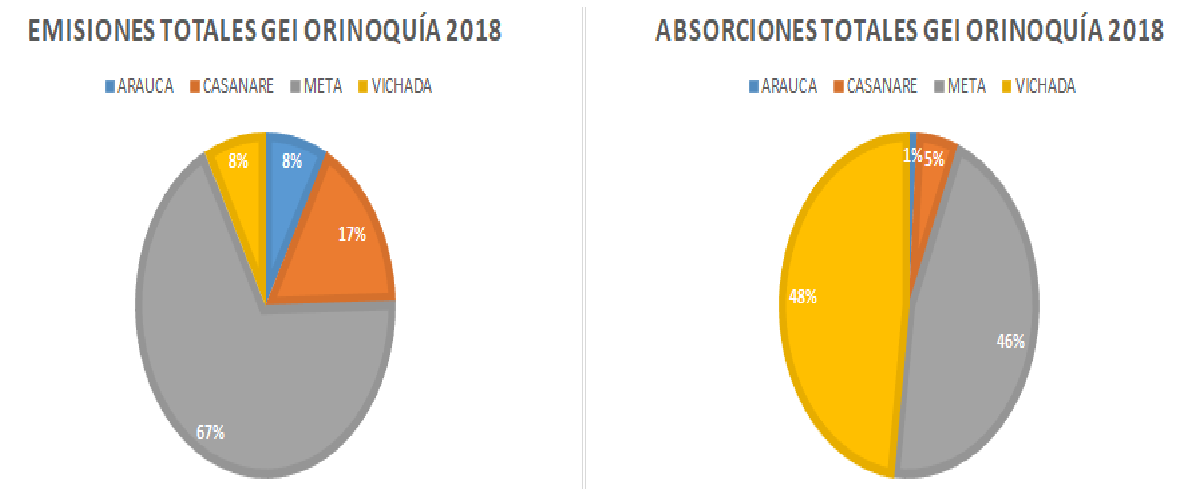


Figure 39. Departmental participation in GHG emissions and removals in Orinoquia in 2018 (IDEAM et al. 2021)

With respect to participation by component, 78,7% of the region's total emissions in 2018 corresponded to Agriculture, Forestry, and Other Land Use - AFOLU. The data for this module, at the departmental level, were 97,4% of emissions from Vichada, 82,5% from Meta, 80,8% from Arauca, and 53,3% from Casanare. The Energy module contributed 19,8% of total regional emissions, 44,1% of emissions in Casanare, 16,5% in Arauca, 16,2% in Meta and 2% in Vichada. The modules Waste (1,4% of regional emissions), and Industrial Processes and Product Use - IPPU (0,2% of the region's emissions), had a smaller contribution to the total regional and departmental emissions estimated for 2018 (Table 18 and Figure 40).

Table 18. Participation by module in GHG total emissions in Orinoquia Departments (2018)

| Department | GHG Module Emissions | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1. Energy | | 2. IPPU | | 3. AFOLU | | 4. Waste | |
| | Emissions (Gg $CO_2$eq) | Percentage | Emissions (Gg $CO_2$eq) | Percentage | Emissions (Gg $CO_2$eq) | Percentage | Emissions (Gg $CO_2$eq) | Percentage |
| Arauca | 621 | 16,5% | 7 | 0,2% | 3.050 | 80,8% | 95 | 2,5% |
| Casanare | 3.564 | 44,1% | 31 | 0,4% | 4.310 | 53,3% | 185 | 2,3% |
| Meta | 5.305 | 16,2% | 52 | 0,2% | 26.983 | 82,5% | 353 | 1,1% |
| Vichada | 74 | 2,0% | 1 | 0,0% | 3.647 | 97,4% | 23 | 0,6% |
| **Total Orinoquia** | **9.564** | **19,8%** | **91** | **0,2%** | **37.989** | **78,7%** | **657** | **1,4%** |

Source: Own elaboration according to GHG Department Inventory 2018 (IDEAM et al. 2021)

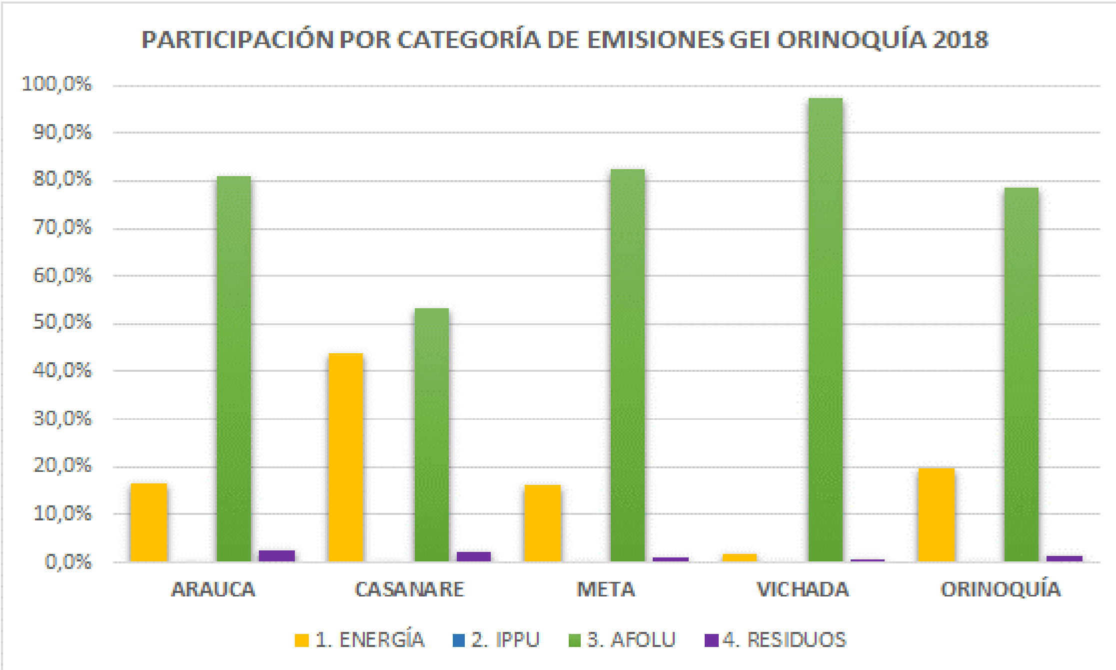


Figure 40.Participation by module in GHG emissions in 2018, regional and departamental scale (IDEAM et al. 2021)

## 4.3. AFOLU emissions and removals regional profile[167]

According to the guidelines proposed by the Intergovernmental Panel on Climate Change (IPCC), the AFOLU module is composed of three broad categories: 3A. Livestock, 3B. Land and 3C. Aggregate sources (Figure 41). Categories 3A and 3C correspond to direct GHG emissions from all agricultural and livestock activities, while category 3B refers to emissions associated with the use and change of use of forest, cropland, pasture and other lands. This last category estimates emissions and removals related to the loss or gain of carbon due to the removal or growth of plant biomass, dead organic matter and soils (IDEAM and UNDP 2018), being the land use change due to deforestation the most important source of emissions for this category in the country and in the region.

[167] The information presented corresponds to the synthesis of the results of the 2018 regional and departmental GHG inventory, updated for the project "Low Carbon Sustainable Development in the Orinoco Region - Biocarbon Fund" (February 2023).

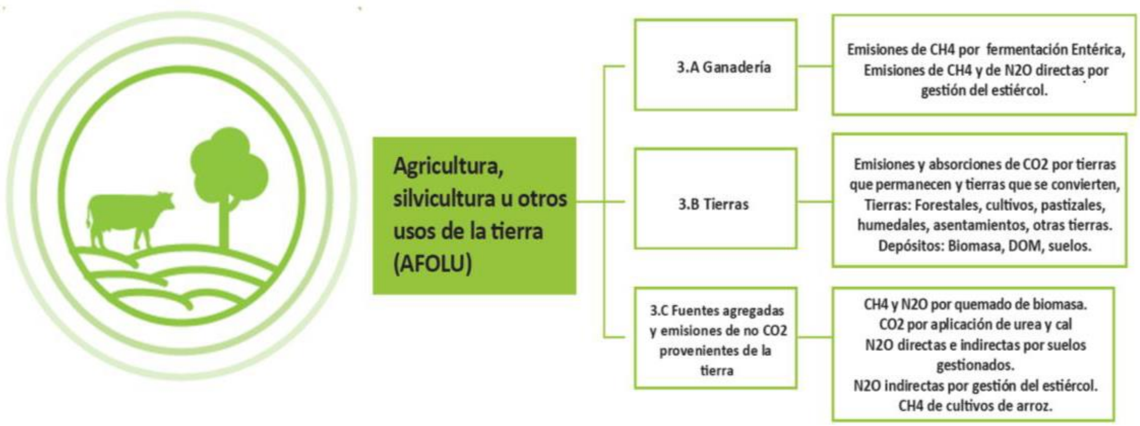


Figure 41. Categories for AFOLU module in inventory in Colombia (IDEAM y PNUD 2018)

The AFOLU module emissions in the Orinoco region, estimated for 2018, corresponded 70,7% to category 3B (Land), 22,3% to category 3A (Livestock) and the remaining 7% to category 3C (Aggregate sources and non-$CO_2$ emissions from land). In the case of the departments of Meta and Vichada, most of the AFOLU emissions were included in the Land category (84,6% and 85,2%, respectively); in Arauca and Casanare, the greatest weight was in the Livestock category (59,4% and 59,3%, respectively), followed by the Land category and a greater participation of the Aggregate sources and non-$CO_2$ emissions from land, compared to the results for Meta and Vichada (Table 19 and Figure 42).

Table 19. Participation by category in AFOLU emissions in Orinoquia departments (2018)

| Department | AFOLU Emissions Category | | | | | |
|---|---|---|---|---|---|---|
| | 3A. Livestock | | 3B. Land | | 3C. Aggregate Sources | |
| | **Emissions (Gg $CO_2$eq)** | **Percentage** | **Emissions (Gg $CO_2$eq)** | **Percentage** | **Emissions (Gg $CO_2$eq)** | **Percentage** |
| Arauca | 1.839 | 59,4% | 969 | 31,3% | 287 | 9,3% |
| Casanare | 3.186 | 59,3% | 855 | 15,9% | 1.332 | 24,8% |
| Meta | 3.077 | 11,6% | 22.413 | 84,6% | 995 | 3,8% |
| Vichada | 406 | 12,6% | 2.747 | 85,2% | 69 | 2,2% |
| **Total Orinoquia** | **8.508** | **22,3%** | **26.985** | **70,7%** | **2.683** | **7,0%** |

Source: Own elaboration according to GHG regional and departmental inventory 2018 (update in February 2023)

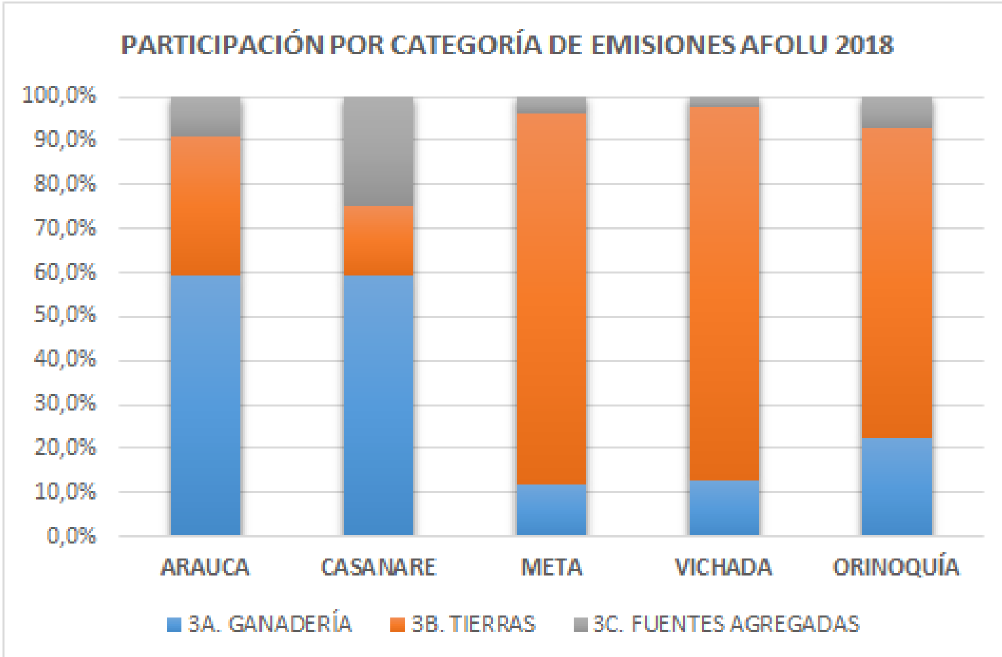


Figure 42. Participation by category in AFOLU emissions in 2018, regional and departmental scale (Own elaboration according to regional and departmental inventory 2018, update in February 2023)

Regarding GHG removals estimated for 2018, most of them are included in category 3B Land, there are also estimates in a new subcategory of the inventory, called 3D.1 Harvested wood products. 88,1% of GHG removals in the Orinoco corresponded to subcategory 3B.1 (Forest land), 10,3% to 3B.2 (Cropland), 1,3% to 3B.3 (Grassland) and 0,3% to 3D.1 Harvested wood products. At the departmental scale, the distribution of removals was similar, with the participation of the cropland subcategory standing out in Meta and Casanare (Table 20 and Figure 43).

Table 20. Participation by sub-category in removals in Orinoquia departments (2018)

| Department | Removals subcategory | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 3B.1. Forest land | | 3B.2. Crop land | | 3B.3. Grasslands | | 3D.1. Recollected Wood products | |
| | Removals (Gg $CO_2$eq) | Percentage | Removals (Gg $CO_2$eq) | Percentage | Removals (Gg $CO_2$eq) | Percentage | Removals (Gg $CO_2$eq) | Percentage |
| Arauca | 640 | 94,0% | 28 | 4,1% | 7 | 1,0% | 6 | 0,9% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Casanare | 1.223 | 87,3% | 164 | 11,7% | 10 | 0,7% | 5 | 0,3% |
| Meta | 2.301 | 78,6% | 536 | 18,3% | 79 | 2,7% | 10 | 0,3% |
| Vichada | 2.145 | 99,5% | 11 | 0,5% | 0 | 0,0% | 0 | 0,0% |
| **Total Orinoquia** | **6.310** | **88,1%** | **739** | **10,3%** | **96** | **1,3%** | **21** | **0,3%** |

Source: Own elaboration according to GHG regional and departmental inventory 2018 (update in February 2023)

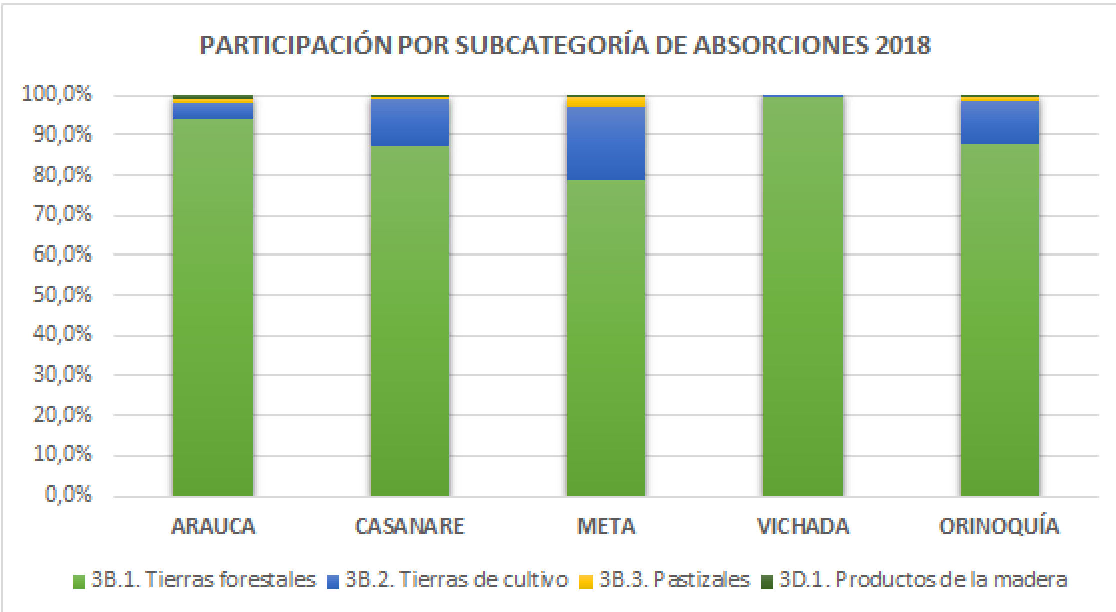


Figure 43. Participation by sub-category in removals 2018, regional and departmental scale (Own elaboration according to regional and departmental inventory 2018, update in February 2023)

The departmental-scale results of total GHG emissions for the AFOLU module, estimated with the 2018 regional inventory data, are synthesized below.

### 4.3.1. **Arauca AFOLU emissions**

59,4% of the GHG emissions of the AFOLU module in the department of Arauca corresponded to the Livestock category (3A), mainly for the subcategory Enteric Fermentation. 31,3% of the AFOLU emissions in Arauca were included in the Land category (3B); in this category the most relevant sources of emissions were Pasture (forest land converted to pasture) and Forest land (remaining forest land). The category Aggregate sources and non-$CO_2$ emissions from land (3C) contributed 9,3% of the AFOLU departmental inventory, with special reference to direct and indirect $N_2O$ emissions from managed soils (Table 21).

Table 21. Participation by category and sub-category in AFOLU emissions in Arauca (2018)

| AFOLU Categories | Total Emissions (Gg $CO_2$eq) | Percentage from AFOLU |
|---|---|---|
| **3A Livestock** | **1839** | **59,4%** |
| 3A.1 Enteric fermentation | 1802 | 58,2% |
| 3A.2 Manure management | 37 | 1,2% |
| 3B Land | **969** | **31,3%** |
| 3B.1 Forest land | 359 | 11,6% |
| 3B.2 Cropland | 40 | 1,3% |
| 3B.3 Grasslands | 529 | 17,1% |
| 3B.4 Wetlands | 32 | 1,0% |
| 3B.5 Settlements | 1 | 0,0% |
| 3B.6 Other land | 8 | 0,3% |
| **3C Aggregate sources and emissions of non-CO2 from land** | **287** | **9,3%** |
| 3C.1 Emissions from biomass burning | 0 | 0,0% |
| 3C.2 Liming | 1 | 0,0% |
| 3C.3 Urea application | 0 | 0,0% |
| 3C.4 Direct N2O emissions from managed soils 3C.5 Indirect N2O emissions from managed soils | 136 | 4,4% |
| 3C.5 Indirect N2O emissions from managed soils 3C.6 Indirect N2O emissions from managed soils | 102 | 3,3% |
| 3C.6 Indirect N2O emissions from manure management 3C.7 Rice farming | 3 | 0,1% |
| 3C.7 Rice cultivation | 45 | 1,4% |
| **Total AFOLU** | **3095** | **100,0%** |

Source: Own elaboration according to GHG regional and departmental inventory 2018 (updated in February 2023)

### 4.3.2. **Casanare AFOLU emissions**

59,3% of the estimated GHG emissions for the AFOLU module in the department of Casanare corresponded to the Livestock category (3A), mainly for the subcategory Enteric fermentation. 15,9% of AFOLU emissions in Casanare were estimated in the Land category (3B), with relevance of the subcategories Forest land (remaining forest land) and Grassland (forest land converted to grassland). Finally, the category Aggregate sources and non-$CO_2$ emissions from land (3C) contributed 24,8% of the department's AFOLU emissions, with the most important subcategory being the direct emissions from rice cultivation (Table 22).

Table 22. Participation by category and sub-category in AFOLU emissions in Casanare (2018)

| AFOLU Categories | Total Emissions (Gg $CO_2$eq) | Percentage from AFOLU |
|---|---|---|
| **3A Livestock** | **3186** | **59,3%** |
| 3A.1 Enteric fermentation | 3131 | 58,3% |
| 3A.2 Manure management | 55 | 1,0% |
| **3B Land** | **855** | **15,9%** |
| 3B.1 Forest land | 408 | 7,6% |
| 3B.2 Cropland | 65 | 1,2% |
| 3B.3 Grasslands | 355 | 6,6% |
| 3B.4 Wetlands | 20 | 0,4% |
| 3B.5 Settlements | 0 | 0,0% |
| 3B.6 Other land | 8 | 0,1% |
| 3C Aggregate sources and emissions of non-CO2 from land | **1332** | **24,8%** |
| 3C.1 Emissions from biomass burning | 0 | 0,0% |
| 3C.2 Liming | 18 | 0,3% |
| 3C.3 Urea application | 8 | 0,1% |
| 3C.4 Direct N2O emissions from managed soils 3C.5 Indirect N2O emissions from managed soils | 212 | 4,0% |
| 3C.5 Indirect N2O emissions from managed soils 3C.6 Indirect N2O emissions from managed soils | 174 | 3,2% |
| 3C.6 Indirect N2O emissions from manure management 3C.7 Rice farming | [ 3 | 0,1% |
| 3C.7 Rice cultivation | 917 | 17,1% |
| **Total AFOLU** | **5373** | **100,0%** |

Source: Own elaboration according to GHG regional and departmental inventory 2018 (update in February 2023)

### 4.3.3. **Meta AFOLU emissions**

84,6% of the estimated GHG emissions for the AFOLU module in the department of Meta corresponded to the Land category (3B), where the most important subcategory was Grasslands (forest land converted to pasture), which contributed almost half of the emissions for the entire AFOLU; the subcategory Forest land (remaining forest land) also stood out. Livestock (3A) accounted for 11,6% of emissions, mainly from the Enteric Fermentation subcategory. Only 3,8% of departmental AFOLU emissions were estimated within the category Aggregate sources and non-$CO_2$ emissions from land (3C), where the largest contributions were in the subcategories Rice cultivation and Direct and indirect N2O emissions from managed soils (Table 23).

Table 23. Participation by category and sub-category in AFOLU emissions in Meta (2018)

| AFOLU Categories | Total Emissions (Gg $CO_2$eq) | Percentage from AFOLU |
|---|---:|---:|
| **3A Livestock** | **3077** | **11,6%** |
| 3A.1 Enteric fermentation | 2990 | 11,3% |
| 3A.2 Manure management | 87 | 0,3% |
| **3B Land** | **22413** | **84,6%** |
| 3B.1 Forest land | 8912 | 33,6% |
| 3B.2 Cropland | 393 | 1,5% |
| 3B.3 Grasslands | 12874 | 48,6% |
| 3B.4 Wetlands | 146 | 0,6% |
| 3B.5 Settlements | 5 | 0,0% |
| 3B.6 Other land | 83 | 0,3% |
| **3C Aggregate sources and emissions of non-CO2 from land** | **995** | **3,8%** |
| 3C.1 Emissions from biomass burning | 2 | 0,0% |
| 3C.2 Liming | 8 | 0,0% |
| 3C.3 Urea application | 4 | 0,0% |
| 3C.4 Direct N2O emissions from managed soils 3C.5 Indirect N2O emissions from managed soils | [ 308 | 1,2% |
| 3C.5 Indirect N2O emissions from managed soils 3C.6 Indirect N2O emissions from managed soils | 210 | 0,8% |
| 3C.6 Indirect N2O emissions from manure management 3C.7 Rice farming | 10 | 0,0% |
| 3C.7 Rice cultivation | 453 | 1,7% |
| **Total AFOLU** | **26486** | **100,0%** |

Source: Own elaboration according to GHG regional and departmental inventory 2018 (update in February 2023)

### 4.3.4. Vichada AFOLU emissions

85,2% of the estimated GHG emissions for the AFOLU module in the department of Vichada corresponded to the Land category (3B), with the most relevant subcategories being Grasslands (forest land converted to grassland) and Forest land (remaining as such). Livestock (3A) accounted for 12,6% of AFOLU emissions in Vichada, mainly for the Enteric Fermentation subcategory. The remaining 2,2% was grouped in the category Aggregate sources and non-$CO_2$ emissions from land (3C), with greater relevance of the subcategories Direct and indirect $N_2O$ emissions from managed soils (Table 24).

Table 24. Participation by category and sub-category in AFOLU emissions in Vichada (2018)

| AFOLU Categories | Total Emissions (Gg $CO_2$eq) | Percentage from AFOLU |
|---|---|---|
| **3A Livestock** | **406** | **12,6%** |
| 3A.1 Enteric fermentation | 400 | 12,4% |
| 3A.2 Manure management | 6 | 0,2% |
| **3B Land** | **2747** | **85,2%** |
| 3B.1 Forest land | 1106 | 34,3% |
| 3B.2 Cropland | 34 | 1,1% |
| 3B.3 Grasslands | 1552 | 48,2% |
| 3B.4 Wetlands | 43 | 1,3% |
| 3B.5 Settlements | 1 | 0,0% |
| 3B.6 Other land | 11 | 0,3% |
| **3C Aggregate sources and emissions of non-CO2 from land** | **69** | **2,2%** |
| 3C.1 Emissions from biomass burning | 0 | 0,0% |
| 3C.2 Liming | [ 0 | 0,0% |
| 3C.3 Urea application | 0 | 0,0% |
| 3C.4 Direct N2O emissions from managed soils 3C.5 Indirect N2O emissions from managed soils | 40 | 1,2% |
| 3C.5 Indirect N2O emissions from managed soils 3C.6 Indirect N2O emissions from managed soils | 28 | 0,9% |

| AFOLU Categories | Total Emissions (Gg $CO_2$eq) | Percentage from AFOLU |
|---|---|---|
| 3C.6 Indirect N2O emissions from manure management 3C.7 Rice farming | 0 | 0,0% |
| 3C.7 Rice cultivation | 1 | 0,0% |
| Total AFOLU | **3223** | **100,0%** |

Source: Own elaboration according to GHG regional and departmental inventory 2018 (updated in February 2023)

### 4.3.5. Relevant results summary

Table 15 presents a summary of the main conclusions on the results of the inventory of AFOLU emissions and removals in the four departments of the Orinoco region, considered as a key input for the identification of causes and agents, mitigation priorities, and the development of measures and actions achieving effective emission reductions in each department and in the region as a whole.

Table 25. Relevant results for AFOLU emissions and removals in Orinoquia departments (2018)

| GHG Category | Department | Main Findings |
|---|---|---|
| **AFOLU Emissions** | Meta, Vichada | Most of the departmental emissions corresponded to the **conversion of forest to pasture** and, to a lesser extent, forest land remaining as such. |
| | Casanare, Arauca | Most of the departmental emissions corresponded to **enteric fermentation** of cattle. Other relevant sources were the conversion of forests to pasture, forest lands remaining as such, direct emissions from rice cultivation, and nitrogen fertilization of soils. |
| **AFOLU Removals** | Vichada, Arauca | GHG removals were concentrated in the forest land subcategory. |
| | Meta, Casanare | GHG removals were concentrated in the forest land subcategory and, to a lesser extent, cropland. |

Source: Own elaboration according to GHG regional and departmental inventory 2018 (update in February 2023)

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# 5. CHARACTERIZATION OF CAUSES AND AGENTS OF DEFORESTATION IN THE ORINOCO REGION

According to the available information and the regional and departmental profile of GHG emissions and removals (presented in Chapter 5), the most relevant sources were defined in each case, identifying the most pertinent elements of the characterization of causes and agents, and of intervention for the design of effective measures and actions.

- The explicit information available, generated by IDEAM's SMByC, has prioritized the depth of the analyses related to the **multitemporal dynamics of deforestation**. Considering the importance of deforestation as a source of AFOLU emissions in the Orinoco region, these analyses represented a starting point to conduct the characterization of the drivers of GHG emissions and removals in the AFOLU component (described in Chapters 7 and 8, respectively).
- Spatial information for different periods, related to the **specification of coverage changes** in non-forest and other land cover changes, has generated adjustments in the GHG inventory of the region and complements the analysis of causes and agents.
- Most of the emissions in Meta and Vichada correspond to the **transformation of forests to pastures** and, to a lesser extent, forest lands that remain as such. This gives priority to deforestation as the main source of emissions in these departments, especially in the areas corresponding to the Amazon biome: southern Meta and, with a much lesser impact, the southern area of the municipality of Cumaribo, Vichada.
- In Casanare and Arauca, the main source of emissions is **enteric fermentation** of cattle. Other sources are the conversion of forests into pastures, forest lands remaining as such, direct emissions from rice cultivation and nitrogen fertilization of soils. In these departments the sources of AFOLU emissions are more distributed, but the central axis continues to be livestock activity, deforestation for their establishment and fertilization to sustain grazing areas.
- In Vichada and Arauca, **GHG removals** are concentrated in the forest land subcategory, while in Meta and Casanare, cropland is also of some relevance. This should be considered for the definition of interventions in the production chains prioritized by the project (rice, cacao, forestry, livestock, marañon and palm oil).

Deforestation is the most important source of GHG emissions in the Orinoco region. Therefore, the characterization of the causes and agents of emissions in the region necessarily requires the analysis of deforestation dynamics, in terms of quantity and location.

## 5.1. High Deforestation hotspots[168] (NAD) 2019

The SMByC identified six hotspots that concentrated deforestation in 2019 in the Orinoco region (Figure 44). However, due to their characteristics and for the purpose of this characterization, these six hotspots are grouped into four main zones: 1) southwestern Meta area comprising the entire extension of the NAD Sur del Meta and part of two other areas of the Amazon deforestation arc (NAD Sabanas del Yarí-Bajo Caguán and NAD Guaviare-Marginal de la selva); 2) NAD Mapiripán (Meta) of the Amazon deforestation arc, with adjustment to the region's cut; 3) NAD Sarare (Arauca) and 4) NAD Cumaribo (Vichada). These areas concentrated 69,6% of Orinoco deforestation and 17,1% of national deforestation in 2019 (IDEAM 2020).

### 5.1.1. Hotspot 1: Southwestern zone of Meta

This area was highly affected by natural forests deforestation, including protected areas such as La Macarena and Tinigua National Parks, mainly due to logging for land grabbing and unsustainable extensive cattle ranching practices. There were also areas affected by illicit crops, but with a tendency to reduce them (ODC 2020). The informal expansion of road infrastructure, burning that resulted in forest fires, and the presence of illegal armed groups have all contributed to the persistent loss of forest throughout the area (Figure 45).

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[168] A hotspot of high deforestation is defined as a geographic area where significant concentrations of deforested areas are present in a specific reference period (González et al. 2018a).

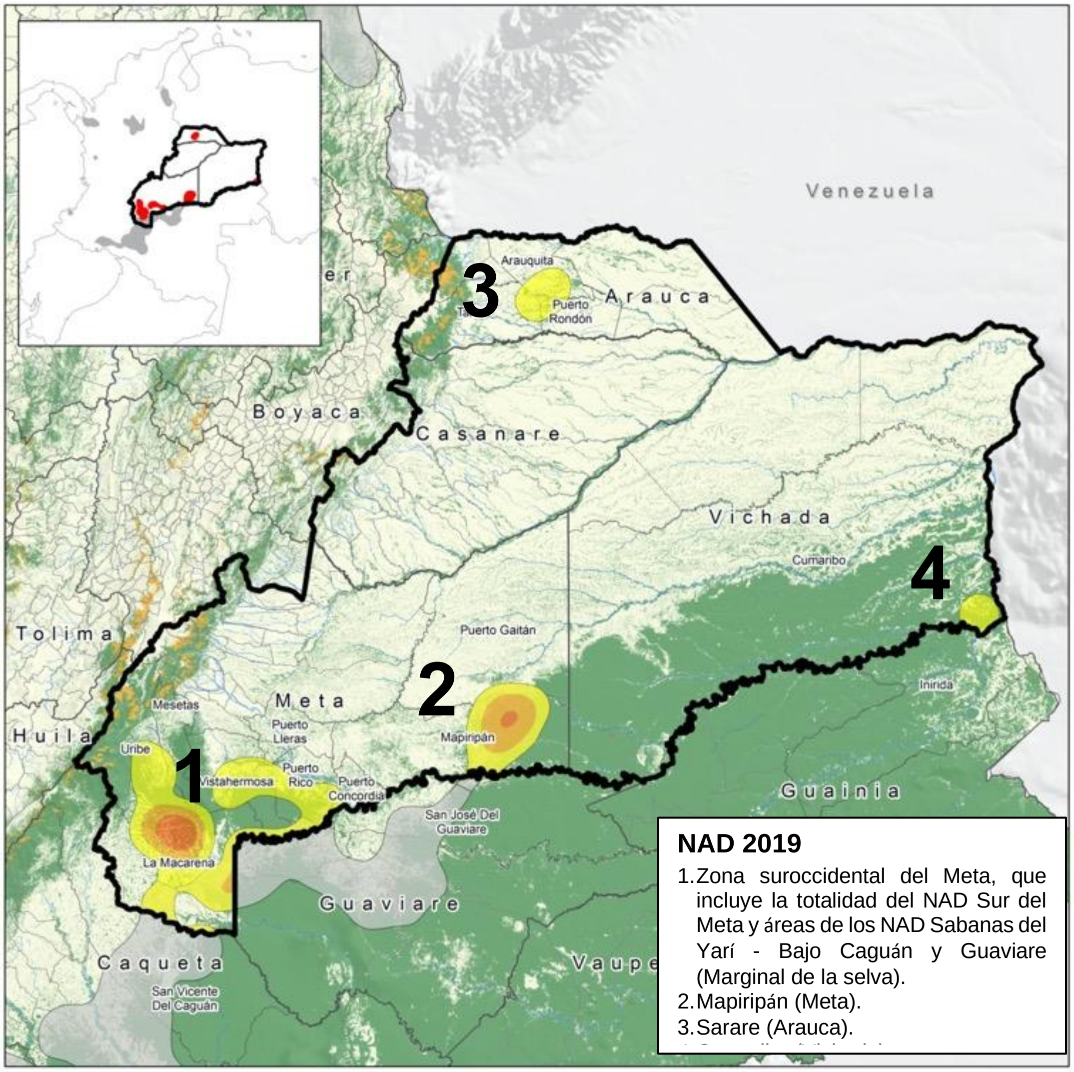


Figure 44. Hotspots of high deforestation identified in Orinoquia, 2019 (Own elaboration according to IDEAM, 2020)

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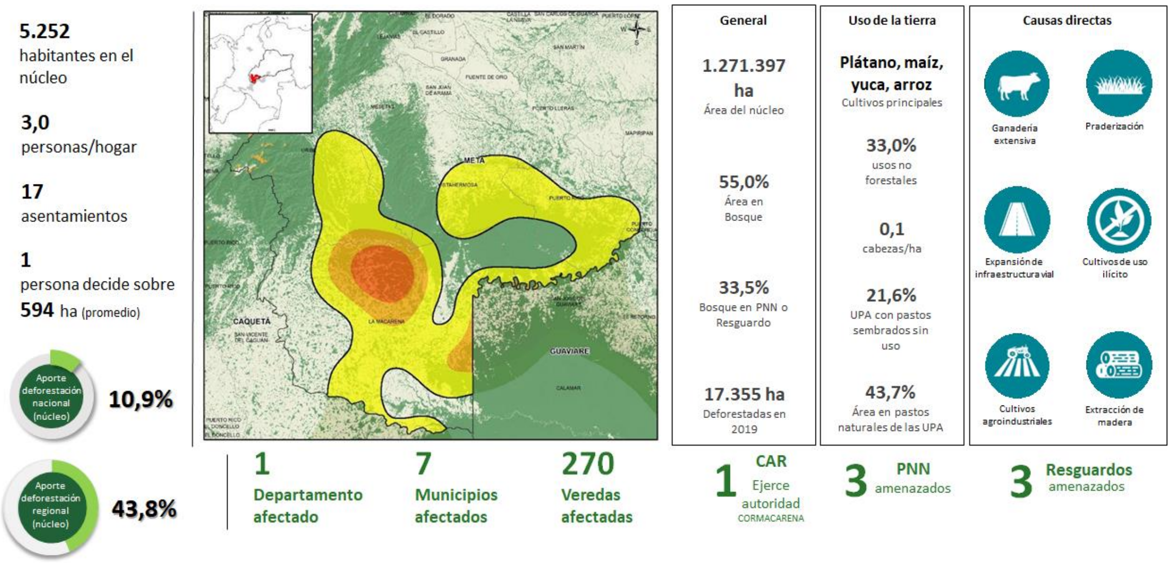


Figure 45. High deforestation hotspot characteristics 2019 “Southwest Meta zone” (Own elaboration according to IDEAM 2020 and DANE 2014)

### 5.1.2. Hotspot 2: Mapiripán (Meta)

The hotspot corresponds to an area on the border between the Amazon biome and the Orinoco, a region where threats to natural forests were identified in relation to the expansion of extensive cattle ranching (based on the replacement of savannahs or forests with technically improved grasslands) and agro-industrial crops. An informal land-grabbing market has been consolidated in the area, managed by large investors, which has put pressure on small producers to move into new areas of forest. Illicit crops continued to show a downward trend (ODC 2020), but still remain a threat to natural forests in the area (Figure 46).

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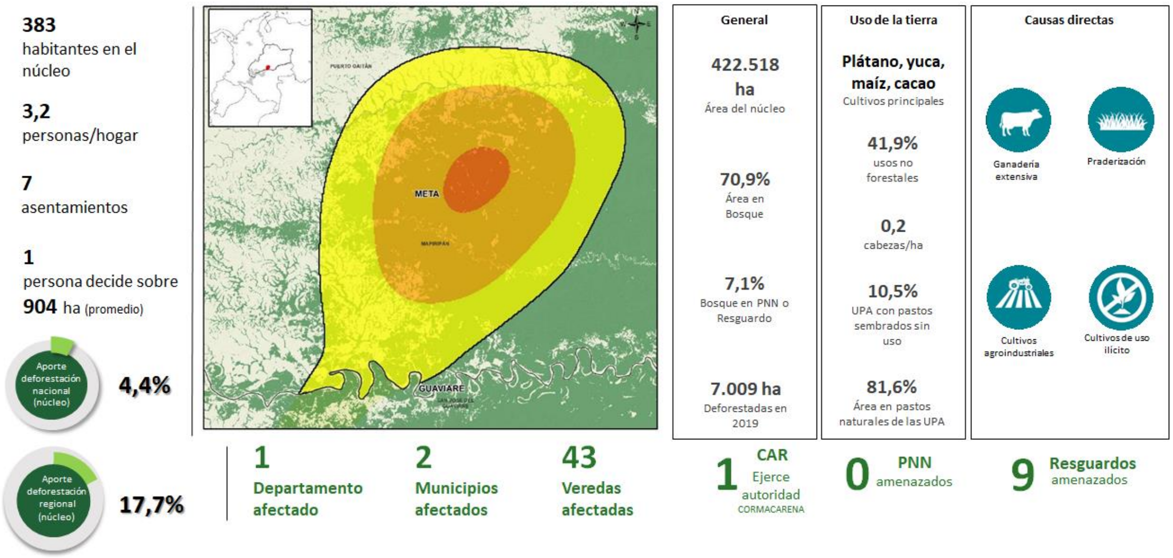


Figure 46. High deforestation hotspot characteristics 2019 “Mapiripán (Meta)” (Own elaboration according to IDEAM 2020 and DANE 2014)

### 5.1.3. **Hotspot 3: Sarare (Arauca)**

The establishment of pastures for cattle ranching continues to be one of the most representative economic activities in the area. Bad practices related to this activity continue to expand, starting from previously intervened areas, over natural savannahs and remaining forests with a high degree of fragmentation that connect grazing areas. In general, extensive breeding and fattening systems were identified, with low stocking capacities, as well as semi-intensive systems that incorporate more technology related to pasture management, genetics and health. The expansion of unplanned road infrastructure, associated with productive activities, boosted deforestation in the area (Figure 47).

### 5.1.4. **Hotspot 4: Cumaribo (Vichada)**

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Small-scale production systems were identified, which are related to subsistence activities and the generation of surpluses from the cultivation of some coca fields on soils unsuitable for agriculture. These activities generated pressures on the area's ecosystems, which led to slash-and-burn practices for the establishment of illicit crops and pastures for extensive cattle ranching. Some forest cover loss events in the area may have been related to natural seasonal flooding of nearby rivers (Orinoco, Guaviare and some tributaries) (Figure 48).

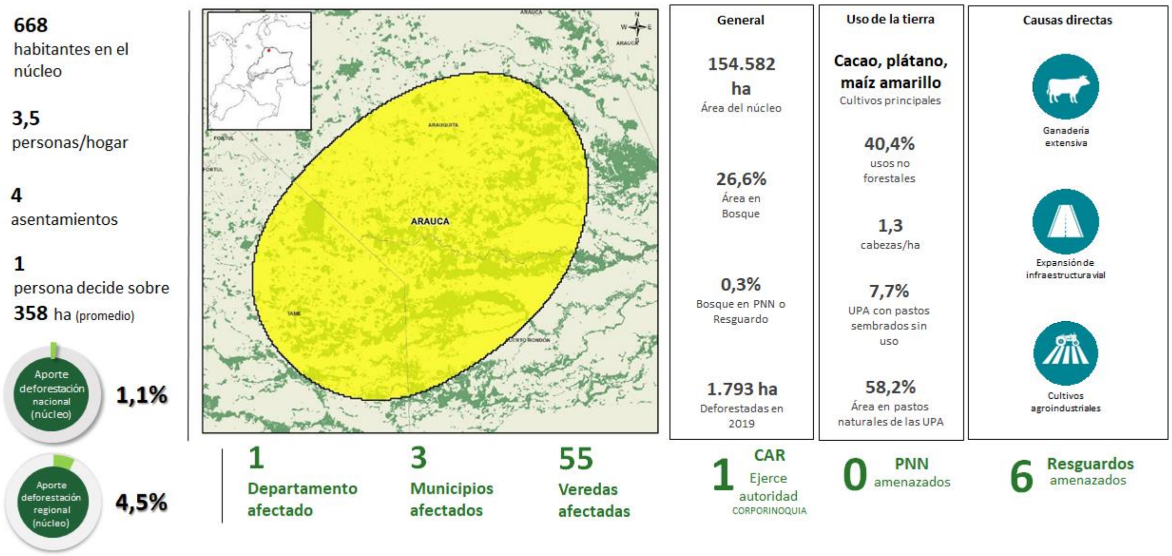


Figure 47. High deforestation hotspot characteristics 2019 “Sarare (Arauca)” (Own elaboration according to IDEAM 2020 and DANE 2014)

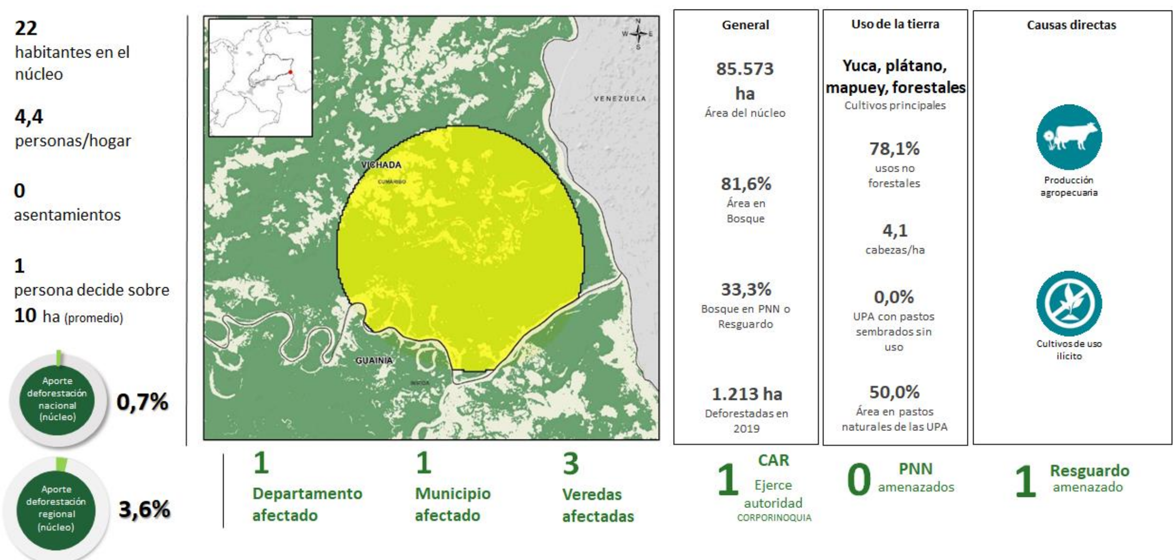


Figure 48. High deforestation hotspot characteristics 2019 “Cumaribo (Vichada)” (Own elaboration according to IDEAM 2020 and DANE 2014)

## 5.2. Deforestation causes and agents by department

The dynamics of the causes and agents of deforestation are similar in the four departments that make up the region. However, the patterns of deforestation and the importance of the causes differ in each case. Figure 49 presents a first approximation of the relative importance of the direct causes of deforestation by department, based on a descriptive analysis of aspects such as the area dedicated to the activity, its economic importance, its direct and indirect impact on the forest, among others.

The main direct cause of deforestation in the four departments is the use of woodlands for land grabbing and/or the establishment of extensive cattle ranching systems. Agriculture occurs at different scales, but the greatest impact on deforestation is linked to the expansion of agro-industrial crops (with the exception of Vichada, where the predominant agricultural activity is small-scale).

According to information from ODC (2020) for 2019 no areas with coca crops are identified in Casanare and Arauca; in Vichada they have a tendency to disappear and in Meta they show a trend of reduction since 2018. Timber extraction and mineral extraction are causes of reduced direct impact in terms of deforestation.

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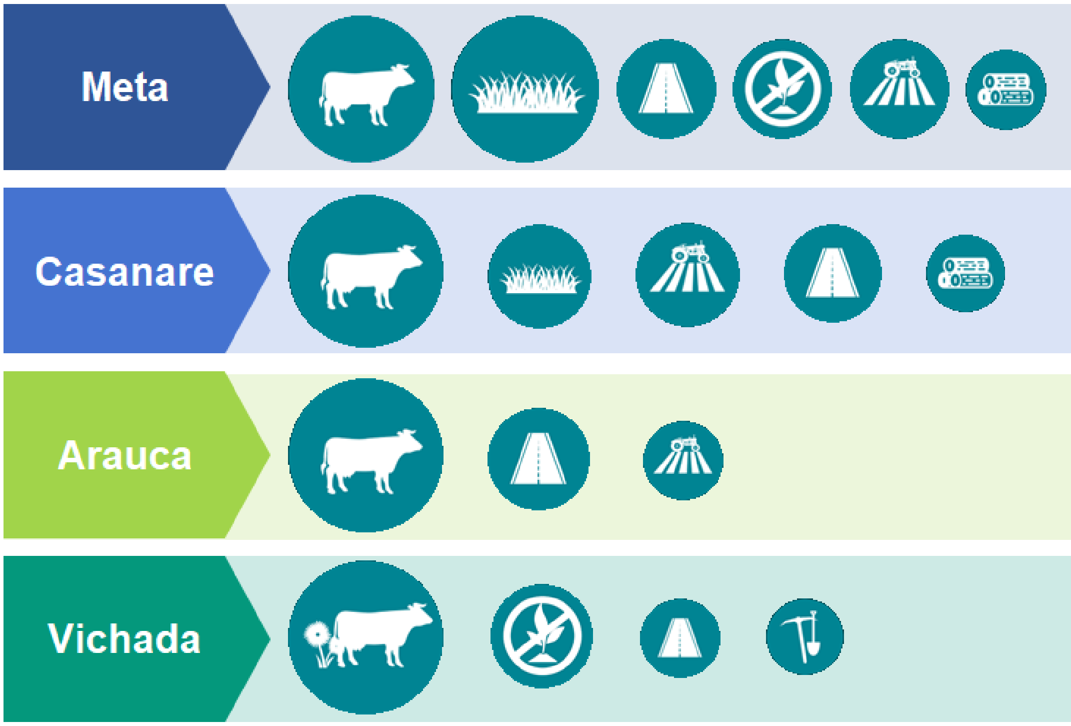


Figure 49. Main direct causes of deforestation and their importance in Orinoquia departments (Own elaboration)

### 5.2.1. Meta Department

The main direct cause of deforestation in the department is the expansion of the agricultural frontier, which can take the form of extensive cattle ranching/grazing land, agricultural production on different scales, or illicit crops. The expansion of transportation infrastructure has an important indirect impact by allowing other causes to enter new forest areas, and timber extraction generates more specific impacts.

- **Agricultural frontier expansion**
  - **Livestock/Forestry:** The establishment of pastures for cattle ranching is a deeply rooted activity in the department and is a profitable economic alternative for local producers and investors from other regions because of its relatively low costs and the high demand for livestock products in the country. The activity is developed at different scales and affects different types of ecosystems, from the Andean forests and the foothills of the eastern mountain range to the gallery forests of the high-plains; it also affects the humid forest in the south of the department, corresponding to the transition with the Amazon biome. The fires are associated with the establishment of pastures, an activity used for extensive livestock production and/or land grabbing

- **Agricultural production:** Agricultural production can be differentiated according to the scale in two groups. First, small-scale agricultural production is based on the cultivation of short-cycle crops for the production of food for sale and self-consumption, especially bananas, corn, cassava and vegetables. The impacts of this activity are occasional, but may require larger extensions of land where the soils exhaust their productive capacity. In second place is industrial agricultural production, which is characterized by the use of large extensions of land for the establishment of mono-crop systems, mainly of African palm, rice and some citrus fruits
- **Crops of illicit use:** Coca cultivation is mainly due to the pressure generated by illegal armed groups on local inhabitants and the continuity of the activity in the absence of viable productive alternatives. According to figures from the annual monitoring of areas cultivated with coca, conducted by the United Nations Office on Drugs and Crime (UNODC), this activity shows a trend of reduction in the department of Meta as of 2018, with the municipalities of Puerto Rico and Vistahermosa being mainly affected; in protected areas the affectation continues mainly in the PNN Sierra de La Macarena, but also shows a trend of reduction since 2018 (ODC 2020).

- **Transport infrastructure expansion:** The construction of land accesses generates a high impact in terms of deforestation, causing a double threat. On one hand, it directly affects the forests that are removed accelerating their fragmentation and, on the other hand, it allows access to other agents of deforestation and generates speculation in land prices. This second effect is highly relevant in Meta, mainly in the south of the department, where the expansion and/or improvement of roads of all levels (both formal and informal) is associated with new fronts of expansion of the agricultural frontier and deforestation.
- **Wood extraction:** It is considered a less relevant cause in the department, based mainly on informal systems for local timber use or commercialization at different scales. In the latter case, extraction is selective and focused on species with high market value, with the municipalities of Vistahermosa, Puerto Rico and Mapiripán being particularly affected.

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### 5.2.2. Casanare Department

The expansion of the agricultural frontier to establish extensive cattle ranching systems is the main cause of deforestation in Casanare. Agriculture, in different scales, has a lesser impact on forests. These expansion processes continue to be boosted by the expansion of transportation infrastructure.

- **Agricultural frontier expansion**
  - **Livestock/Forestry:** Cattle ranching has been historically linked to the economic and cultural development of Casanare, to the point that it is one

    of the first departments in terms of herd size (number of heads) at the national level. The systems are mainly extensive with an emphasis on beef cattle production, affecting natural savannah and gallery forest ecosystems; the greatest stocking capacities are achieved with introduced pastures that require fertilization and management practices. Fires are associated with the practice of burning for pasture renewal and establishment.

  - **Agriculture production:** Small-scale agriculture is based on the production of food for self-consumption and the sale of surpluses; mainly bananas, cassava, corn and coffee are grown. Impacts at this scale are occasional, but may require larger extensions of land where soils exhaust their capacity. Industrial agricultural production is characterized by the use of large extensions of land for the establishment of mono-crop systems, especially rice and African palm; at the departmental level, these two monocultures continue to be a priority and have ample incentives for their development, as does cattle ranching.

- **Road infrastructure associated with hydrocarbons expansion:** The formal and informal construction of land accesses in the department continues to generate some impact in terms of deforestation. On the one hand, it directly affects the forests that are removed for their establishment, accelerating fragmentation processes, and on the other hand, it allows access to other agents of deforestation, mainly cattle ranchers and agro-industrialists.

- **Infrastructure associated with settlement expansions:** The demographic growth of the department's urban centers, particularly the city of Yopal, has in recent years, generated greater pressure on the remaining forests in the urban expansion zones. This is enhanced by the need for connectivity between these new settlements.

- **Wood extraction:** In rural areas of Casanare, informal timber extraction for self-consumption is still common, being used as fuel or construction material. The impact is more related to forest degradation than to deforestation processes.

### 5.2.3. **Arauca Department**

The loss of natural forests in the department of Arauca is directly related to the expansion of the agricultural frontier, specifically the extensive production of cattle. These expansion processes are also stimulated by the opening or improvement of road infrastructure.

- **Agricultural frontier expansion (livestock):** The establishment of pastures dedicated to cattle ranching is one of the most representative economic activities in the department. Cattle ranching intensified and became widespread in Arauca as a result of colonization since the mid-20th century, and currently represents the main land use, constantly threatening natural savannah and forest cover, which is highly fragmented and generally surrounded by grazing areas. There are extensive breeding and fattening systems, with low stocking capacities, as well as semi-intensive systems that incorporate more technology related to pasture management, genetics and health.

- **Transport infrastructure expansion:** Hydrocarbon exploitation has intensified in the department since the end of the 20th century, becoming one of the main sectors of its economy. The expansion of road infrastructure associated with the extraction and transportation of hydrocarbons and other productive activities has boosted the region's economy, but has also allowed access to new areas of forest with the consequent deforestation (mainly for agricultural and livestock use).

### 5.2.4. Vichada Department

The expansion of the agricultural frontier is the main direct cause of deforestation in Vichada. It is especially related to extensive cattle production and, in some areas, to agricultural production on different scales. The legal crops remain in smaller areas and are tending to disappear in the department. Mineral extraction and the expansion of road infrastructure represent more of a potential threat to the remaining forests.

- **Agricultural frontier expansion**
    - **Extensive livestock:** The main productive activity in Vichada is cattle ranching, which occupies a large part of the natural savannahs in the high-plains. Cattle are generally raised in super-extensive systems (densities of less than 0,5 head of cattle per hectare), without the incorporation of technology and with low productivity levels. Despite the level of adaptation of the production systems to the conditions of their environment, this activity still represents a constant threat to the department's gallery forests.
    - **Agriculture production:** Small-scale agriculture is associated with the settlements; it is based on the production of cassava, corn, plantain, and bread crops, among others, for subsistence purposes and with a reduced and dispersed impact on the forests. The establishment of agro-industrial crops has been encouraged in recent decades due to the high availability of low-cost land. Currently, mono-crops of African palm, soybean, cocoa and forest plantations (pine, acacia, eucalyptus and rubber) are the most important. These activities put pressure on the forests associated with savannah ecosystems through burns that can lead to forest fires and the expansion of road infrastructure for product movement.
    - **Crops of illicit use:** According to UNODC annual reports, coca production in Vichada has been declining rapidly since 2009 and reached 245 ha in 2019. However, the potential impact of illicit crops on the forests of the municipality of Cumaribo, where the totality of the activity in the department

is concentrated, must be considered. In this municipality, coca crops remain in two main areas, north of the Vichada River in Palmarito, and south of the same river in the population centers of Chupave and Puerto Príncipe (ODC 2020).

- **Mineral extraction:** Mineral extraction in the department of Vichada has become an activity of growing interest in recent years, particularly due to the existence of mineral deposits known as rare earths. There is extraction of construction materials, rare minerals (coltan, tungsten) and gold, mainly in the municipalities of Cumaribo (Vichada river basin) and Puerto Carreño (ANM 2019). Although some of this activity is developed traditionally and without affecting the landscape, mechanized practices represent a potential threat to forest cover.
- **Transport infrastructure expansion:** Oil fields are found in Vichada, which are concentrated in the savannah zones in the north of the department (ANH 2018). This activity may represent a potential threat to gallery forests and their associated ecosystems, due to the fact that access roads are required which, indirectly, may allow the entry of other deforestation agents.

## 5.3. Analysis of the relationship between deforestation and livestock expansion

The historical trend of regional and departmental INGEI indicates an increase in regional emissions for the AFOLU module starting in 2017. This coincides with the increase in the livestock herd (Figure 50) and deforestation (Figure 51) at the regional scale, starting in the same year. It is important to highlight that deforestation in the Orinoco is conditioned by the magnitude of the phenomenon in the department of Meta, especially in its southern zone. In this period, the effects of the peace process with the FARC and the signing of the final Agreement with the national government at the end of 2016 are evident, on the access and transformation of territories with high ecological importance.

In this context, there are coincidences between the increase in the cattle herd and deforestation in specific areas of the Colombian Orinoco.[The increase in the cattle herd seems to be related to the massive arrival of large numbers of cattle to new areas of expansion within the region, mainly in the departments of Meta and Casanare; but there is also the possibility that it is due to improved access to areas previously restricted by the armed conflict which has allowed the vaccination of cattle against foot-and-mouth disease.

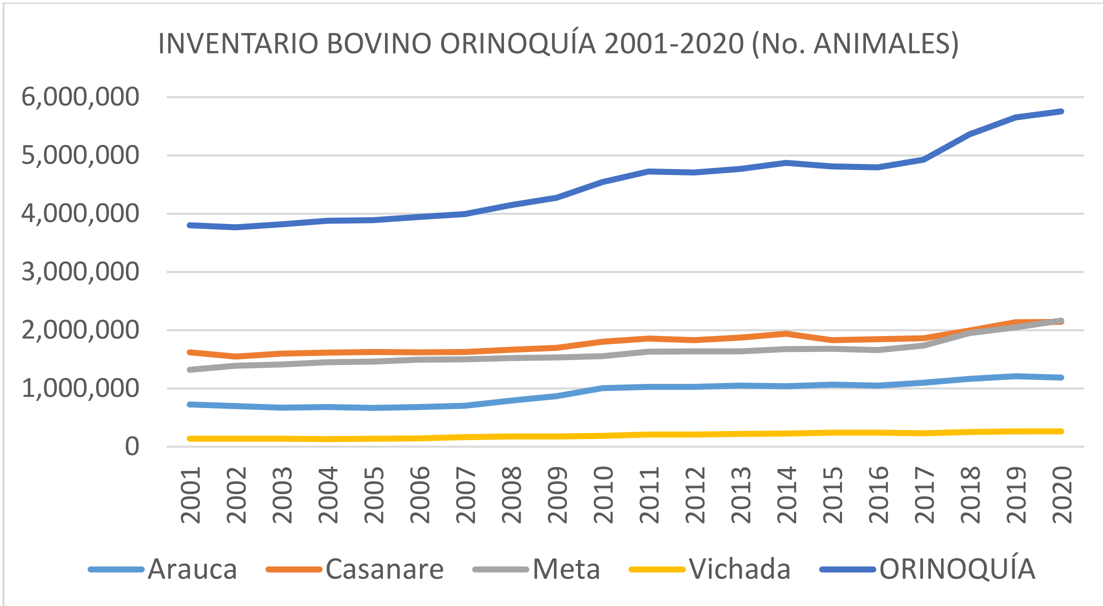


Figure 50. Cattle inventory at departmental and regional level (Orinoco), 2001-2020 (FEDEGAN-FNG 2020, data 2001-2015; ICA 2020, data 2016-2020).

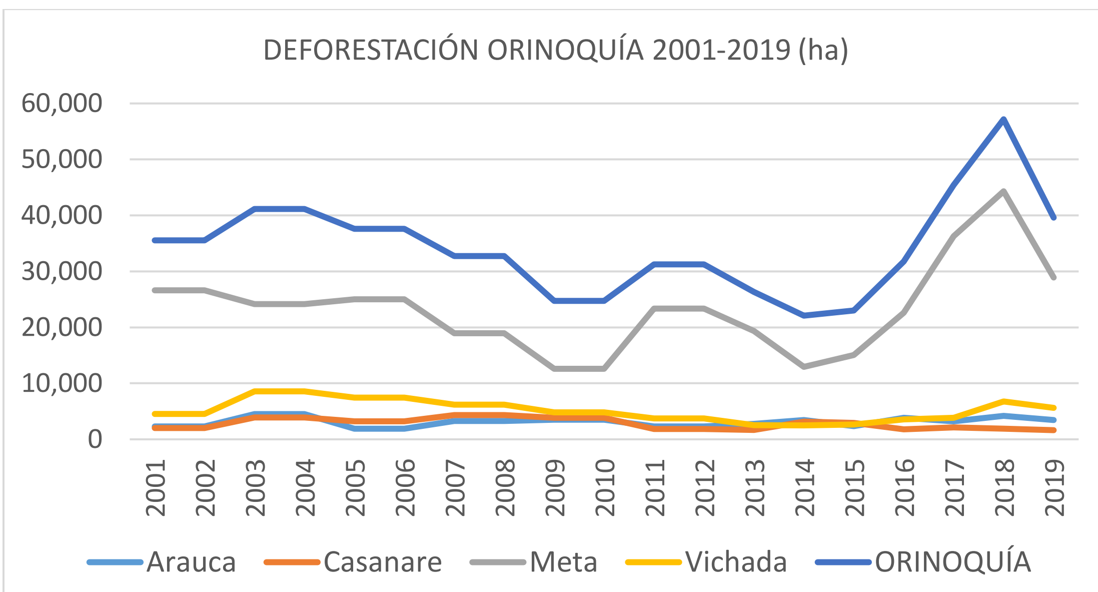


Figure 51. Annual deforestation at departmental and regional scale (Orinoco), 2001-2019 (IDEAM 2020)

The information available for livestock, deforestation and regional AFOLU emissions, allowed identifying important trends in the behavior of key variables for the recent period (2015-2019). Of the 59 municipalities that make up the four departments of the region, six of them presented the highest levels of deforestation during the period. Of this group of key municipalities, five belong to the department of Meta (La Macarena, Mapiripán, Uribe, Puerto Rico and Vistahermosa) and one to the department of Vichada (Cumaribo). In general, they presented large increases in deforestation, heads of cattle and land with cattle between 2016 and 2019 (Table 26).

Table 26. Deforestation, bovine inventory and properties in the municipalities of the Orinoco region with the highest deforestation 2015-2019

| MUNICIPALITY | Defor. 2015-2019 (ha) | Defor. 2016 (ha) | Defor. 2019 (ha) | Change (%) | Cattle 2016 (No.) | Cattle 2019 (No.) | Change (%) | Properties 2016 (No.) | Properties 2019 (No.) | Change (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| La Macarena | 54.216 | 5.278 | 11.304 | 114% | 44.871 | 163.397 | 264% | 493 | 1.500 | 204% |
| Mapiripán | 24.112 | 2.033 | 8.011 | 294% | 65.262 | 108.744 | 67% | 372 | 662 | 78% |
| Uribe | 22.674 | 7.405 | 2.443 | -67% | 26.000 | 57.213 | 120% | 255 | 625 | 145% |
| Cumaribo | 20.914 | 3.383 | 5.251 | 55% | 46.438 | 56.604 | 22% | 489 | 574 | 17% |
| Puerto Rico | 15.542 | 2.067 | 2.181 | 5% | 53.000 | 82.831 | 56% | 440 | 816 | 85% |
| Vistahermosa | 13.775 | 1.192 | 2.606 | 119% | 79.000 | 129.432 | 64% | 840 | 1.292 | 54% |
| **TOTAL MUNICIPALITIES** | **151.234** | **21.357** | **31.796** | **49%** | **314.571** | **598.221** | **90%** | **2.889** | **5.469** | **89%** |
| **REGION** | **197.062** | **31.775** | **39.618** | **25%** | **4.796.549** | **5.652.538** | **18%** | **38.138** | **44.285** | **16%** |
| **Municipalities participation** | **76,7%** | **67,2%** | **80,3%** | | **6,6%** | **10,6%** | | **7,6%** | **12,3%** | |

Source: Own elaboration according to information for deforestation from IDEAM (2020) and for cattle and properties from ICA (2020)

In the period 2015-2019 these six municipalities concentrated 77% of cumulative regional deforestation, increasing from 67% in 2016 to 80% in 2019. Significant increases in deforestation are observed in La Macarena, Mapiripán and Vistahermosa, which are areas recurrently reported as high deforestation nuclei (NAD). There were also increases in livestock and land with livestock in La Macarena and Uribe, but in the latter case deforestation was reduced during the same period. This may be because some of the cattle are vaccinated in the municipality, but then move on to new farms in other municipalities such as La Macarena. The situation in La Macarena is of concern, considering that most of its territory corresponds to protected areas.

Finally, it is important to highlight that in these six municipalities there was a 90% increase in the livestock inventory and 89% increase in the number of properties with cattle in the period 2015-2019, compared to regional increases of 18% and

16%, respectively, in the same period. By 2019, the prioritized municipalities only accounted for 11% of the livestock and 12% of the livestock farms in the Orinoco region.

## 5.4. Coca crops and deforestation relationship analysis

Figure 52 shows the behavior of the areas with coca crops in the Orinoco region (regional total and departments) compared to deforestation in the period 2011-2019[169]. According to the information generated annually by the Integrated Illicit Crop Monitoring System (SIMCI) of the United Nations Office on Drugs and Crime (UNODC), illicit crops have largely decreased in the region since 2017, only with persistence in some areas of the department of Meta, especially in the municipalities of Puerto Rico and Vistahermosa, and in the municipality of Cumaribo (Vichada). Casanare had no presence of coca cultivation in the period and Arauca reached zero affectations in 2019 (ODC 2020). Therefore, coca cultivation decreased its relevance as a cause of deforestation in the Orinoco region.

The same municipalities that concentrated deforestation in the region (80% in 2019), concentrated the areas under coca cultivation (97,5% in 2019). However, in these municipalities there has been a large reduction in the expansion of cultivation between 2016 and 2019, equivalent to 72% in area (equal to the regional reduction). As previously mentioned, the greatest persistence of cultivation is in the municipalities of Puerto Rico and Vistahermosa (Meta), mainly in areas belonging to the Sierra de La Macarena National Park (Table 27).

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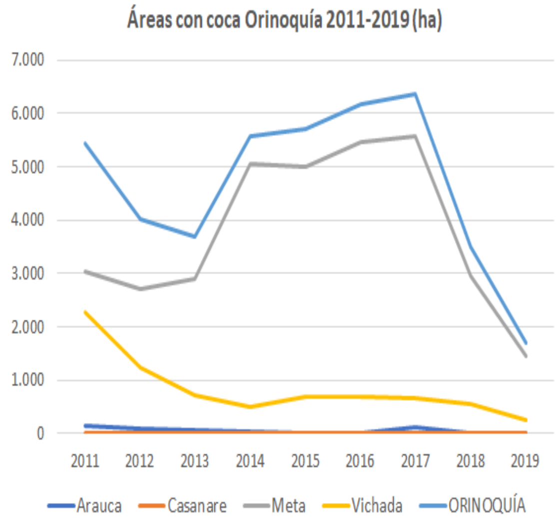
[169] This period is shorter than the one used for livestock, because coca serie is comparable just as of 2018



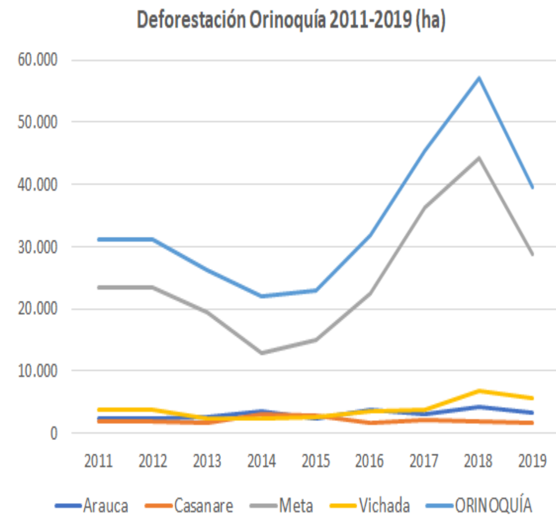




Figure 52. Areas under coca cultivation and annual deforestation at departmental and regional level (Orinoco), 2011-2019 (ODC 2020, data for coca; IDEAM 2020, data for deforestation).

Table 27. Deforestation and coca cultivated areas in the municipalities of the Orinoco region with the highest deforestation 2015-2019

| MUNICIPALITY | Defor. 2015-2019 (ha) | Defor. 2016 (ha) | Defor. 2019 (ha) | Change (%) | Coca area 2016 (ha) | Coca area 2019 (ha) | Change (%) |
|---|---|---|---|---|---|---|---|
| La Macarena | 54.216 | 5.278 | 11.304 | 114% | 1.635 | 178 | -89% |
| Mapiripán | 24.112 | 2.033 | 8.011 | 294% | 338 | 135 | -60% |
| Uribe | 22.674 | 7.405 | 2.443 | -67% | 202 | 5 | -98% |
| Cumaribo | 20.914 | 3.383 | 5.251 | 55% | 699 | 245 | -65% |
| Puerto Rico | 15.542 | 2.067 | 2.181 | 5% | 1.593 | 617 | -61% |
| Vistahermosa | 13.775 | 1.192 | 2.606 | 119% | 1.451 | 488 | -66% |
| **TOTAL MUNICIPALITIES** | **151.234** | **21.357** | **31.796** | **49%** | **5.919** | **1.668** | **-72%** |
| **REGION** | **197.062** | **31.775** | **39.618** | **25%** | **6.172** | **1.711** | **-72%** |
| **Municipalities participation** | **76,7%** | **67,2%** | **80,3%** | | **95,9%** | **97,5%** | |

Source: Own elaboration with information from IDEAM (2020) for deforestation and ODC (2020) for coca cultivated areas.

## 5.5. Deforestation and terrestrial accessibility relationship analysis

One of the main causes historically related to deforestation in the country is the expansion and/or improvement of road accesses. Through the spatial analysis developed by IDEAM's SMByC, it was possible to identify the distance relationship between the deforested areas during the 2010-2019 period and the roads in the Orinoco; for this purpose, the forest cover change layers generated annually by the SMByC and the official road layer for 2019 available in the IGAC geoportal were used.

Table 28 shows that during the period analyzed (2010-2019) the largest amount of deforested area was identified between 1 and 5 kilometers away from a road (123.789 ha, corresponding to 41,4% of the total deforested in the region). In general terms, there is a trend of less deforested area as the distance from the road increases. 92% of regional deforestation occurred at distances of up to 10 km and 98% at distances of up to 20 km.

Table 28. Deforestation (2010-2019) by ranges of distance to land routes (2019) in the Orinoco region.

| Road distance range | Deforestation (ha) | Deforestation (%) | Cumulative deforestation (%) |
|---|---|---|---|
| < 1 km | 107.633 | 36,0% | |
| >1 km y < 5 km | 123.789 | 41,4% | 77,4% |
| > 5 km y < 10 km | 42.823 | 14,3% | 91,7% |
| > 10 km y < 20 km | 17.562 | 5,9% | 97.6% |
| > 20 km | 7.217 | 2,4% | 100,0% |

Source: Own elaboration with information from IDEAM (2020) for deforestation and IGAC (2019) for roads.

IDEAM's SMByC has developed the interpretation of land accessibility in prioritized areas in order to characterize their relationship with deforestation dynamics. In the Orinoco region, information is available on land access in the main high deforestation areas (NAD) of the region: southwestern Meta and the municipality of Mapiripán (Meta).

When analyzing the spatial relationship between distance to land accesses and deforested areas in the main NADs (Figure 53), it was identified that most of the areas transformed during the 2010-2019 period (78,3%) are located less than 1 km away from the accesses, and 97% of the deforestation accumulated up to a distance of 5 km from the accesses (Table 29). Comparing the results obtained in relation to land accesses at the NAD level and roads at the regional scale, there is evidence of a higher proportion of deforested areas in the NADs in shorter distances to land accesses, unlike the same analysis performed with official roads for the region as a whole.

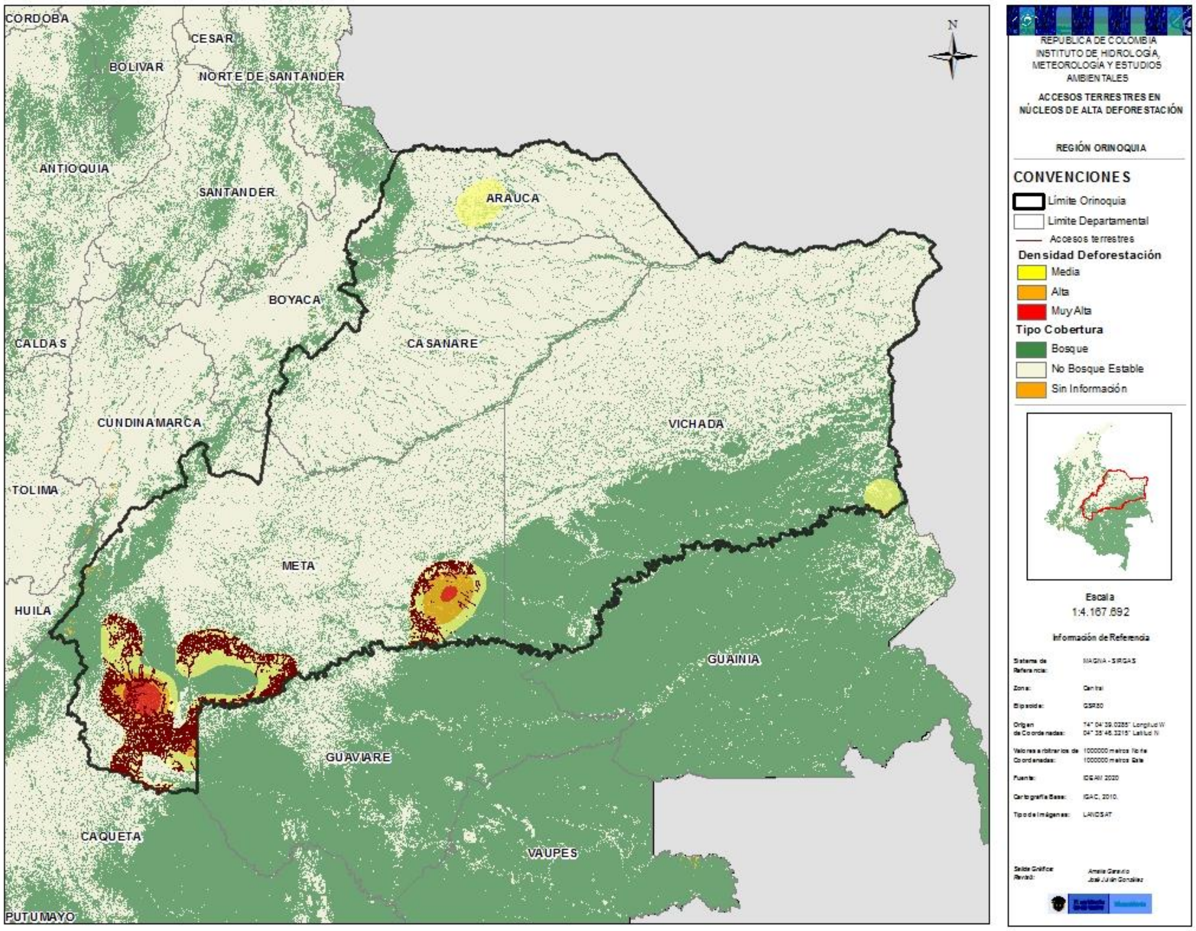



Figure 53. Land accesses in the main NADs of the Orinoco region (Own elaboration according to IDEAM 2020).

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Table 29. Deforestation (2010-2019) by range of distance to land access in the main NADs of the Orinoco region.

| Range distance to roads | Deforestation (%) | Cumulative deforestation (%) |
|---|---|---|
| < 1 km | 78,3% | |
| > 1 km y < 3 km | 14,1% | 92,4% |
| > 3 km y < 5 km | 4,4% | 96,8% |

| | | |
|---|---|---|
| > 5 km y < 10 km | 2,1% | 98,9% |
| > 10 km y < 20 km | 1,1% | 100,0% |
| > 20 km | 0,0% | 100,0% |

Source: Own elaboration with information from IDEAM (2020) for deforestation and IGAC (2019) for roads

## 5.6. Deforestation and population dynamics relationship analysis

The most recent information from the National Population and Housing Census (DANE 2018) indicates a high level of permanence of the dispersed rural population within the same department in the region. In the five years prior to the census, 88,8% of rural inhabitants in Meta, 95,3% in Arauca, 93,3% in Casanare and 97,1% in Vichada remained in their same department. Compared to the other three departments, the rural population of Meta has greater migratory dynamics, an exceptional case being the result of the municipality of La Macarena, where only 75,8% of the dispersed rural population remained in the same place in that five-year period. This may show some relationship with the deforestation processes in the territory, since the department of Meta, and particularly in the municipality of La Macarena, is located in the main deforestation hotspot of the Orinoco region.

Analyzing the relationship between deforested areas and the distance to settlements at the regional scale (Table 30), using official information on population centers (DANE 2016) and the SMByC natural forest cover change layers (IDEAM 2020), it was identified that deforestation for the period 2010-2019 was less relevant in the areas closest to settlements, being concentrated in distances greater than 5 km (84,8% of deforestation).

Table 30. Deforestation (2010-2019) by ranges of distance to settlements (2016) in the Orinoco region.

| Distance range to settlements | Deforestation (ha) | Deforestation (%) | Cumulative Deforestation (%) |
|---|---|---|---|
| < 1 km | 2.748 | 0,9% | |
| >1 km y < 5 km | 42.824 | 14,3% | 15,2% |
| > 5 km y < 10 km | 79.080 | 26,4% | 41,7% |
| > 10 km y < 20 km | 104.733 | 35,0% | 76,7% |
| > 20 km | 69.640 | 23,3% | 100,0% |

Source: Own elaboration with information from IDEAM (2020) for deforestation and from DANE (2016) for settlements.

# 6. CAUSES AND AGENTS IN AFOLU REGIONAL EMISSION CHARACTERIZATION

In the area of the project "Sustainable low-carbon development in the Orinoco region - Biocarbon Fund", the characterization of AFOLU emissions necessarily involves the study of the causes and agents of deforestation and its relationship with the expansion of the agricultural frontier, with special reference to the growth of cattle ranching. This activity plays a dual role as the main source of regional emissions; on the one hand, there are direct emissions due to the increase in the size of the cattle herd and the processes of nitrogen fertilization of soils for the establishment and maintenance of pastures, and on the other hand, indirect emissions caused by the change in natural cover for the establishment of pastures (mainly due to deforestation). The main direct causes, underlying causes, agents, and chains of events of AFOLU GHG emissions identified in the region are described below.

## 6.1. Direct causes in AFOLU emissions

According to the analyses, and considering the role of deforestation and cattle ranching as the most relevant emission sources, six main direct causes of AFOLU emissions in the Orinoco region are identified: 1) expansion of the agricultural frontier - cattle ranching; 2) expansion of the agricultural frontier – grazing land; 3) expansion of the agricultural frontier - industrial crops; 4) expansion of the agricultural frontier - illicit crops; 5) expansion of transportation infrastructure; and 6) timber extraction. The relationship between the direct causes and the subcategories of the regional GHG inventory (updated to 2018) is presented in Table 31.

Table 31. Relationship between direct causes of regional AFOLU emissions and GHG inventory subcategories

| Direct cause of AFOLU emissions | AFOLU sub-category in GHG regional inventory* |
|---|---|
| **Expansion of the agricultural frontier - Livestock** | **3A1a Enteric fermentation cattle** |
| | **3C4 Direct N2O emissions from managed soils** |
| | **3C5 Indirect N2O emissions from managed soils** |
| | 3A2a Cattle manure management |

| Direct cause of AFOLU emissions | AFOLU sub-category in GHG regional inventory* |
|---|---|
| | 3C1c Emissions from biomass burning in pastures<br>3C1c Emissions from biomass burning in pastures |
| | 3C6a Indirect N2O emissions from manure management - Cattle |
| **Expansion of the agricultural frontier - Grazing land expansion** | **3B3bi Forest land converted to pasture** |
| | 3C1a Emissions from biomass burning on forested land<br>3C7 Rice cultivation |
| **Expansion of the agricultural frontier - Industrial crops** | **3C7 Rice cultivation** |
| | **3C4 Direct N2O emissions from managed soils** |
| | **3C5 Indirect N2O emissions from managed soils** |
| | **3B2bi Forest land converted to cropland** |
| | 3B2a... Cropland remaining cropland (emissions from permanent crop renewal) |
| | 3B2axi Other (CO2 emissions from burning of crops) |
| | 3C1b Emissions from biomass burning in crops |
| **Expansion of the agricultural frontier - Illicit crops** | **3B1aii1 Forest land remaining forest land-Stock change (change from forest to other non-forest forest cover)** |
| | **3B1aii2 Forest land remaining forest land-Stock change (loss of other woody vegetation)** |
| | 3C4 Direct emissions of N2O from managed soils |
| | 3C5 Indirect N2O emissions from managed soils |
| | 3B2bi Forest land converted to cropland |
| **Expansion of transportation infrastructure** | **3B3bi Forest land converted to Grassland** |
| | **3B1aii1 Forest land remaining forest land-Stock change (change from forest to other non-forest forest cover)** |
| | **3B2bi Forest land converted to cropland** |
| | **3B6bi Forest land converted to other land** |
| | 3B5bi Forest land converted to settlements |
| **Timber extraction** | **3B1aii1 Forest land remaining forest land-Stock change (may include deforestation/degradation by selective logging)** |

| Direct cause of AFOLU emissions | AFOLU sub-category in GHG regional inventory* |
|---|---|
| | **3B1aii2 Forest land remaining forest land-Stock change (loss of other woody vegetation)** |
| | **3B1ai Forest Land Remaining Forest Land-Natural forest (degradation from fuelwood consumption)** |
| | 3B1aiii Forest Land Remaining Forest Land-Plantations |

Source: Own elaboration with information from the 2018 regional and departmental GHG inventory.

* The size and highlighting of the text indicate a greater importance of the subcategory in the regional GHG inventory.

When the analysis of the causes of deforestation (Figure 49) is translated into a characterization of the causes of GHG emissions (Figure 54), in some activities the magnitude and order of importance changes. Conversion of forests to pasture is the main direct cause of AFOLU emissions in Meta and Vichada, while in Casanare and Arauca it is cattle ranching, which adds emissions from enteric fermentation and, to a lesser extent, from nitrogen fertilization of pastures, biomass burning and cattle manure management.

The extraction of timber, which leads to deforestation and degradation processes due to a decrease in carbon content, is more relevant, especially in the department of Meta. The expansion of the transportation infrastructure has low direct emissions, but it stimulates the advancement of other causes towards new areas of transformation. Industrial agricultural production is an important economic activity in the Orinoco region, but it has a lower weight in regional emissions when compared to other causes.

Finally, the expansion of the agricultural frontier by illicit crops is considered a minor cause of direct emissions, with permanence in the department of Meta (and with a tendency to disappear in Vichada), but it still generates an important indirect effect by stimulating the expansion of other agricultural activities that generate more emissions.

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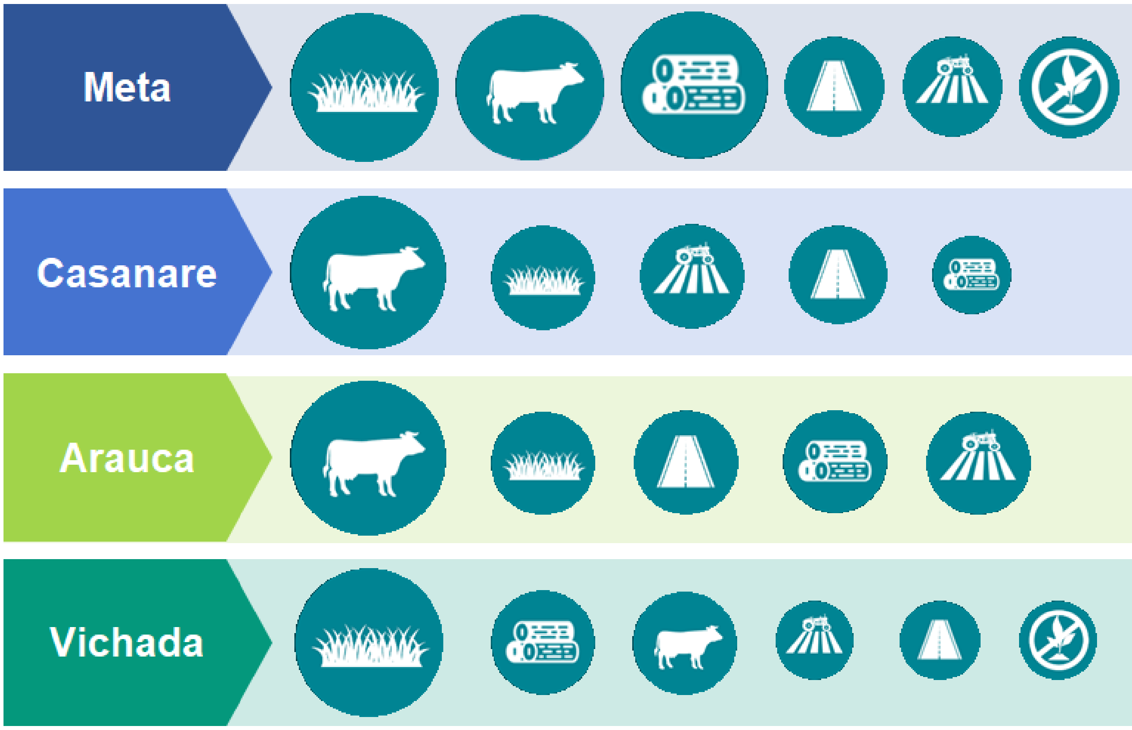


Figure 54. Main direct causes and relative importance for AFOLU emissions in each Orinoquia department (Own elaboration)

The approximate presence and spatial distribution of these six direct causes in the region is presented in Figure 55, the detail in departmental level are in Figure 56, Figure 57, Figure 58 and Figure 59. The systematized and analyzed results allowed the generation of maps with the location of 321 points that describe the approximate distribution of the six main direct causes of GHG emissions for the AFOLU sector in the Orinoco region. The cause with the highest spatial representation at the point level was industrial crops (24% of locations), followed by timber extraction (23%), livestock (18%), transportation infrastructure (18%), logging (11%) and illicit crops (6%). [

The causes were concentrated in the foothills of the departments of Arauca, Casanare and Meta, especially due to the expansion of the agricultural frontier through cattle ranching, logging and industrial crops. Coca crops are in the southern part of the departments of Meta and Vichada, where there is an important generation of deforestation processes by logging and extensive cattle ranching, even affecting the interior of protected areas (national parks and others).

In the high-plains and areas of natural savannah, characteristic of the Orinoco biome, there was also an important presence of the causes and their expansion towards the east. The axes of transformation (historical and current) are related to transportation infrastructure, through the expansion of land roads and the navigability of the region's main rivers.

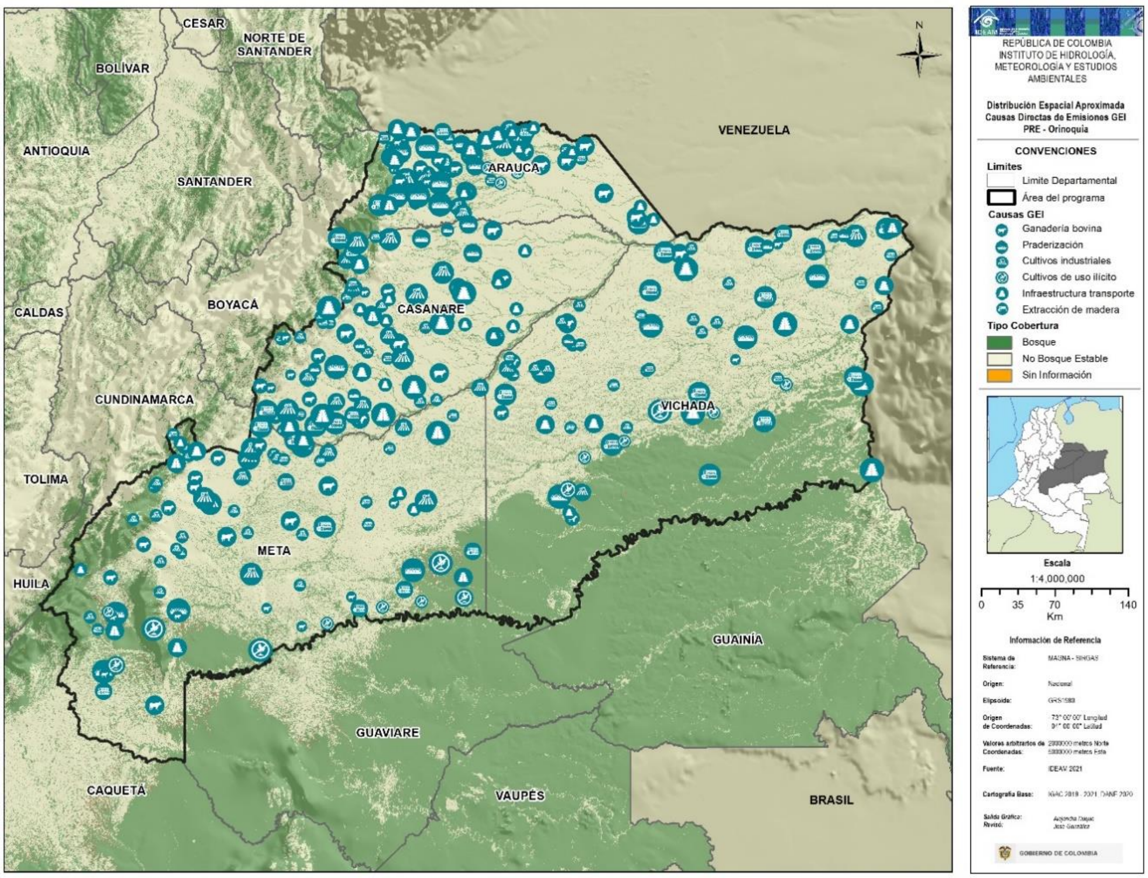


Figure 55. Spatial distribution of the direct causes of AFOLU emissions in the Orinoco region (own elaboration based on social mapping with regional stakeholders).

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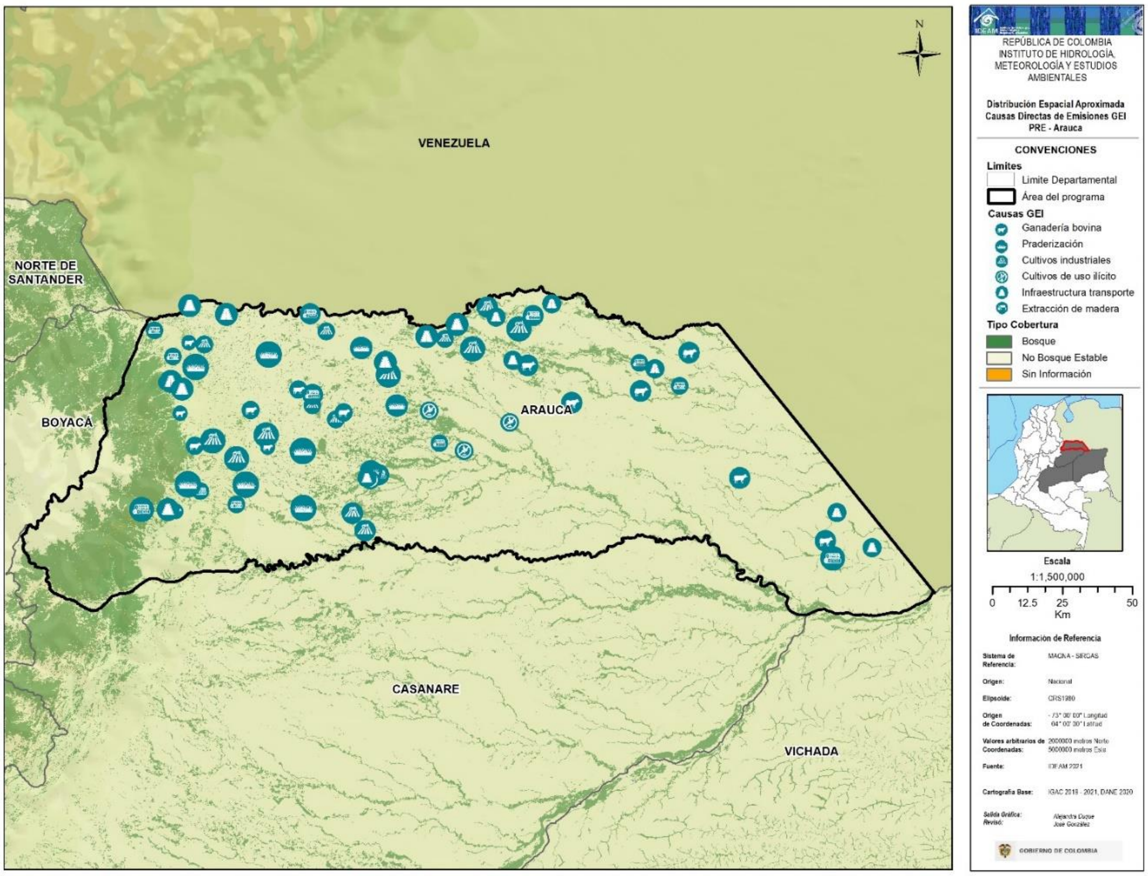


Figure 56. Spatial distribution of the direct causes of AFOLU emissions in the department of Arauca (own elaboration based on social mapping with regional stakeholders).

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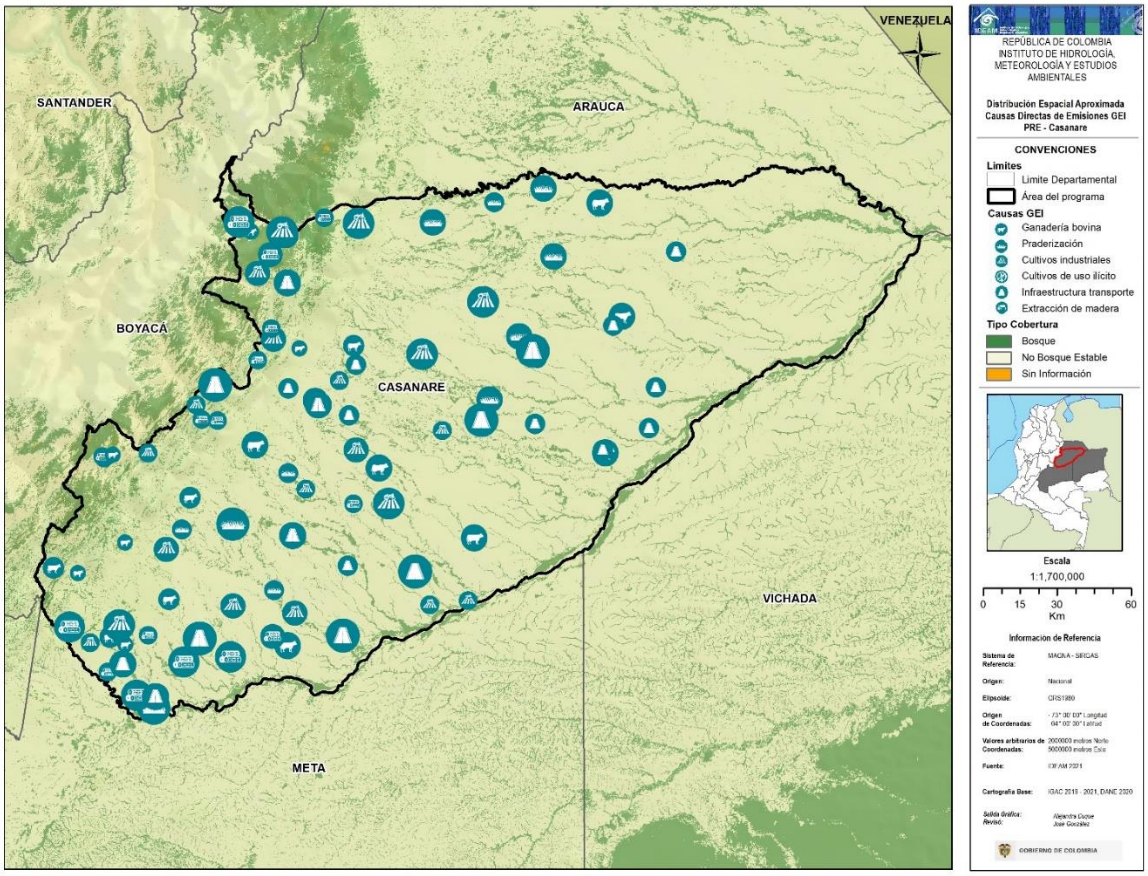


Figure 57. Spatial distribution of the direct causes of AFOLU emissions in the department of Casanare (own elaboration based on social mapping with regional stakeholders).

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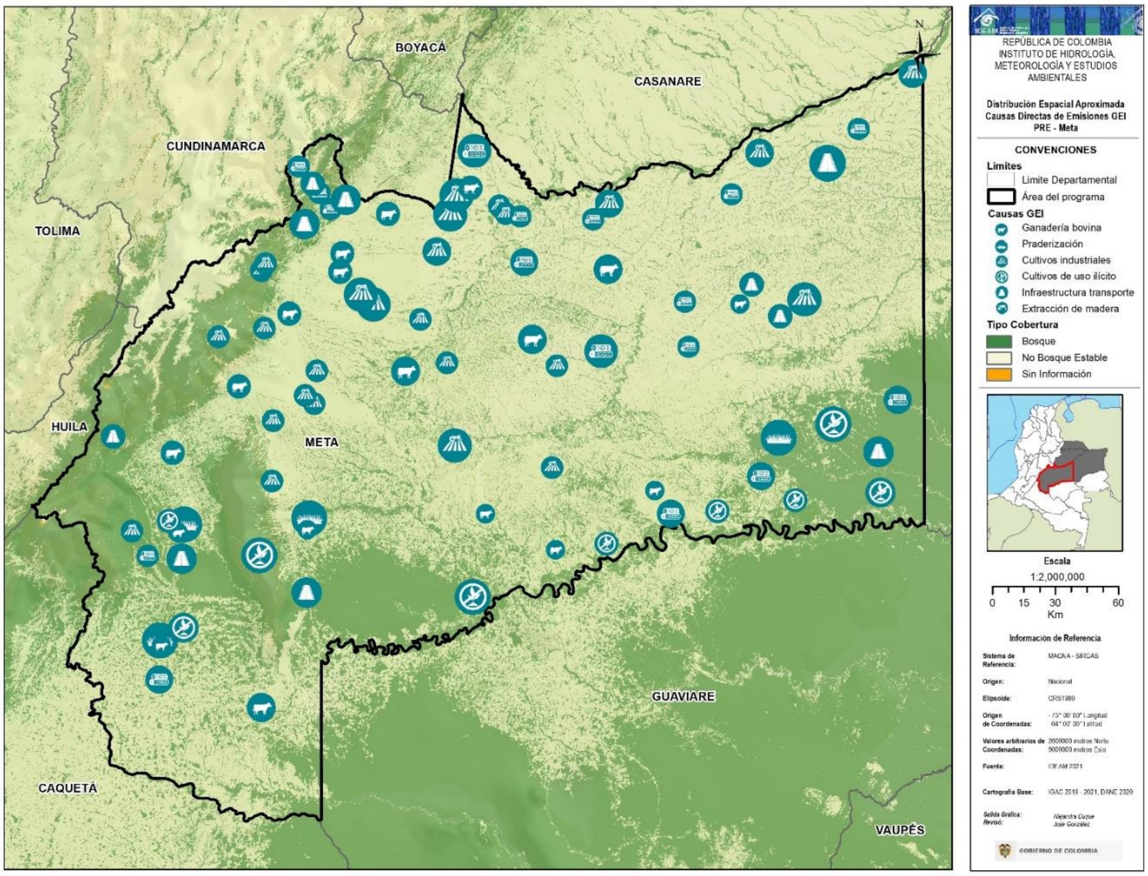


Figure 58. Spatial distribution of the direct causes of AFOLU emissions in the department of Meta (own elaboration based on social mapping with regional stakeholders).

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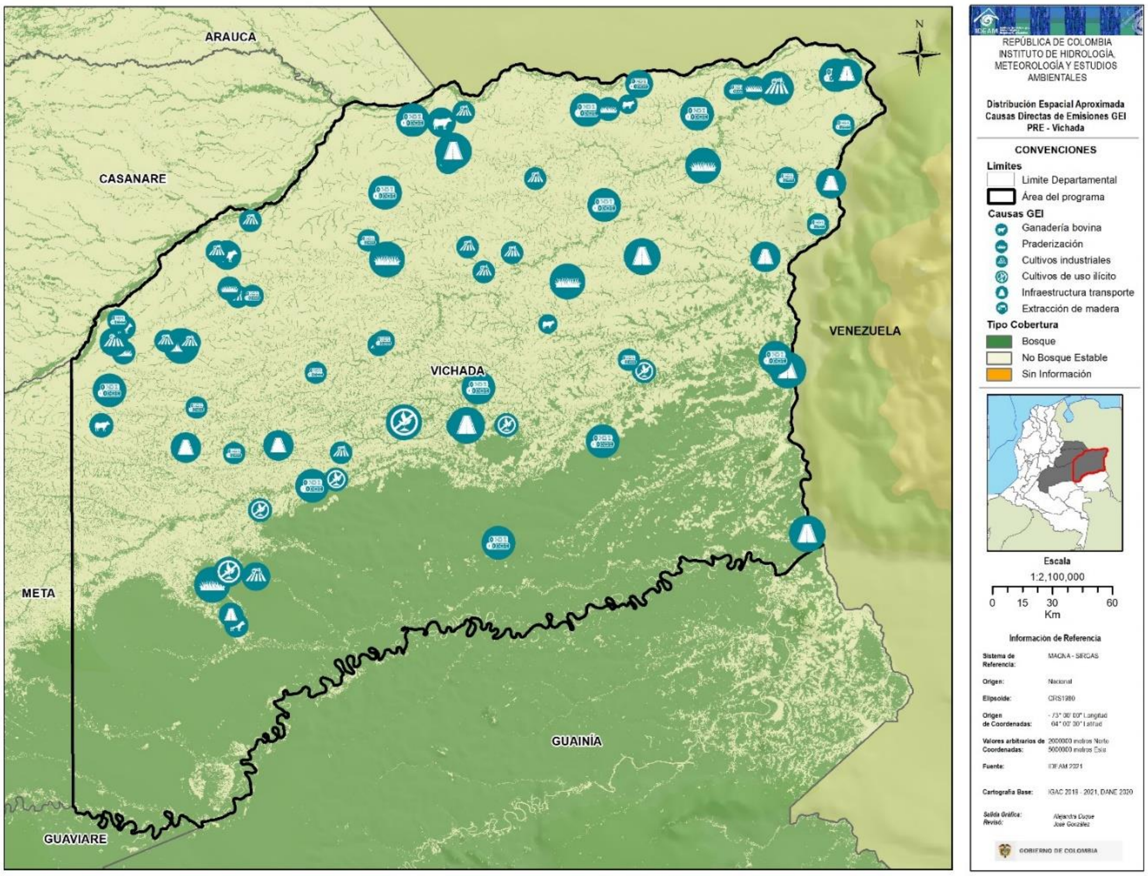


Figure 59. Spatial distribution of the direct causes of AFOLU emissions in the department of Vichada (own elaboration based on social mapping with regional stakeholders).

### 6.1.1. **Agricultural frontier expansion - Livestock**

Corresponds to the establishment and expansion of cattle production systems that lead mainly to the generation of methane emissions from enteric fermentation processes, which are directly related to herd size (number of animals), age distribution and productive purpose. Burning for pasture renewal and nitrogen fertilization for the growth of improved pastures complement GHG emissions from livestock systems. Finally, this cause includes some minor emissions (direct and indirect) related to cattle manure management.

The size of the cattle herd in the region shows a clear trend of increase since 2001, with a higher growth rate from 2017 (Figure 60), which, as previously analyzed, coincides with the highest deforestation rates in the southwestern area of the department of Meta and the municipality of Mapiripán (main NADs in the region) during the recent period (2017-2020).

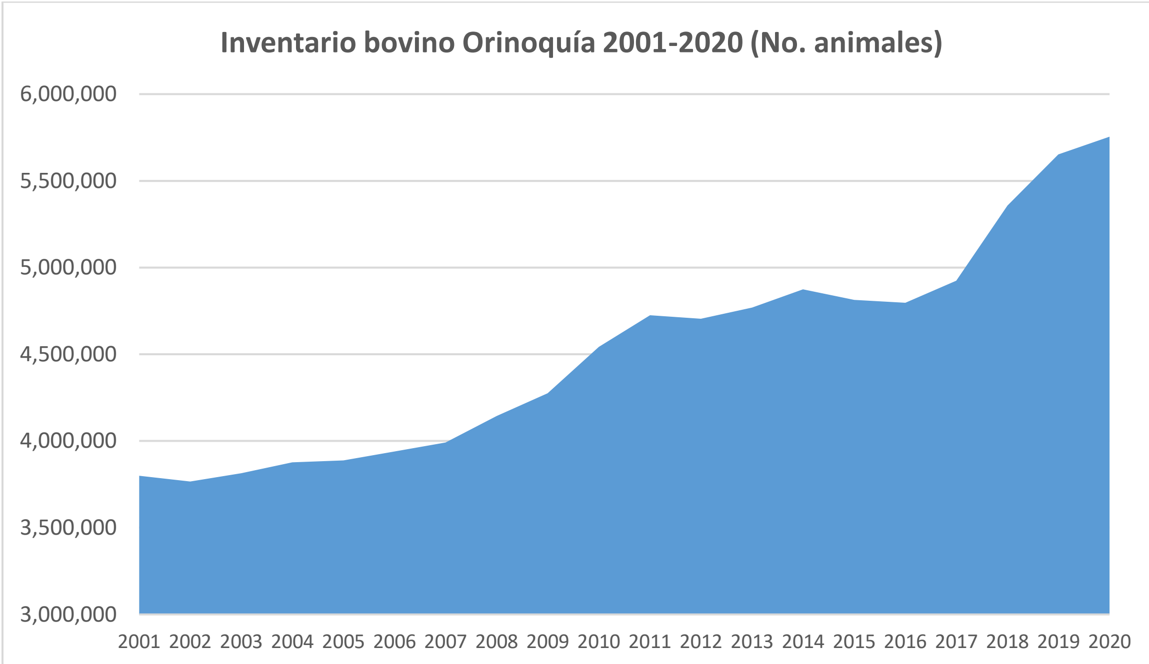


Figure 60. Behavior of cattle inventory in the Orinoco region 2001-2020 (FEDEGÁN-FNG 2020, data 2001-2015; ICA 2020, data 2016-2020).

Figure 61 shows the density of cattle heads per unit area for each of the 59 municipalities in the Orinoco region. The departments of Arauca, Casanare and Meta have areas with a higher cattle density, mainly in the western zone corresponding to the foothill ecosystem, which coincides with the areas with the greatest anthropic intervention in the region. The department of Vichada has a low cattle-raising density in all its municipalities, which may be associated with the poor road infrastructure in the area, making difficult to transport products derived from this activity.

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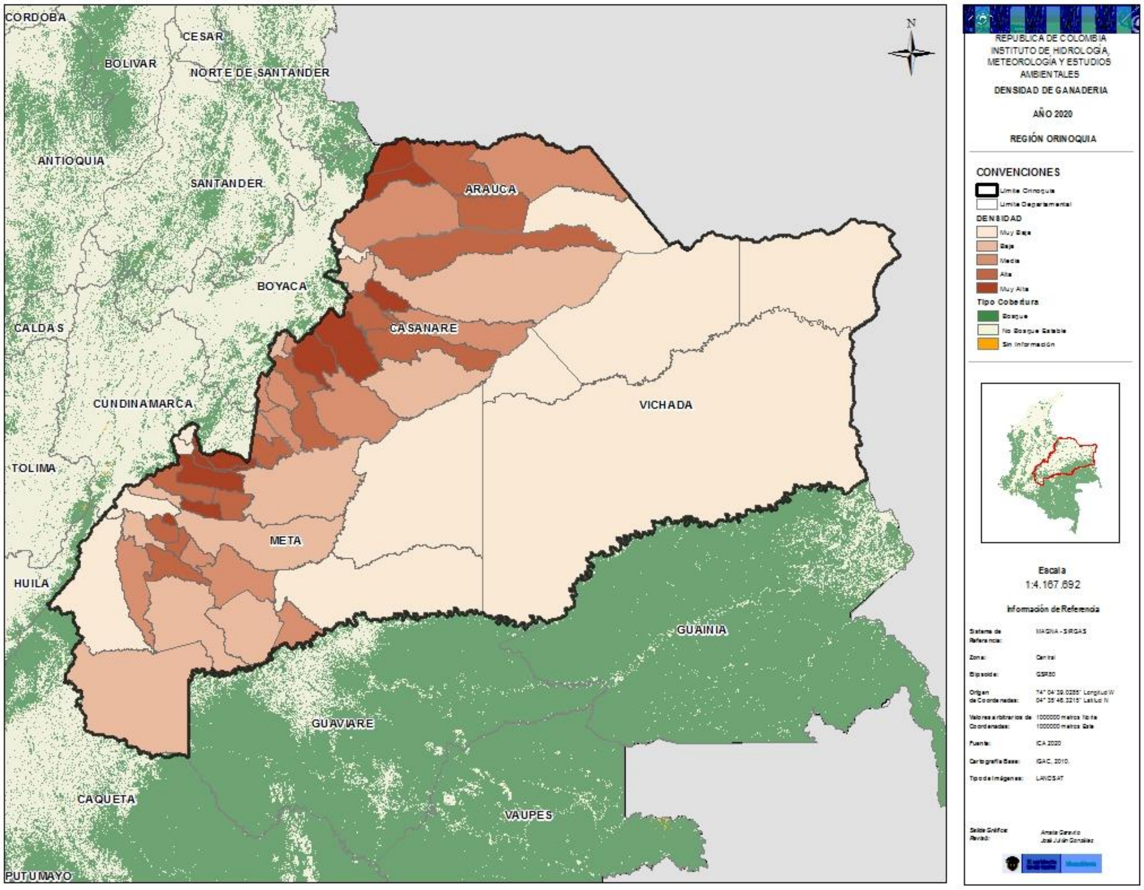


Figure 61. Density of head of cattle by municipality in the Orinoco region (Own elaboration with data from ICA 2020).

### 6.1.2. Agricultural frontier expansion - Grazing land expansion

This refers to the change from natural cover (mainly forest) to pasture, which adds emissions due to the change in land use and the burning that is frequently used in the process. In general, the new deforested plots expand from already transformed areas, using them for land grabbing or the establishment of new cattle grazing areas.

According to the land cover classification under the Corine Land Cover (CLC) methodology at a scale of 1:100.000, Table 32 presents information on the land covers associated with pastures and grasslands for the years 2012 and 2018. Clean pastures (equivalent to introduced pastures with management practices) increased their area by almost one million ha in the six-year period, while pasture-crop mosaics, wooded pastures, and matted pastures reduced their area in the same period. Grasslands, which correspond mainly to natural savannah cover, were reduced by 1.361.256 ha during the period. This allows us to identify a trend of transformation of natural grassland cover and the introduction of improved pastures in the Orinoco region.

Table 32. Distribution of CLC coverages related to pastures and grasslands in the Orinoco (years 2012 and 2018).

| CLC Coverage (Level 3) | 2012 (ha) | 2018 (ha) |
|---|---|---|
| Clean pastures | 2.070.108 | 3.047.469 |
| Wooded pastures | 54.901 | 48.731 |
| Weeded pastures | 179.297 | 175.271 |
| Mosaic of pastures and crops | 429.659 | 352.662 |
| Mosaic of pastures with natural spaces | 479.243 | 592.812 |
| Grasslands | 11.262.603 | 9.901.347 |

Source: Own elaboration from information of IDEAM (2021)

The information from the cover change matrices in the Orinoco for the years 2000, 2010 and 2018, generated by IDEAM's SMByC (in the framework of the construction of the ERP) through the quantification of area losses and gains, shows the dynamics of the aggregate cover of grasslands and pastures and other covers related to land use change (Table 33 and Table 34).

In both periods (2000-2010 and 2010-2018) the gains in grassland and pastures areas come mainly from natural forest and other woody vegetation cover (natural forest cover that does not meet the definition of forest in the national monitoring), while losses are mainly directed to the change categories of other crops, palm oil and commercial forest plantations.

Table 33. Losses and gains in the Orinoco's main land cover areas (year 2000 vs. 2010)

| Coverage year 2000 | Coverage year 2010 (ha lost or gained) | | | | | |
|---|---|---|---|---|---|---|
| | Other woody vegetatio n | Forests | Forest plantations | Palm oil | Other crops | Pastures and grassland s |
| **Other woody vegetation** | | 76.056 | -390 | -3.639 | -2.124 | -307.537 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Forests** | -76.056 | | -45 | -967 | -1.044 | -251.192 |
| **Forest plantations** | 390 | 45 | | 0 | 8 | 4.329 |
| **Palm oil** | 3.639 | 967 | 0 | | 5.647 | 28.894 |
| **Other crops** | 2.124 | 1.044 | -8 | -5.647 | | 82.521 |
| **Pastures and grasslands** | 307.537 | 251.192 | -4.329 | -28.894 | -82.521 | |

Source: Own elaboration with information from the matrices of land cover change in the Orinoco region for the years 2000 and 2010.

Table 34. Losses and gains in the Orinoco major cover areas (year 2010 vs. 2018).

| Coverage year 2010 | Coverage year 2018 (ha lost or gained) | | | | | |
|---|---|---|---|---|---|---|
| | Other woody vegetation | Forests | Forest plantations | Palm oil | Other crops | Pastures and grasslands |
| **Other woody vegetation** | | 145.525 | -262 | -1.345 | 2.584 | -212.281 |
| **Forests** | -145.525 | | -38 | -299 | -1.364 | -303.322 |
| **Forest plantations** | 262 | 38 | | -49 | 694 | 57.933 |
| **Palm oil** | 1.345 | 299 | 49 | | 39.201 | 84.512 |
| **Other crops** | -2.584 | 1.364 | -694 | -39.201 | | 246.899 |
| **Pastures and grasslands** | 212.281 | 303.322 | -57.933 | -84.512 | -246.899 | |

Source: Own elaboration with information from the matrices of change of coverages in the Orinoco region for the years 2010 and 2018.

### 6.1.3. Agricultural frontier expansion – Industrial crops

Corresponds to the change of natural cover (mainly forests) to various industrial mono-crops of economic importance in the region, such as palm oil, rice, coffee, cocoa, rubber, and fruit trees, among others. This process of land use change is complemented by emissions from burning for the establishment and/or renewal of crops, nitrogen fertilization, direct emissions from rice cultivation and, to a lesser extent, those generated by the renewal of permanent crops.

The Orinoco region accounts for about 28% of national agricultural production, including products such as palm oil, sugarcane, bananas, mechanized rainfed rice, technified corn and cassava. Although the region has 4.557.921 ha with agricultural vocation, only 14% of this area is used according to this purpose, while the remaining 86% is destined for livestock use at different scales (Medrano 2018).

According to the CLC cover classification at a scale of 1:100.000 (IDEAM 2021), an increase in areas related to crops is identified between 2012 and 2018, equivalent to 258.000 ha. The change is mainly in the categories of cereals and leguminous crops (rice, corn, soybeans, sorghum and others) and permanent tree crops (palm oil, cocoa, rubber and others), with increases of 138.684 ha and 96.118 ha, respectively (Table 35). These categories include the commercial crops with the greatest regional importance in economic and land use terms, as well as with the greatest participation in the balance of GHG emissions for the AFOLU sector in the Orinoco region.

The analysis of crop density at the municipal level leads to the conclusion that more than 90% of the regional area has low and very low densities. As in the case of livestock, the highest crop densities are found in the municipalities located in the foothills and in lowland areas with better transportation infrastructure. The municipalities with very high densities are in the Department of Meta (San Carlos de Guaroa and Fuente de Oro) (Figure 62).

Table 35. Distribution of CLC coverages related to cash crops in the Orinoco region (years 2012 and 2018).

| CLC Coverage (Level 3) | 2012 (ha) | 2018 (ha) |
|---|---|---|
| Permanent herbaceous crops | 250 | 14.938 |
| Permanent tree crops | 187.894 | 284.011 |
| Permanent shrub crops | 0 | 905 |
| Agroforestry crops | 0 | 164 |
| Other transitory crops | 22.610 | 34.841 |
| Cereals and leguminous crops | 85.703 | 224.387 |
| Crop mosaic | 48.446 | 21.717 |
| Mosaic of crops and natural areas | 6.989 | 18.454 |
| Mosaic of crops, pastures and natural spaces | 191.543 | 202.015 |
| **Total** | **543.434** | **801.433** |

Source: Own elaboration in information from IDEAM (2021)

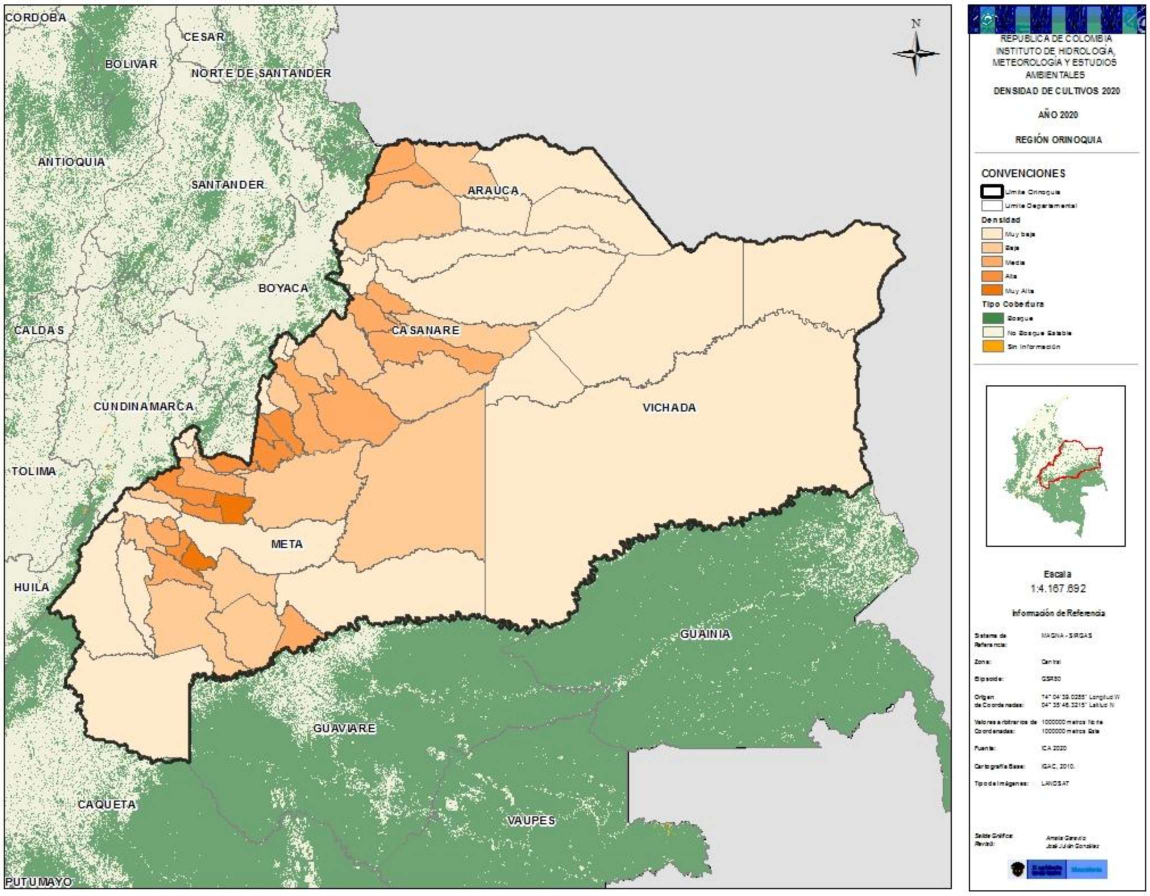


Figure 62. Density of agricultural crops by municipality in the Orinoco region (own elaboration with data from MADR 2020).

### 6.1.4. **Agricultural frontier expansion - Illicit crops**

It implies the change of the natural cover for the establishment of coca fields, which generates direct emissions complemented by the nitrogen fertilization of the crop. When coca is established in the forest matrix, it indirectly generates a process of degradation of the natural forest towards other forest cover (non-forest), which adds emissions due to the decrease in carbon content. Illegal crops can have an indirect effect by stimulating the expansion of other agricultural activities.

The country's official databases on the monitoring of areas with illicit crops include the number of hectares planted with coca (*Erythroxylum coca*) and poppy (*Papaver rhoeas*); however, for the Orinoco region, only information on coca crops is registered for the reporting period. The information analyzed corresponds to data from 2011 to 2020, given that the calculations generated by the Integrated Illicit Crop Monitoring System (SIMCI) of UNODC from 2001 to 2010 were made by the ring methodology, from the time period starting in 2011 the methodology by centroid assignment is used. For this reason, the information from both periods does not have the same parameters and is statistically not comparable.

In the 2011-2020 period, a total of 43.512 ha of coca cultivation was reported in the Orinoco region, showing an increase between 2014 and 2017, in which the annual figure exceeded 5.000 ha; after 2017 there is a decreasing trend to reach 1.356 ha cultivated in the region by 2020 (Figure 63).

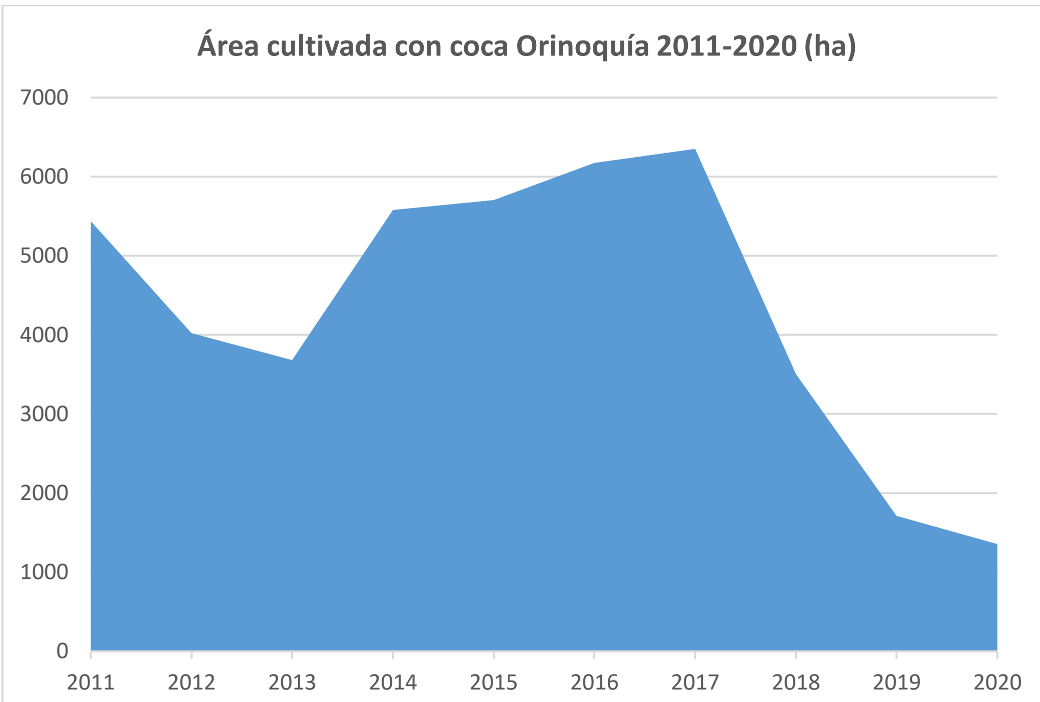


Figure 63. Areas under coca cultivation in the Orinoco region 2011-2020 (own elaboration with data from ODC 2021)

When analyzing the information for each of the departments in the region (Table 36), it was identified that in the department of Casanare no coca cultivation was recorded during the entire period 2011-2020. In Arauca, a total of 464 ha were recorded during the ten years, with evidence of total eradication of cultivation since 2019.

The highest concentration and regional persistence of illicit crops is found in the departments of Meta and Vichada, which for the same period reported total affected areas calculated at 35.367 ha and 7.681 ha, respectively.

Figure 64 shows the concentration of coca cultivation in each of the municipalities of the Orinoco region, showing a higher density (historical and current) of coca cultivation in the southern part of the region, which corresponds to the transition with the Amazon biome. During the period of analysis, the greatest coca cultivation was found in the municipalities of Vistahermosa, Puerto Rico, La Macarena and Mapiripán (department of Meta), and in Cumaribo (Vichada).

Table 36. Coca cultivated areas in the Orinoco departments (2011-2020)

| **Year** | **Coca cultivated areas (ha)** | | |
|---|---|---|---|
| | **Arauca** | **Meta** | **Vichada** |
| 2011 | 133 | 3.039 | 2.264 |
| 2012 | 82 | 2.699 | 1.242 |
| 2013 | 69 | 2.898 | 713 |
| 2014 | 26 | 5.042 | 511 |
| 2015 | 17 | 5.002 | 683 |
| 2016 | 9 | 5.464 | 699 |
| 2017 | 121 | 5.577 | 653 |
| 2018 | 7 | 2.945 | 550 |
| 2019 | 0 | 1.466 | 245 |
| 2020 | 0 | 1.235 | 121 |
| **Total** | **464** | **35.367** | **7.681** |

Source: Own elaboration with data from ODC (2021)

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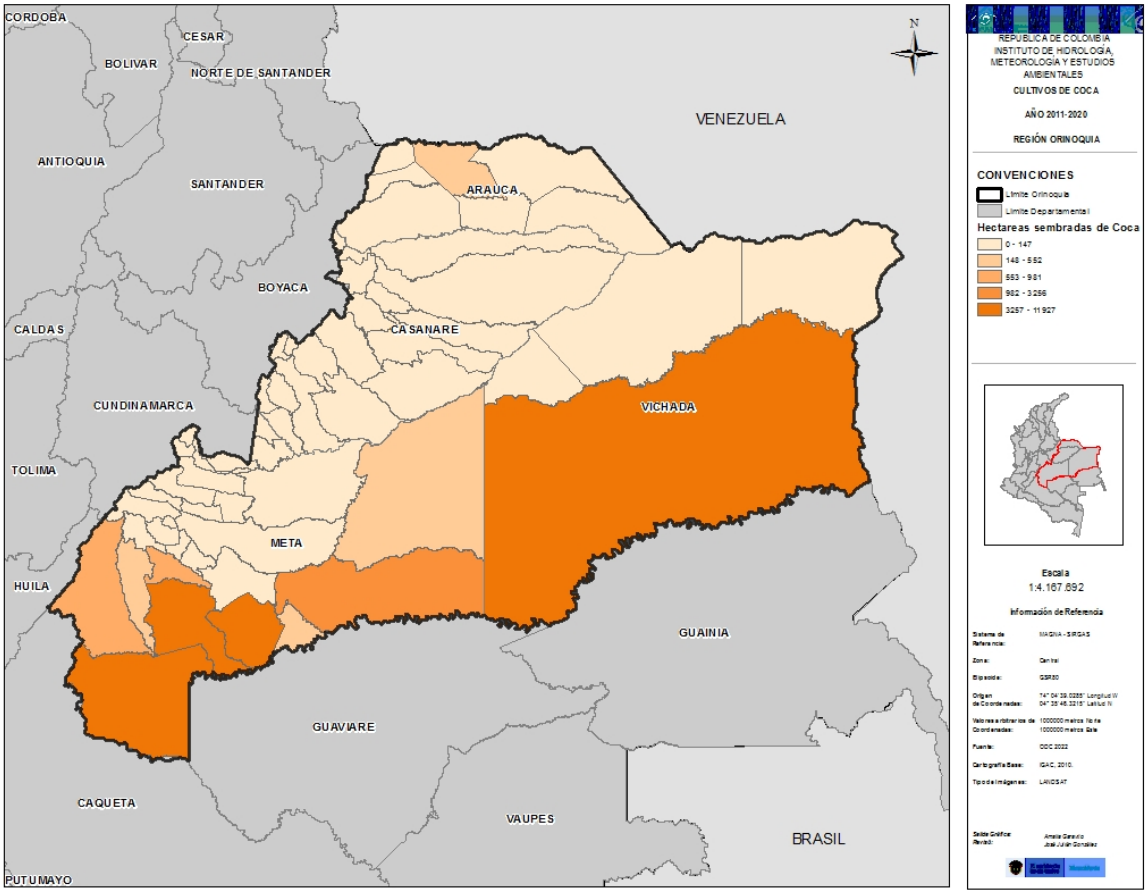


Figure 64. Coca cultivation density by municipality in the Orinoco region, 2011-2020 (own elaboration with data from ODC 2021).

## 6.1.5. **Transport infrastructure expansion**

This refers to the direct effect of the removal of vegetation cover for the construction of road access in rural areas (mainly terrestrial). However, the main effect in terms of GHG emissions is not direct but indirect, as it dynamizes the expansion of other causes and it allows access to new areas and transformations.

According to the official information on land accesses, taken from the base cartography of the Agustín Codazzi Geographic Institute (year 2019), and which processes the data of land roads classified from type 1 to 5, it was possible to calculate the total road length in the Orinoco, which presents a greater concentration in the western area of the region (see section 4.2.3). The department of Meta has the largest road supply in the region, with 40,3% of the total length (Table 37).

Table 37. Length of land roads in the Orinoco departments (year 2019).

| Department | Road length (km) | Percentual participation |
|---|---|---|
| Arauca | 3.053 | 13,3% |
| Casanare | 6.556 | 28,6% |
| Meta | 9.230 | 40,3% |
| Vichada | 4.092 | 17,8% |
| **Total** | **22.931** | **100%** |

Source: Own elaboration with data from IGAC (2019)

On the other hand, it is considered that there is a spatial and economic relationship between the expansion of road infrastructure and connectivity between population centers. The information on population centers is generated by DANE to perform statistical analyses that allow for the identification of relevant areas of population. The layer used corresponds to: 1) population centers, which are understood as a concentration of at least twenty dwellings contiguous to each other, located in the rural area of a municipality or a departmental village or small town; and 2) municipal main towns, defined as the geographic area with an urban perimeter whose limits are established by agreements of the Municipal Council.

Table 38 identifies the distribution of population centers in each of the departments in the region, with Meta and Casanare having the highest concentration of population centers (74% of the total), while the department of Vichada only has 26 official population centers (DANE 2016).

Table 38. Number of population centers in the departments of the Orinoco region (2016)

| Department | Number of population centers | Percentage participation |
|---|---|---|
| Arauca | 70 | 19,2% |
| Casanare | 87 | 23,8% |
| Meta | 182 | 49,9% |
| Vichada | 26 | 7,1% |
| **Total** | **365** | **100%** |

Source: Own elaboration with data from DANE (2016)

### 6.1.6. Wood extraction

Corresponds to the processes of deforestation and/or forest degradation due to selective logging, especially illegal logging, for large-scale commercialization, complemented by emissions from forest degradation generated by small-scale firewood consumption (for self-consumption or local trade). The renewal of commercial forest plantations and the timber products derived from this activity generate some emissions that also add to this cause.

Statistical information related to timber extraction in the region is very limited. In the case of the regional GHG inventory in the AFOLU sector, built in the framework of the ERP, information on the use of firewood as fuel in rural households is used as activity data, which is a preliminary indicator of small-scale forest degradation that is reflected in the inventory. Degradation due to extraction processes at larger scales can be approximated in the calculation of land cover changes generated by the SMByC in the framework of the ERP, and specifically in the change from natural forest to other woody vegetation. In the 2000-2010 transition this change was 76.056 ha, while in 2010-2018 it amounted to 145.525 ha, which represented an increase of 91,3% (Table 33 and Table 34).

The official complementary data on forest harvesting, mobilizations and timber seizures are exceptionally low in the Orinoco compared to what is reported for the other regions of the country, as can be analyzed in the Forestry Statistical Bulletin 2018-2019 (Asocars 2021). This may represent an underreporting in the annual information reported by the Regional Autonomous Corporations with jurisdiction in the Orinoco (Cormacarena and Corporinoquia), which prevents expanding the results for the analysis of causes of regional GHG emissions in the AFOLU sector.

## 6.2. Indirect causes in AFOLU emissions

According to the classification of underlying causes proposed by González et al. (2018a), the main factors that reinforce the direct causes and influence the decisions of AFOLU emissions agents in the Orinoco are described below.

### 6.2.1. Economic and technological factors [

The importance of agricultural activities for the economic development of the Orinoco region and their promotion by different decision main bodies (national and territorial policies) and by private investment, means that economic and technological factors are highly relevant to the process that leads to the generation of GHG emissions in the AFOLU sector. This dynamic is reinforced by the presence and permanence of illicit economies that also generate emissions, such as illegal logging and coca cultivation.

This category highlights specific underlying causes of regional AFOLU emissions such as the following:

- Technological and productive development of large-scale agricultural activities.
- Markets at different scales (regional, national and international) that demand the products that generate AFOLU emissions in the region (e.g. beef, milk and its derivatives, animals, fine woods, coca, among others).
- Availability of cattle for production purposes and inputs for the development of the activity.
- Access to local markets for seeds, fertilizers, and other inputs for the establishment and renewal of industrial mono-crops.
- Incentives and programs to promote the development of productive and extractive activities in the region.
- Local and foreign private investment interested in developing productive and extractive activities in the region.
- Establishment of illegal land markets and illicit economies that promote the transformation of natural land cover.
- Availability of technology and low costs of timber extraction at different scales.

### 6.2.2. Institutional and political factors

All aspects related to land tenure and land concentration have a strong influence on the dynamics of natural cover transformation in the country and at the regional scale. Conflicts in the definition and management of protected areas and collective territories, informal ownership by local stakeholders, the lack of coordination between sectoral and territorial policies, the persistence of armed conflict in several areas, and inadequate development planning in terms of infrastructure, all lead to the continued expansion of productive and extractive activities at the expense of forest ecosystems and natural savannahs in the Orinoco region.

This category highlights specific underlying causes of regional AFOLU emissions such as the following:

- Poorly developed legal status and land tenure leading to informal ownership.
- Expectations of land titling and/or land valuation by agents that do not consider the legal status of the territory.
- Undue occupation of protected areas and indigenous reserves for land grabbing or establishment of productive activities at different scales.
- Sectoral policies that favor the expansion of agricultural activities in the region, putting pressure on natural ecosystems.
- Armed conflict dynamics and the presence of illegal armed actors that pressure the establishment of activities that generate AFOLU emissions.
- Need for connectivity between historically isolated populations with limited economic development.

- Need for the mobilization of livestock, products and inputs related to the transformation processes that lead to the generation of emissions.
- Lack of planning in the growth and type of road infrastructure developed in the region.
- Lack of institutional presence and problems in controlling activities that generate deforestation and AFOLU emissions in the region.

### 6.2.3. Cultural factors

The expansion of the agricultural frontier has historically been linked to the development of the Orinoco region. The processes of colonization and transformation of the territory have consolidated the vision of the region as a priority area for the country's agricultural and livestock growth, which is complemented by social imaginaries based on the availability of large amounts of land at low cost, which can only be used for industrial agriculture or extensive livestock raising, and which require certain cultural practices such as the use of fire for their establishment and renewal.

This category highlights specific underlying causes of regional AFOLU emissions such as the following:

- Vision of the region as the "agricultural and livestock pantry of the country" (current and potential).
- Livestock culture of the region.
- Vision of the nation's empty lands and other public or collectively owned lands as areas subject to appropriation and transformation.
- Inappropriate cultural practices such as the irrational use of fire for land appropriation or the establishment of productive activities.

### 6.2.4. Demographic factors

Demographic dynamics, especially those related to migration and population growth, continue to influence the processes of occupation, settlement, and transformation of natural cover in the region. The signing of the peace agreement with the FARC and their demobilization as an armed group generated new colonization processes towards the Orinoco and their corresponding settlements, which demand infrastructure for their productive and extractive activities.

This category highlights specific underlying causes of regional AFOLU emissions, such as the following:

- Migratory processes to the region following the demobilization of the FARC as an armed group in the territory.

- Population growth in the region's rural areas.
- Population growth in the region's urban areas, which demands agricultural products, timber and other goods that generate AFOLU emissions.
- Establishment of new population centers that generate pressure on natural vegetation cover.
- Demand for the opening of roads or the improvement of existing ones, associated with the establishment of new settlements.

### 6.2.5. **Biophysics factors**

The biophysical characteristics of the region favor the development of diverse productive and extractive activities. However, in several areas, climatic and soil conditions make land use inefficient for these activities and require expansion into new areas where natural land cover is pressured or affected, which leads to an increase in GHG emissions.

This category highlights specific underlying causes of regional AFOLU emissions such as the following:

- Diversity of ecosystems that favor the establishment of different productive activities in the region.
- Availability of flat land for the establishment of extensive livestock systems and large-scale industrial mono-crops.
- Soils with a high level of acidity and very low cattle-loading capacities, leading to the establishment of extensive livestock systems.
- Large hydrocarbon deposits that promote the development of infrastructure for exploration and extraction.
- Climatic conditions that limit the development of agricultural activities during long periods of the year and generate greater pressures on the region's ecosystems.
- Prolonged droughts that favor the loss of control over burning activities and the generation of large-scale vegetation fires.

## 6.3. AFOLU emissions agents

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The territorial stakeholder database, built in the framework of the ERP of the project "Low Carbon Sustainable Development in the Orinoco Region - Biocarbon Fund", included 993 records as of December 2021, of which around 38% corresponded to private companies, 28% to producer associations and guilds, 11% to community organizations (including ethnic groups and civil organizations), 2% to public entities (mayor’s offices, regional governments and environmental authorities), 2% to international cooperation entities, 1% to illegal armed actors and the remaining 18% to other actors, including national non-governmental organizations (NGOs), research centers, Territorial Training and Reincorporation Spaces (ETCR in Spanish), among others (Figure 65).

Of the 993 actors, 723 were identified as potential transformation agents, considering their productive activities, the purposes of these activities and the sectors to which they belong. Most of these potential agents are located spatially in the department of Meta, and in smaller quantities in Casanare, Vichada and Arauca. The classification of these actors, whether they are agents of GHG emissions or removals in the region, depends on the decisions made in their production system, e.g., whether their production practices lead to the generation of emissions or whether they contribute to the increase of removals.

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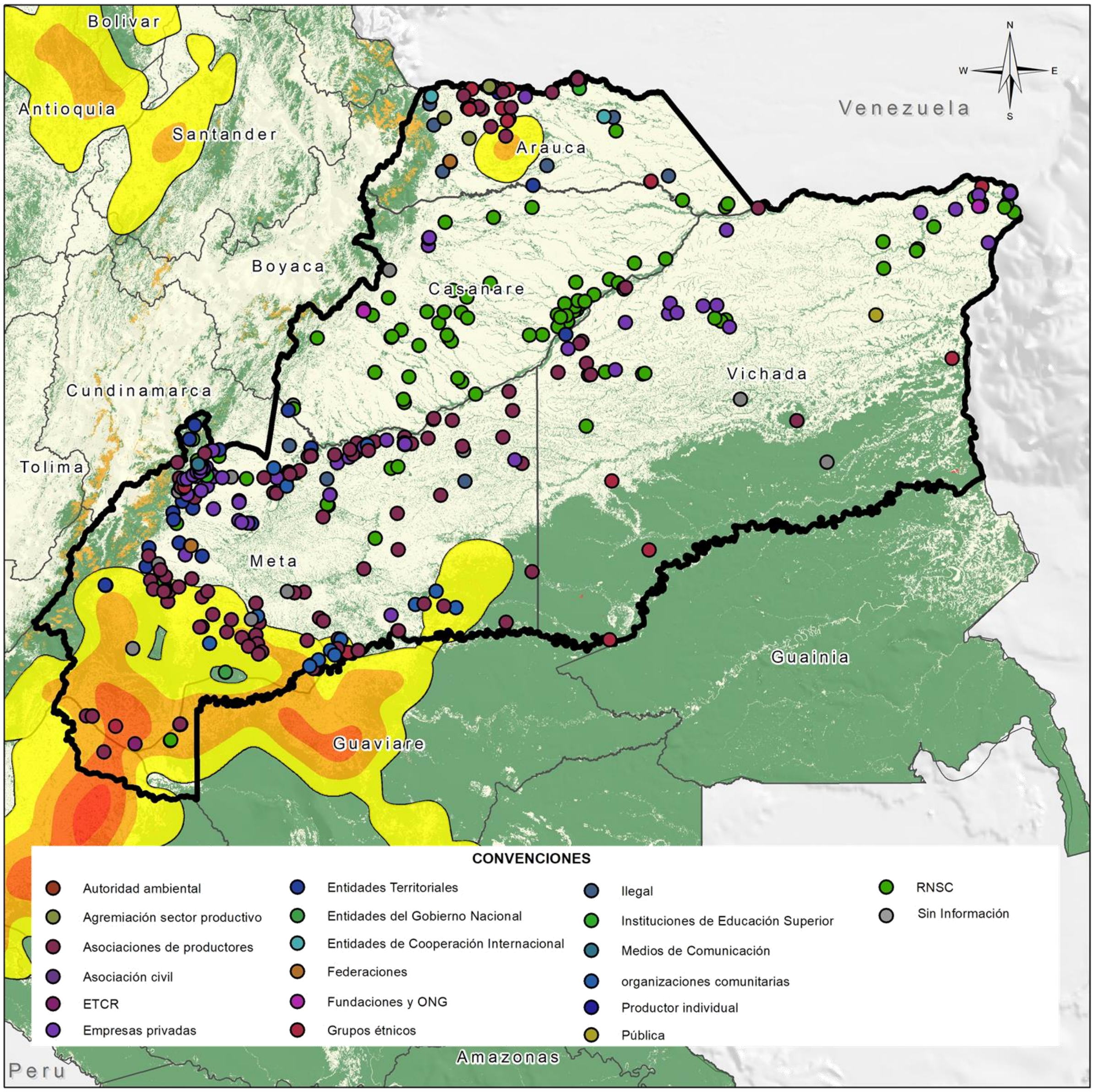


Figure 65. Spatial distribution of the types of stakeholders identified in the Orinoco region (own elaboration)

According to the analyses developed, the following are identified as the main agents of AFOLU emissions in the Orinoco region: 1) large-scale cattle rancher; 2) medium and small-scale cattle rancher; 3) land-grabbing cattle rancher; 4) industrial agricultural producer; 5) coca producer; 6) transport infrastructure builder; 7) timber extractor for self-consumption; and 8) large-scale commercial timber extractor. The relationship between the identified emissions agents and the direct causes is presented in Table 39.

Table 39. Relationship between the agents and the direct causes of AFOLU GHG emissions in the Orinoco region

| Direct associated cause | Name of the main agents of AFOLU emissions in the Orinoco region |
|---|---|
| **Agriculture frontier expansion** | Large-scale cattle rancher. |
| | Small- and medium-scale livestock producer. |
| | Land-grabbing cattle rancher. |
| | Industrial agricultural producer. |
| | Coca producer. |
| **Infrastructure expansion** | Transportation infrastructure builder. |
| **Wood extraction** | Self-consumption timber extractor. |
| | Large-scale commercial timber extractor. |

Soruce: Own elaboration

### 6.3.1. **Large scale livestock farmer**

Corresponds to the agent that makes the decision to transform natural cover, mainly forests, into pastures that allow the expansion of new grazing areas for a growing number of head of cattle, managed in production systems that do not incorporate environmentally sustainable practices. The aggregation of $CO_2$ emissions from deforestation for the expansion of the activity, $CH_4$ and $N_2O$ emissions from the growth of the cattle herd and those generated by burning for the establishment and renewal of pastures, make this type of agent contribute the largest amount of GHG emissions for the AFOLU sector in the region individually.

### 6.3.2. **Small and medium-scale livestock producer**

Refers to the agent that decides to maintain or increase its livestock herd in production systems that do not incorporate environmentally sustainable practices, and in areas where there is no need to transform new areas of forest or natural savannahs. The main emissions generated in this case correspond to $CH_4$ and $N_2O$ from the processes of enteric fermentation of cattle and nitrogen fertilization of improved pastures, in addition to emissions from burning for pasture renewal.

### 6.3.3. **Prader for grabbing purposes**

In this case, the agent makes the decision to deforest new areas, establish them and divide them with pastures (lots), with the purpose of accumulating and illegally hoarding land that will later increase in value (e.g. if a new road is opened in the area) and sold in informal markets at the local level. The main emissions contributed by this agent correspond to $CO_2$ from deforested areas, in addition to other emissions from the use of fire in the process.

### 6.3.4. Agriculture industrial producer

Refers to the agent that decides to transform natural cover for the establishment of large-scale industrial mono-crops in production systems that do not incorporate environmentally sustainable practices, which generally require the use of fire in their establishment and demand large quantities of fertilizers for their growth and production. Depending on the species cultivated, the scale of production, cultural practices and whether there is deforestation to establish new cultivation areas, this agent can contribute $CO_2$, $CH_4$ and $N_2O$ emissions in different magnitudes.

### 6.3.5. Coca producer

This is the agent, generally a small producer, who decides to establish coca cultivated areas on his or her farm, whose product (coca leaf) is marketed locally and provides the income to expand production areas, either the same coca, other licit agricultural products or pasture for extensive cattle raising. Although, as mentioned above, coca areas in the region are decreasing, their persistence in some areas stimulates the transformation processes and allows the action of other agents. In this case, emissions correspond mainly to $CO_2$ generated by deforestation for the establishment of illicit crops and $N_2O$ from the fertilization required.

Transportation infrastructure builder

This refers to the agent that decides to transform natural land cover for the expansion of transportation infrastructure in the region, especially that related to the construction (formal and informal) of tertiary or lower tertiary land roads on a rural scale. As previously mentioned, the greatest contribution of emissions from this type of agent corresponds to the dynamics that are indirectly accelerated by the possibility of access to new areas of transformation, in addition to the direct $CO_2$ emissions resulting from deforestation due to infrastructure works.

### 6.3.6. Wood extractor for self-consumption

This agent corresponds to a rural producer who extracts wood on a small scale for use as fuel (firewood), housing construction or as an input in agricultural activities (fence posts, stakes for certain crops, boxes, etc.). In this case, $CO_2$ emissions are contributed by the forest degradation and/or deforestation processes generated by the extraction of the resource.

### 6.3.7. Wood extractor for high-scale commerce

Corresponds to an agent that extracts timber in larger quantities for commercialization purposes at different scales and markets. Generally, the agent illegally harvests fine timber and commercializes it on a large scale in local, regional markets or large cities if the demand exists. Emissions generated by this type of agent correspond to $CO_2$ from deforestation and/or forest degradation caused by the extraction of the resource.

## 6.4. Chains of events in AFOLU emissions

AFOLU emissions in the Orinoco region are directly related to the expansion of the agricultural frontier (extensive cattle ranching, grazing, industrial crops and coca crops), considering the impact that this expansion generates in terms of deforestation and, to a lesser extent, its impact on other land covers such as natural savannahs. The processes of transformation of natural land cover lead to the continued expansion of the frontier, mainly by cattle ranching, and with fire as a means for the growth of the activity from previously transformed areas.

The conversion of forests to pasture (Grazing land expansion) and the expansion of extensive cattle ranching are the main direct causes of regional emissions, especially when they occur synergistically, because in addition to the change in land cover, they imply an increase in the cattle herd and its direct emissions. Agriculture is developed at different scales, with a greater contribution in emissions from agro-industrial crops. According to ODC (2020), coca crops show a clear trend of reduction in the Orinoco region; however, they still stimulate important natural cover conversion processes, mainly in the southern area of the department of Meta.

The underlying causes are mainly associated with the legal status and land tenure, the presence and effectiveness of protected areas and indigenous reserves, the vision of the region as the "agricultural and livestock pantry of the country" (current and potential), the technological and productive development of large-scale agricultural activities, the livestock culture of the region, the presence of illegal armed actors that promote conversion activities, among others. These factors condition the decisions of the agents of emissions, including livestock and agricultural producers (industrialists and coca growers) and land grabbers, who do not incorporate environmentally sustainable practices into their production systems. The greatest contribution to GHG emissions comes from those agents that promote large-scale conversion of natural land cover to pasture for unsustainable livestock expansion.

The resulting deforestation and the increase in livestock herds in unsustainable systems make these two sources of emissions (change from natural forest to other uses and enteric fermentation of livestock) the main sources of emissions in the region, adding the highest emissions of $CO_2$ and $CH_4$, respectively. In addition, $N_2O$ emissions from nitrogen fertilization of improved pastures, industrial crops (mainly rice) and coca crops remain in the region (Figure 66).

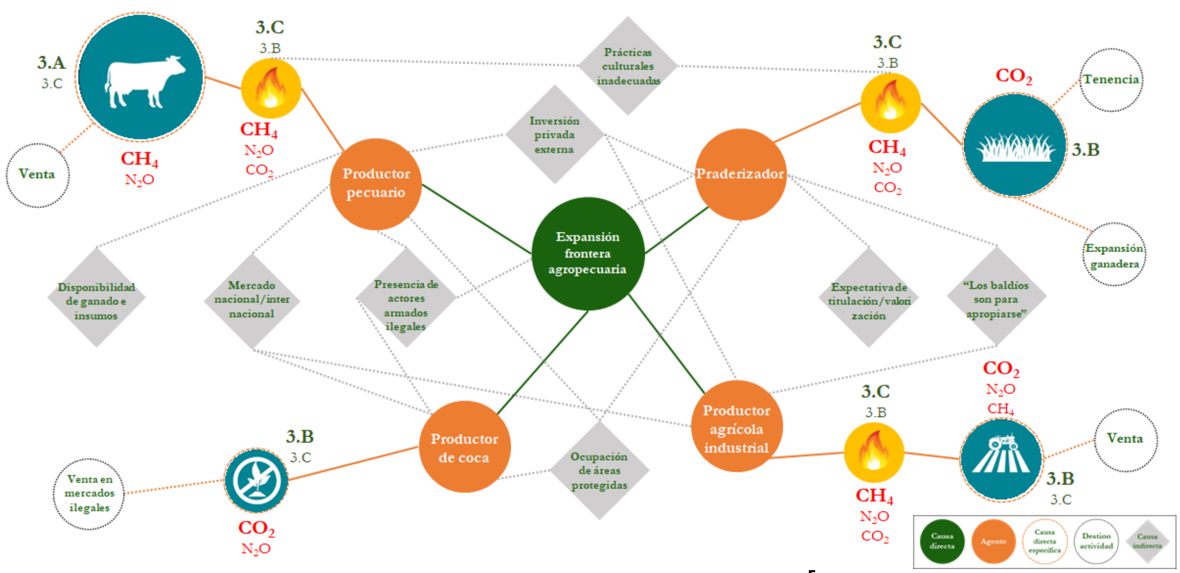


Figure 66. Chain of events of regional AFOLU emissions due to expansion of the agricultural frontier (own elaboration)[170]

The expansion of transportation infrastructure includes a formal component related to the construction of roads for hydrocarbon exploration and exploitation, biofuel production and, to a lesser extent, mining activities. There are also agents that build or improve informal roads (roads and cattle trails), even inside protected

[170] In these chains of events, the number followed by a letter indicates the relevant AFOLU categories of the GHG inventory, and in red letters the main gases emitted in each sub-chain, according to their degree of importance.

areas, for connectivity purposes between isolated population centers or to have the possibility of moving the large quantities of livestock that arrive and are marketed in the region.

Other underlying causes that condition the decisions of the agents (formal and informal builders of transport infrastructure) are the availability of investment resources at different scales and objectives, planning and control problems in the expansion of this type of infrastructure, and the presence of illegal armed actors, among others.

Although the direct impact of this chain is centered on the change in land use for formal and informal road construction, which generates small $CO_2$ emissions, the results indicate that the greatest impact of this expansion is indirect, e.g., it allows the expansion of the agricultural frontier and the consequent growth of the livestock herd and deforestation, which ultimately results in higher GHG emissions (Figure 67).

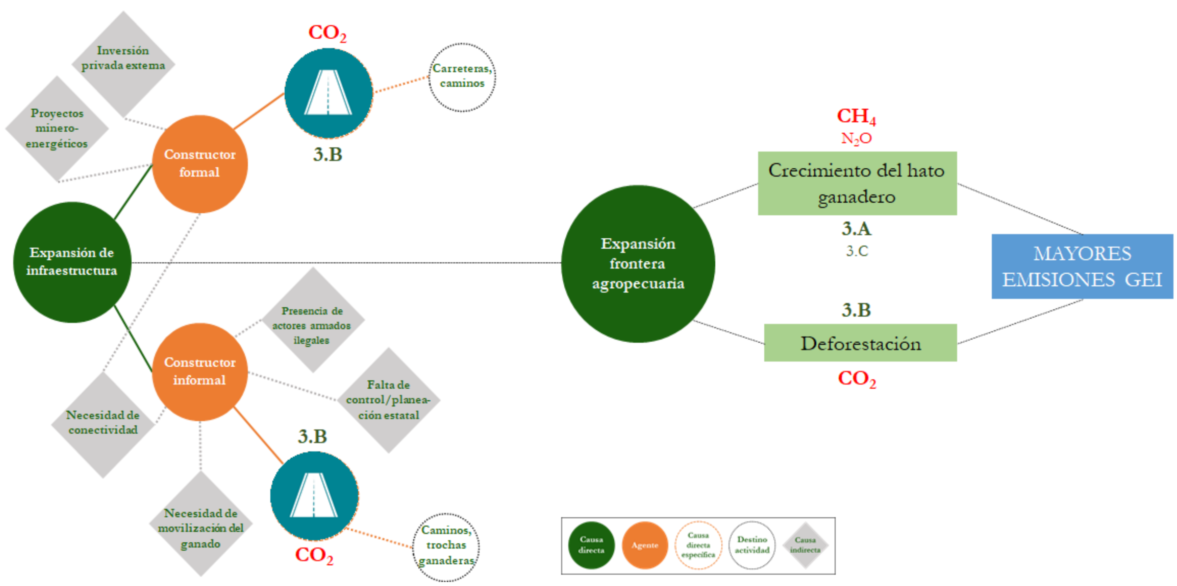


Figure 67. Chain of events of regional AFOLU emissions due to transportation infrastructure expansion (own elaboration)

From the point of view of emissions accounting, timber extraction basically refers to forest degradation processes whose impact depends on the scale of extraction; that is, small-scale logging (for firewood consumption) has lower impacts than large-scale selective logging (for commercial purposes). Factors such as cultural roots in the local use of wood, easy access, and low extraction costs, as well as the illegality of the activity facilitated by the presence of organized armed actors, the lack of forest control and surveillance, and the demand for fine wood, all contribute to this chain of emissions events.

The interrelationship between the indirect or underlying causes described above, the decisions of the agents (timber harvesters for self-consumption or sale) and the transformation of natural cover through direct causes (extraction processes at different scales), generate significant $CO_2$ emissions that are part of category 3B (Land) of the AFOLU component in the regional GHG inventory (Figure 68).

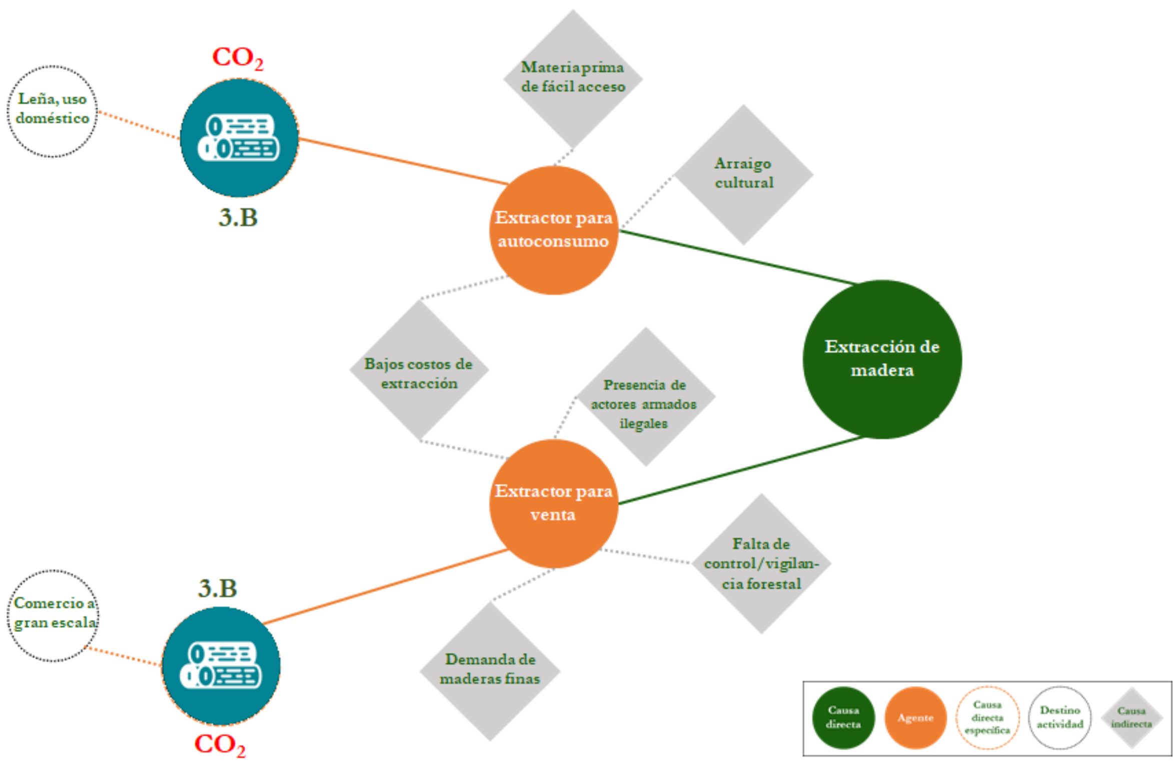


Figure 68. Chain of events of regional AFOLU emissions from timber harvesting (own elaboration)

# 7. CAUSES AND AGENTS IN AFOLU REGIONALS REMOVALS

The analyses developed, complemented with the information from the multitemporal change matrices for different land cover and the adjustments of the regional GHG inventory (updated to 2018), have allowed us to have an approximation of the identification and characterization of the main direct causes of GHG removals in the Orinoco region for the AFOLU component.

## 7.1. AFOLU removals direct causes

The analysis of the AFOLU emissions/removals balance for the Orinoco region, contrasted with the available information sources and the participatory technical work of the ERP of the project "Low Carbon Sustainable Development in the Orinoco Region - Biocarbon Fund", has allowed to identify (preliminarily) five main direct causes of GHG removals at regional scale: 1) natural regeneration and forest restoration; 2) forest plantations in previously transformed areas; 3) permanent crops in previously transformed areas; 4) silvopastoral systems; and 5) sustainable soil and degraded pasture management practices. The relationship between the direct causes of removals and the subcategories of the GHG inventory (updated as of 2018) is presented in Table 40.

Table 40. Relationship between direct causes of regional AFOLU removals and GHG inventory subcategories

| Direct cause of removals | AFOLU subcategory in GHG regional inventory* |
|---|---|
| **Natural regeneration and forest restoration** | **3B1aii2 - Forest Land Remaining Forest Land-Stock change other woody vegetation)** |
| | **3B1b Land converted to forest land** |
| | 3B1aii1 Forest land remaining as forest land-Stock change [ |
| **Forest plantations in previously transformed areas** | **3B1aiii Forest land remaining as forest land-Stock change** |
| | 3D1 Harvested wood products |
| **Permanent crops in previously transformed areas** | **3B2aiii Cropland Remaining Cropland-Palms** |
| | **3B2aiii Cropland Remaining Cropland-Cocoa** |
| | 3B2avii Cropland remaining cropland-Lemon |
| | 3B2aix Cropland remaining cropland-Orange |
| | 3B2aiv Cropland Remaining Cropland-Avocado |

| Direct cause of removals | AFOLU subcategory in GHG regional inventory* |
|---|---|
| | 3B2aviii Cropland remaining cropland-Mandarin |
| | 3B2ai Cropland remaining cropland-Coffee |
| **Silvopastoral systems** | **3B3a Grassland Remaining Grassland** |
| **Sustainable soil and degraded pasture management practices** | **3B3a Grassland Remaining Grassland** |
| | 3B2bii Grassland Converted to Cropland (NE) |

Source: Own elaboration with information from the 2018 regional and departmental GHG inventory.

* The size and highlighting of the text indicate a greater importance of the subcategory within the regional GHG inventory.

NE: Not estimated but may be an important element of improvement within the inventory.

The baseline information on emissions and removals for the period 2009-2018, obtained from the SMByC change analyses and other sources, indicate that these removals are due to permanence and gains in the areas of coverages classified as other woody vegetation (not included in the country's definition of forest), commercial forestry plantations, palm oil cultivation, other permanent crops, silvopastoral systems and regeneration processes. Most of the estimated removals for the Orinoco region depend on the first three subcategories referenced (other woody vegetation, forest plantations and palm).

### 7.1.1. Natural regeneration and forest restauration

Corresponds to the different natural forest recovery processes that, in the long term, allow the restored or regenerated areas to be quantified as forest in the national monitoring and lead to increased removals (Tapasco et al. 2018). For the regional GHG inventory, removals corresponding to the forest regeneration rate are estimated, assuming a default timeframe of 20 years for full recovery, after this time it is assumed that the regenerated area enters dynamic equilibrium and its accumulation rate is zero.

Forest regeneration and restoration is understood as a process that involves the gradual recovery of native vegetation over time. It involves the reintroduction of various species, including those that composed the original vegetation. This process allows the return, maintenance and balance of the environmental system and its functions (Da costa et al. 2021). At the landscape scale, naturally regenerating forests can contribute cost-effectively to biodiversity conservation and restoration through the creation of buffer zones, the establishment of biological corridors in the agricultural matrix, and the recovery of disturbed areas within protected areas. Similarly, restoration can serve to increase ecosystem coverage, mitigate edge effects, reestablish connectivity and enrich degraded areas, thus contributing to the increase of carbon stocks accumulated in forest biomass (Guevara et al. 2005).

A forest in the process of natural regeneration after agricultural use is a social-ecological system in transition. When socioeconomic and biophysical conditions are favorable, this system is likely to recover the structural properties, species composition and social-ecological functions of the previous forest ecosystem. However, unfavorable conditions may push the system towards a state where active interventions are required to restore the forest ecosystem (Fischer et al. 2009). The successful establishment of natural regeneration is conditioned by ecological processes and anthropic disturbances; for example, the expansion of the agricultural frontier and free grazing in forest areas, which has generated a rapid transformation of landscapes into mosaics of crops, pastures and forest fragments of different sizes and floristic composition, leading to the interruption of growth and effective incorporation of regenerative processes (Gaitán et al. 2009).

It is important to contemplate that the restoration of native vegetation need not require the massive abandonment of local producers and the diminution of rural livelihoods or traditions. It requires the integration of new ways of thinking about how natural regeneration, with other solutions, can promote traditional knowledge to thrive with local economies and forest recovery. Natural regeneration is not a viable option for forest restoration if these changes do not provide benefits to rural residents (Chazdon et al. 2020).

Quantification of restored areas in Colombia is complex, due to the decentralization of information and the scale at which these activities are generated. However, the Environment and Sustainable Development Ministry has designed an information system in which the different restoration projects in the country are reported, in addition to having a counter of trees planted with the objective of restoration. According to this system (MADS 2021), for the Orinoco region, the department that reports the largest number of validated restoration processes is Meta, which covers more than 10.000 ha in the southern part of the department. In Arauca, the projects developed by the regional government have resulted in 6.564 ha restored; in Casanare, the projects are located mainly in Tauramena, Yopal and Paz de Ariporo, but these do not reach 200 ha registered. Finally, there is no validated information for the department of Vichada. On this way, the information on natural regeneration associated with the change data reported annually by the SMByC (IDEAM 2020), indicates that between 2010 and 2018, 1.493 hectares were quantified in the region as natural regeneration, with 56% corresponding to Vichada, 34% to Meta, 5% to Arauca and 5% to Casanare.

### 7.1.2. **Forest grassland in previous transformed areas**

According to their production cycle, the establishment of commercial tree plantations from other non-forest cover can significantly increase GHG removals (Tapasco et al. 2018). However, this land-use change should be encouraged from previously transformed areas, which present soil and/or pasture degradation or are underutilized, and not from natural covers such as savannah ecosystems typical of the Orinoco. The regional GHG inventory accounts for the accumulation of biomass in plantations until the harvest period is completed for each species.

The Food and Agriculture Organization of the United Nations (Brown, 2000) defines that forest plantations can be planted in the context of an afforestation process (converting areas that have been without forest for at least 50 years to forested areas) or reforestation (converting non-forested areas to forested areas). These may contain introduced or native species that meet the requirements of a minimum area of 0,5 ha, a canopy cover of at least 10% and a total height of adult trees of more than five meters.

The main purpose of these plantations is the industrial production of timber or for domestic use as construction material, firewood and fodder. The advantages of using native species are centered on the conservation of biodiversity and the reduction of soil degradation, while introduced species can produce benefits in less time and in greater quantities per unit area. Both systems can have a positive environmental impact, that is, they provide ecosystem services and generate a mitigating effect on global warming by acting as important carbon sinks (Ruiz et al. 2006).

By planting trees on scales where intensive management achieves high productivity, sufficient timber can be produced to reduce pressure on natural forests.

Forest plantations are often an important component of landscape-scale restoration and can bring degraded lands back into production and enhance the provision of ecosystem services. If well managed, they have the potential to sustainably provide goods and services required by society and thus enable other forest areas to be managed for conservation and protection objectives (Freer-Smith et al. 2019). These benefits of forest plantations do not consider as an alternative the change of use from natural forest to plantations, but to changes in areas that have already been converted and that their previous uses were mainly livestock and agricultural (Facciotto et al. 2015).

On a national scale, the Orinoco region presents an important role in relation to the area of commercial forest plantations, being the region with the second largest planted area (171.876 ha) after the Andean region (220.687 ha). Figure 69 shows the number of registered hectares of forest plantations by 2020 in each of the departments in the region. The departments of Vichada (110.589 ha) and Meta (54.288 ha) are the most representative of the region in terms of area allocated to this activity, and rank second and third at the national level (MADR 2021).

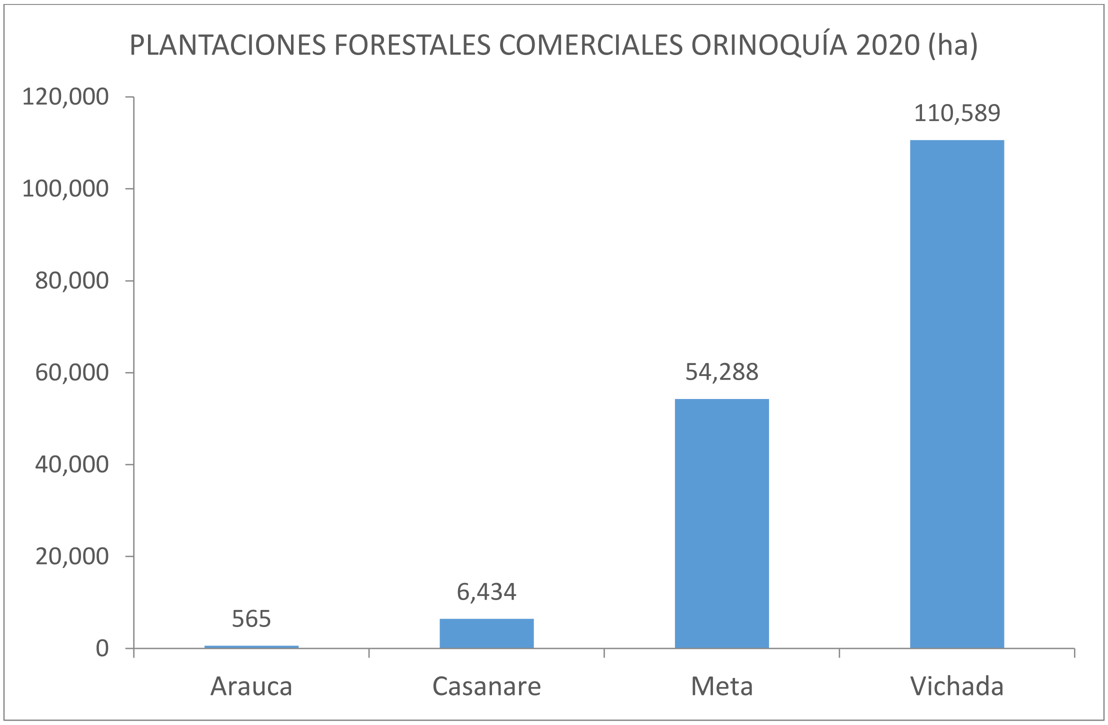


Figure 69. Area planted with commercial forestry plantations by department of the Orinoco region, year 2020 (own elaboration with data from MADR 2021).

According to the information recorded in the Forestry Statistical Bulletin (MADR 2021), the species with the largest planted area in the region in 2020 are mostly introduced species (Figure 70), including *Pinus caribea* (44.800 ha), *Acacia mangium* (44.574 ha), *Eucalyptus pellita* (28.760 ha) and *Hevea brasiliensis* (rubber) (26.410 ha).

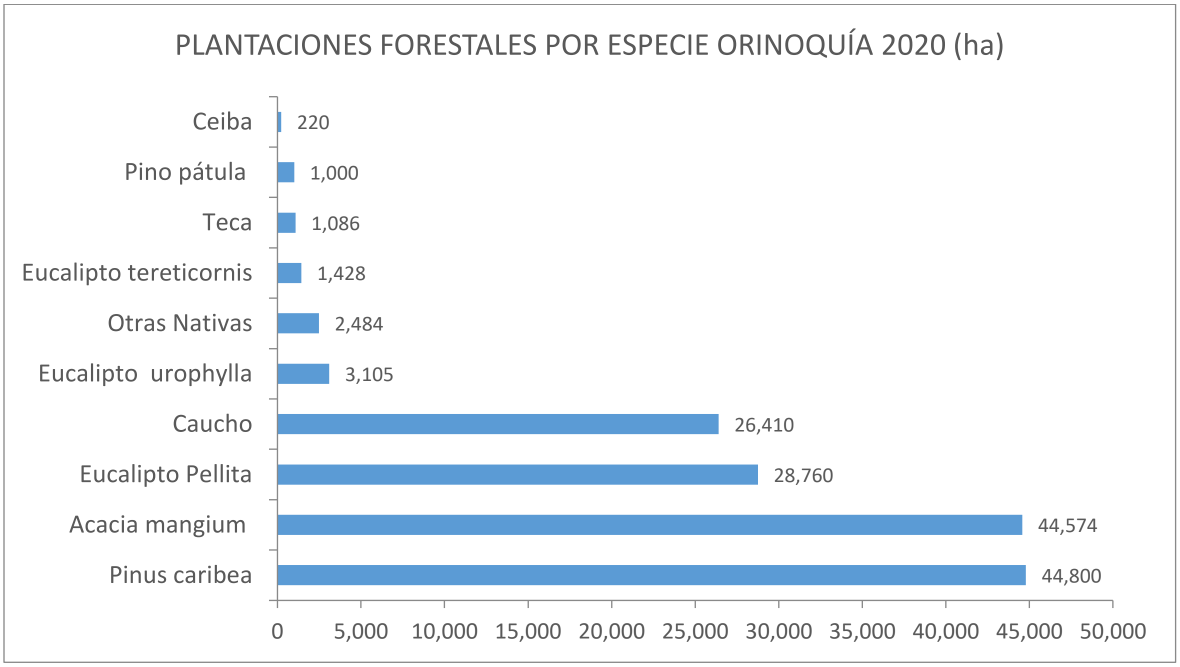


Figure 70. Species for forest plantations with the largest planted area in the Orinoco region, year 2020 (own elaboration with data from MADR 2021).

### 7.1.3. **Permanent crops in previous transformed areas**

It involves the change of previously transformed non-forest cover, which present a certain level of degradation or underutilization, towards permanent mono-crops based on tree species (palm oil, fruit trees) or agroforestry arrangements (rubber, cocoa, coffee) (CIAT and Cormacarena 2017). These changes are based on the analysis of activity data corresponding to the area planted and replanted of each type of crop in the region. In the case of coffee, the areas are differentiated according to the level of solar exposure of the crop (in shade, semi-shade and free exposure).

The incorporation of trees and shrubs in the agricultural matrix can increase carbon sequestration significantly compared to other systems such as mono-crops pastures. In addition to storing significant amounts of carbon in aboveground biomass, there are significant accumulations in belowground biomass (Nair et al. 2009). Studies on GHG removals in permanent tree crops allow the identification of species-specific trends, particularly with variables such as planting densities, management practices and carbon sequestration efficiency (Mota 2011).

Agroforestry systems (AFS) focus on changing the conventional management of land and natural resources for an integral and sustainable one; they are essentially a replica of natural forests that are made up of a diversity of species with different ecosystem functions, playing an important role in the conservation and sustainability of agroecosystems. In addition, the input requirements and productive capacity are highly adequate to cover the food and income needs of the families that implement them (Iglesias 1999).

AFS are important in carbon sequestration, greenhouse gas mitigation and improvement of soil physicochemical characteristics. They also contribute to biodiversity conservation, increasing species richness, abundance and diversity, compared to conventional agricultural systems; contribute to water conservation and availability by reducing runoff and pollution; and improve air quality by reducing odors from livestock facilities (Casanova et al. 2016).

According to information from the 1:100.000 land cover map of Colombia for 2018 (IDEAM 2021), the Orinoco has 284.010 ha of permanent tree crops, 905 ha of permanent shrub crops and 164 ha agroforestry crops, in addition to other tree crop covers that can be part of different crop mosaics. Most of these coverages are in the departments of Meta and Casanare.

### 7.1.4. Silvopastoral systems

Corresponds to the inclusion of tree and shrub species, in different densities and with different use objectives, in livestock grazing systems. Silvopastoral arrangements allow improving the efficiency of the system and increasing cattle carrying capacities per unit area (CIAT and Cormacarena 2017). To be an effective cause of increased GHG removals, it is important that improvements in efficiency do not imply a significant increase in the size of the cattle herd and, consequently, in methane emissions from enteric fermentation. If the system allows the release of extensive grazing areas, in the long term, removals can be increased by allocating these areas to forest restoration processes or crops in forestry arrangements such as cocoa (Tapasco et al. 2018).

In silvopastoral systems, perennial woody plants (trees and/or shrubs) interact with traditional components (herbaceous forage and animals) under an integrated management system. Trees can be natural or planted for timber, fruit or as multipurpose trees in specific support for animal production. Therefore, there are several types of silvopastoral systems. In Colombia there is grazing in natural forests, in commercial forestry plantations, in fruit tree plantations; pastures with fodder trees and/or shrubs; mixed systems with multipurpose trees or shrubs for cutting, live fences, fodder banks, among others (Mahecha 2003). The more complex the system or the greater the density of trees, the greater the benefits.

However, in the establishment and benefits of a silvopastoral system, it is necessary to consider the type of forage species to be used, the appropriate density, and their adaptability to the type of soil, climatic conditions and shade (Camero 2019).

In addition to their value for providing food of high nutritional value, especially during the dry season, and for their economic value as timber and source of environmental services (carbon sink and biodiversity conservation), silvopastoral arrangements contribute to mitigate $CO_2$ emissions to the atmosphere, since this gas is used by plants to perform photosynthesis and, therefore, carbon is captured and stored to maintain the woody structures of plant organisms. Therefore, it is considered that the conversion of pastures to silvopastoral systems can reduce soil carbon losses (Lara 2019).

In ecoregions such as the Colombian Orinoco, livestock landscapes converted to silvopastoral systems contribute to the conservation of native forests, the protection of wetlands, the low impact management of natural savannahs and, simultaneously, transform the matrix of introduced pastures without trees into an agroforestry territory through the combination of different arrangements (Chará et al. 2011).

### 7.1.5. Sustainable management practices for degraded soils and pastures

The recovery of soils and/or pastures with high level of degradation or low productivity (excluding natural savannahs), through the implementation of management practices that do not involve nitrogen fertilization, can increase carbon accumulation and cattle carrying capacities (Tapasco et al. 2018). This can lead to the release of extensive grazing areas to conservation uses or agroforestry systems and, ultimately, represent an interesting contribution to the projected removals of the regional GHG inventory.

Pressures on soils in rural areas continue to increase, due to the intensification of their use for agricultural activities and the demand of the growing population, which when combined with unsustainable management practices and extreme climatic anomalies produce the degradation of the resource, which in the country reaches about 40% of the total area of the territory (MADS and IDEAM 2015). Therefore, proposing sustainable management strategies for degraded soils and pastures is an essential process to reverse this trend, provided that it does not affect food security or the provision of ecosystem services (Dietl and Fernandez 2009).

Although conventional tillage techniques used in agriculture normally generate soil erosion and, therefore, a decrease in carbon sequestration and storage, good practices (also known as sustainable or conservation agriculture) help to halt the release of GHGs by managing organic matter, improving soil structure and conserving habitats. These sustainable systems are based on three interrelated principles: minimal soil disturbance, permanent vegetation cover, and diversification and rotation of crop species (Mota 2011).

Implementing sustainable soil and pasture management strategies allows GHG absorption, because pastures have the capacity to capture atmospheric CO2 and transform it into organic carbon, in addition to being considered one of the main covers for storing carbon in the soil (about 30% of soil carbon pools are found in pastures). Although CO2 absorptions that occur in soils covered by grasslands are not as efficient as those generated by tropical forests and other forest species (plantations), they are a good alternative in carbon sequestration, given that in one hectare a little less than two tons of carbon can be retained (Marín 2018).

In addition to the above, different benefits have been identified by integrating sustainable soil and degraded pasture management practices in territories with livestock potential, as is the case of the Colombian Orinoco region. Among these benefits are: greater cattle carrying capacities, ecological balance, recovery of pastures and savannah ecosystems, reduction of labor, reduction in the cost of medicines and supplements, and increase in net profitability per unit area (Melado 2014).

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## GLOSARY

**a. Actions:** Correspond to the specific activities to be developed in each of the measures (direct or enabling) defined and prioritized for implementation at the national, subnational and/or local level (adapted from González et al. 2018c).

**b. Agents of emissions/absorptions AFOLU:** Correspond to individuals, groups of individuals or institutions that, influenced by the underlying causes, make the decision to establish productive activities that transform natural cover, and generate greenhouse gas emissions or removals (adapted from González et al. 2018a).

**c. Forest (national monitoring):** Land occupied mainly by trees that may contain shrubs, palms, guaduas, herbs and lianas, in which tree cover predominates with a minimum canopy density of 30%, a minimum canopy height (in situ) of 5 meters at the time of identification, and a minimum area of 1.0 hectare. Tree cover of commercial forest plantations, palm plantations, and trees planted for agricultural production are excluded. This definition is consistent with the criteria defined by the UNFCCC in decision 11/COP.7. Any other type of land cover different from forest is defined as "Non-forest" (IDEAM 2020).

**d. GHG emissions/removals chain of events:** chain of events analysis seeks to identify the relationships between main groups of agents and causes (direct and underlying) of transformation, to try to explain the logical sequence of the process leading to the generation of emissions or increased removals of GHGs in a particular area (adapted from González et al. 2018a).

**e. Direct causes of AFOLU emissions/removals:** direct causes (also called drivers) are related to agricultural, forestry or other land-use activities that lead to the generation of GHG emissions or removals. They generally involve the change of natural land covers to productive use (which can generate GHG emissions), their permanence or their regeneration (which can increase GHG removals) (adapted from González et al. 2018a).

**f. Underlying or indirect causes of AFOLU emissions/removals:** these are social, economic, technological, political and biophysical factors or processes that reinforce the direct causes of AFOLU emissions/removals and influence the decisions made by agents or their motivations (adapted from González et al. 2018a).

**g. Activity data:** quantitative information that makes it possible to establish the magnitude of human activities that result in GHG emissions or removals occurring during a given period of time (IDEAM and UNDP 2018).

**h. Deforestation:** Direct and/or induced conversion of forest cover to another type of land cover in a given period of time (IDEAM 2020).

**i. Emission factor:** A representative value that relates the amount of a gas emitted into the atmosphere to the activity associated with the emission of that gas (IDEAM and UNDP 2018).

**j. Inventory of GHG emissions and removals:** It is the quantification of greenhouse gases emitted into the atmosphere as a product of anthropogenic sources (resulting from human activities) and the amount of removals by carbon sinks, occurred in a geographical area during a specific period of time (e.g. one year) (IDEAM and UNDP 2018).

k. **Measures:** Set of actions carried out at the national, sub-national and/or local scale to address the causes and agents of emissions and to increase GHG removals. The measures are framed within national policies and strategies on climate change and deforestation control; they include policy instruments, practices, incentives, among others, and seek to generate changes to achieve GHG emission reduction targets in the AFOLU sector. Direct measures seek the achievement of results in terms of reduced emissions or increased removals, while enabling measures establish the necessary conditions for direct interventions to be feasible to implement and, finally, to be effective, efficient, and equitable (adapted from González et al. 2018c).

l. **High deforestation core:** Defined as that geographic area where significant concentrations of deforested areas are present in a specific reference period (González et al. 2018a).

m. **Forest and Carbon Monitoring System (SMByC):** It is the set of processes, methodologies, protocols and tools for the periodic generation of information on: i) Colombia's forest area and its changes over time; ii) carbon stocks stored in natural forests; iii) causes and agents of deforestation and forest degradation; and iv) GHG emissions and removals associated with deforestation and forest degradation (MADS 2017).

n. **Annual rate of deforestation:** Variation in the area covered by natural forest in a given spatial unit of reference (j), between the initial year (t1) and the final year (t2) (IDEAM 2020).

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## Annex 2: Financing Plan for ISFL ER Program

The methodological steps to estimate the costs of the Biocarbon ERP (PRE BioCarbono in Spanish) are as follows:

- Analysis of the basic actions of the program
- Definition of basic costing units
- Unit cost estimation
- Quantity projection
- Cost projection
- Classification and distribution

The projection of quantities was based on the emission reduction goals and the estimated $CO_2$ emission (reduction) factors per hectare for the coverage associated with the activities associated with each production chain and group of measures.

Based on the definition of activities and measures, an analysis is carried out to determine what type of actions or interventions are required for each measure. For example, it is defined whether research, consulting, technical assistance, integrated rural extension, producer training, staff training, etc., are required.

For each type of action or intervention of the program, the corresponding basic costing unit is defined. For example, if training is required for 1000 producers, then the basic unit may be one training session for 50 attendees and 20 basic units will be required to complete the intervention. In this way, the basic costing units can represent:

- Inputs necessary to develop a measure (Professionals' working days, transportation fares, conference/workshop rentals, etc.)
- Processes that can be costed together (training workshops, technical assistance visits, training course, etc.)

Services that are contracted on an aggregate basis but can be standardized to a comparable unit (Monthly cost of a standard consultancy or research project, Protocol development, guides or brochures, awareness campaigns). [

**Summary of the Financing Plan for an Emergency Program**

| | Article | Sub-element | Code | Activity | Financial category | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Cost | 1.(a) Implementation costs | | | | | | | | |
| | | 1.(a) (i) Rice chain | AR2 | Selection and implementation of sustainable low-carbon production practices and models for the reduction of GHG emissions in rice production. | | 1.491 | 1.055 | 901 | 83 | 84 |
| | | 1.(a) (ii) Cocoa chain | CA1 | Implementation of low-carbon cocoa crop production strategies. | | 597 | 513 | 590 | 538 | 547 |
| | | 1.(a) (iii) Oil palm chain | PA1 | Planning and rehabilitation of oil palm plantations under a landscape approach. | | 375 | 43 | 1 | 5 | 5 |
| | | | | FILA EXTRA | | | | | | |
| | | | PA2 | Implementation and monitoring of best low carbon practices associated with oil palm production. | | 255 | 296 | 161 | 124 | 124 |
| | | 1.(a) (iv)Marañon chain | MA1 | Development of sustainable low-carbon agroecosystems for marañon cultivation. | | 756 | 482 | 369 | 376 | 382 |
| | | 1.(a) (v) Multichain | MU3 | Promotion of the efficient use of fertilizers and agrochemicals in agricultural production systems | | 333 | 301 | 213 | 219 | 224 |
| | | | MU4 | Implementation of sustainable management practices aimed at reducing GHG emissions in small-scale agricultural systems that contribute to food and nutritional security. | | 564 | 352 | 265 | 271 | 276 |

| | Article | Sub-element | Code | Activity | Financial category | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.(a) (v) Forest plantations | PL1 | Development and consolidation of the commercial forestry plantation production chain as a contribution to increase GHG removals. | | 2.529 | 2.617 | 2.884 | 708 | 524 |
| | | 1.(a) (vi) Rubber chain | CH1 | Development and implementation of sustainable production practices with commercial rubber plantations. | | 395 | 375 | 378 | 32 | 32 |
| | | | IN3 | Additional incentives to increase rubber plantations | | - | - | - | - | - |
| | | 1.(a) (vii) Efficient cooking technology | ES1 | Establishment of dendro-energy crops | | 296 | 296 | 296 | 135 | 127 |
| | | | ES2 | Implementation of eco-efficient cookstoves in rural households | | 2.823 | 2.823 | 2.823 | 2.823 | 2.661 |
| | | 1.(a) (viii) Restoration | RE1 | Implementation of restoration processes in degraded areas and ecosystems | | 2.628 | 1.992 | 2.198 | 1.922 | 1.959 |
| | | | IN1 | Additional incentives for restoration | | 170 | 170 | 170 | 170 | 170 |
| | | 1.(a) (ix) Livestock | GA2 | Bovine feeding management to mitigate GHG emissions | | 842 | 460 | 471 | 483 | 494 |
| | | | GA5 | Rational grazing through division and rotation of paddocks | | 1.367 | 747 | 764 | 784 | 800 |
| | | | GA6 | Restoration and renewal of degraded introduced pastures | | 920 | 587 | 411 | 421 | 431 |
| | | | GA7 | Establishment of intensive and non-intensive silvopastoral systems. | | - | 1.200 | 1.116 | 1.383 | 1.197 |
| | | | GA8 | Release of areas from livestock use for restoration or reconversion to agroforestry systems. | | - | 1.315 | 718 | 736 | 754 |
| | | | GA9 | Landscape-based land planning for the | | 71 | 53 | 227 | 221 | 221 |

| | Article | Sub-element | Code | Activity | Financial category | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | implementation of sustainable livestock systems. | | | | | | |
| | | | GA10 | Management of waste generated in livestock systems | | - | 134 | 78 | 79 | 81 |
| | | 1.(a) (ix) Reduced deforestation | DE1 | Promotion of sustainable productive options based on natural capital that boost the forest economy. | | 294 | 320 | 362 | 332 | 335 |
| | | | DE2 | Implementation of conservation processes and sustainable forest management, including in special protection areas affected by deforestation | | 587 | 506 | 424 | 394 | 397 |
| | | | DE3 | Development of extension, technical assistance and research mechanisms for the sustainable use of biodiversity associated with natural forests. | | 97 | 97 | 97 | 97 | 97 |
| | | | IN2 | Additional incentives for deforestation reduction | | 681 | 681 | 681 | 681 | 681 |
| | | | RE2 | Implementation of processes for conservation, protection and management of areas and ecosystems that contribute to increase carbon stocks | | 478 | 443 | 443 | 443 | 446 |
| | | | ET1 | Contribution to indigenous community projects | | 2.207 | 2.207 | 2.207 | 2.207 | 2.207 |
| | | ***Subtotal Implementation costs*** | | | | **20.756** | **20.064** | **19.249** | **15.667** | **15.258** |
| | | **1.(b) Institutional costs** | | | | | | | | |
| | | 1.(b) (i) Administration | AD1 | IPU administration and operation | | 562 | 562 | 1.124 | 1.124 | 1.124 |
| | | | AD3 | Management of SESA, ESMF, Distribution of benefits | | 339 | 339 | 339 | 339 | 339 |

| | Article | Sub-element | Code | Activity | Financial category | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 1.(b) (ii) Policies and compliance with the law | DE7 | Articulation of deforestation control instruments in NADs and strategic natural forest conservation areas | | 383 | 383 | 383 | 383 | 383 |
| | | | DE8 | Strengthening the administrative, technical and legal capacities of the authorities involved in the prevention, investigation, prosecution and control of environmental crimes | | 383 | 383 | 383 | 383 | 383 |
| | | | DE9 | Implementation of control actions to illegal economies that drive deforestation | | 383 | 383 | 383 | 383 | 383 |
| | | | DE10 | Development of monitoring systems (national, regional and local) to measure the effectiveness of of control interventions to control deforestation and sustainable forest management | | 383 | 383 | 383 | 383 | 383 |
| | | | PG3 | Strengthening of rural property formalization processes | | 65 | 369 | 348 | 348 | - |
| | | | PG4 | Articulation of economic instruments/financial incentives to enable GHG emissions reduction and increase the resilience of regional ecosystems | | 596 | 137 | 137 | 137 | 137 |
| | | 1.(b) (iii) Training and capacity building | GA1 | Management of certification processes for livestock practices related to the mitigation of GHG emissions | | 770 | 500 | 331 | 330 | 337 |
| | | | GA4 | Management of water resources in livestock farms | | 464 | 457 | 68 | 9 | 27 |
| | | | DE5 | Generate technical capacities to develop cross-sectoral planning and management instruments to avoid deforestation | | 65 | 38 | 38 | 23 | 23 |

| | Article | Sub-element | Code | Activity | Financial category | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | DE6 | Strengthening education, communication, knowledge and citizen participation for territorial governance and sustainable forest management. | | 19 | 19 | 19 | 19 | 19 |
| | | | PG5 | Coordination of agricultural and forestry extension, environmental education and citizen participation strategies aimed at low-carbon rural development | | 237 | 237 | 237 | 237 | 237 |
| | | 1.(b) (iv) Other enabling costs: Research | AR1 | Development of rice varieties tolerant to climatic extremes | | 305 | 134 | 96 | 204 | 60 |
| | | | MU2 | Research and establishment of agro-silvopastoral and agroforestry arrangements that contribute to improve the carbon balance in agricultural systems | | 165 | 164 | 77 | 120 | 133 |
| | | | GA3 | Use of bovine breeds and their crosses adapted to the environment and more responsive to low-carbon feeding practices | | 453 | 416 | 417 | 47 | 48 |
| | | 1.(b) (v) Other enabling costs: Planning | MU1 | Planning and efficient management of water resources for the improvement of rubber, oil palm and cocoa crops | | 2.332 | 94 | 2.305 | 33 | 35 |
| | | | DE4 | Development and implementation of comprehensive interventions for the stabilization of NADs, including land use planning, as well as the resolution of conflicts related to the use, occupation and possession of land property | | 371 | 210 | 210 | 210 | 210 |
| | | | PG1 | Environmental and productive planning of the rural territory at different levels (subregional, regional, local) | | 3.770 | 609 | - | - | - |

| | Article | Sub-element | Code | Activity | Financial category | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | PG2 | Strengthening planning processes and capacities to advance climate change adaptation and mitigation | | 649 | 207 | 74 | 517 | 207 |
| | | ***Sub-total institutional costs*** | | | | **12.696** | **6.026** | **7.354** | **5.229** | **4.470** |
| | | **1.(b) Transaction costs** | | | | | | | | |
| | | | AD2 | Integral information system | | 450 | 518 | 135 | 135 | 135 |
| | | | MRV | Monitoring, Reporting and Verification | | 414 | 414 | 369 | 369 | 369 |
| | | ***Subtotal transaction costs*** | | | | **864** | **931** | **504** | **504** | **504** |
| | | **Total costs: 1(a)+ 1(b) +1(c)** | | | | **34.316** | **27.021** | **27.107** | **21.401** | **20.233** |
| **2** | **Sources of funding** | **2(a) National** | | National Budget except CARs | Subsidy | 3.008 | 3.005 | 3.005 | 2.854 | 2.691 |
| | | | | | Mandated | 7.119 | 5.768 | 6.545 | 3.286 | 3.199 |
| | | | | Regional Autonomous Corporations (CARs in Spanish) | Subsidy | 2.701 | 1.415 | 2.074 | 1.239 | 1.250 |
| | | | | Regional governments budgets | Mandated | 1.628 | 1.833 | 1.648 | 1.744 | 1.705 |
| | | | | Municipal budgets | Mandated | 711 | 924 | 842 | 855 | 812 |
| | | | | Private sector and trade unions | Parafiscal Fund | 1.211 | 890 | 765 | 261 | 175 |
| | | ***National subtotal*** | | | | **16.377** | **13.835** | **14.881** | **10.240** | **9.833** |
| | | **2(b) International** | | Multilateral cooperation | | 751 | 573 | - | - | - |
| | | ***International subtotal*** | | | | **751** | **573** | **-** | **-** | **-** |
| | | **2 (c) Income from products and services** | | | | | | | | |
| | | | **Result-based payments** | | | - | - | 2.324 | 7.709 | 7.751 |
| | | ***Sub-total income from products and services*** | | | | **-** | **-** | **2.324** | **7.709** | **7.751** |
| | | **Total sources: 2(a)+2(b)+2(c) +2(d)** | | | | **17.129** | **14.409** | **17.205** | **17.949** | **17.584** |

| | Article | Sub-element | Code | Activity | Financial category | 2024 | 2025 | 2026 | 2027 | 2028 |
|---|---|---|---|---|---|---|---|---|---|---|
| **3** | **Gap** | | | | | **- 17.187** | **- 12.613** | **- 9.902** | **- 3.452** | **- 2.649** |
| **4** | **Options to reduce the gap** | **4(a) Traditional sources** | | General Royalties System (SGR in Spanish) | Subsidy | 6.165 | 4.583 | 3.245 | 1.988 | 1.492 |
| | | **4(b) Alternative sources** | | International cooperation | Loans | 7.801 | 4.563 | 2.483 | 1.464 | 1.157 |
| | | | | Sustainability and Climate Resilience Fund (Fonsurec, in Spanish) | Mandated | 3.221 | 3.467 | 4.175 | - | - |
| | | ***Total options to finance the gap*** | | | | **17.187** | **12.613** | **9.902** | **3.452** | **2.649** |
| **5** | **Financial Sensibility** | **Surplus/deficit** | | + 10% costs | | -18.326 | -13.442 | -10.722 | -3.970 | -3.138 |
| | | | | - 10% in financing | | -18.513 | -13.685 | -11.079 | -4.059 | -3.053 |
| | | | | + 20% costs | | -19.575 | -14.380 | -11.648 | -4.514 | -3.640 |
| | | | | - 20% in financing | | -19.839 | -14.756 | -12.255 | -4.742 | -3.476 |
| | | | | + 30% costs | | -20.875 | -15.439 | -12.649 | -5.225 | -4.233 |
| | | | | - 30% in financing | | -21.165 | -15.828 | -13.431 | -5.461 | -4.000 |
| | | | | - 2 % in financing | | -17.152 | -12.645 | -10.168 | -3.648 | -2.939 |
| | | | | + 2% in financing | | -17.273 | -12.618 | -9.690 | -3.282 | -2.382 |
| **6.** | **Identification of financing risks** | Financing risks | R1 | | | | | | | |
| | | | R2 | | | | | | | |
| | | | R3 | | | | | | | |
| | | | R4 | | | | | | | |
| **7.** | **Proposed measures** | Measures to address financing gap/risks | M1A | | | | | | | |
| | | | M1B | | | | | | | |
| | | | M1C | | | | | | | |
| | | | M2A | | | | | | | |
| | | | M3A | | | | | | | |

## Annex 3: Assessment of Land and Resource Tenure in the Program Area

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## INTRODUCTION

During the last decade there has been a growing international concern about the effects of traditional production schemes on the environmental sustainability of the planet, due among other factors, to carbon emissions, which contribute to exacerbating climate change.

The main dilemma faced when dealing with this issue is that the world population is constantly growing, generating greater demands for fuel, housing, food and all the goods and services required by human beings, so it is necessary to expand land use at the expense of forest areas or those covers that capture and fix carbon, as well as an increase in industrial production and the use of transport, leading to a greater emission of greenhouse gases.

The role of the agricultural sector in the emission of these gases is supported by Organisation for Economic Co-operation and Development (OECD) (2021) research, which argues that the agriculture, forestry and other land use (AFOLU) sector is responsible for about 23% of greenhouse gases worldwide, which has a greater representation in countries that have an agricultural focus, such as Colombia, where the agricultural sector participates with about 26% of emissions and forestry with 36%. (IDEAM, 2016).

In summary, the dynamism of the world population and its growing need for food, generates increases in production and a growing use of land that threaten the environmental sustainability of the planet in the short term.

From this perspective, different multilateral organizations, including the World Bank, are seeking to promote alternative production schemes to meet growing demand with a sustainable approach, that is, without increasing greenhouse gas (GHG) emissions. Precisely, in fulfillment of this purpose, the World Bank manages since 2013 the Sustainable Forest Landscapes Initiative (SFLI) of the BioCarbon fund, whose purpose is to; *"…provide a multilateral service that encourages and rewards gas reductions and increased sequestration through improved land management including strategies such as REDD+ (Reducing Emissions from Deforestation and Forest Degradation), climate-smart agriculture, and smarter land use planning and policies..."* (World Bank, 2021).

Among the beneficiary countries of the ISFL BioCarbon Fund is Colombia, and in particular, the Orinoco region, which is considered the last agricultural frontier of Colombia[171] and, therefore, the right place to formalize a carbon emissions reduction program. To achieve this objective, within the framework of the BioCarbon Fund, the World Bank has defined that this program should be

**[171] In different articles of the World Bank, including *hacia un nuevo modelo de desarrollo sostenible para la Orinoquía en Colombia,* the Orinoco region has been called the last agricultural frontier of the country, since it has a large amount of land available for the development of agricultural and livestock activities.**

developed in two stages, where the first one corresponds to the provision of technical support to conduct a diagnosis on the possibilities of the region to implement an emissions reduction program, while the second one, based on the initial analysis, is to formalize the contracts and their operation.

The development of this document is framed in the first moment, particularly in component 3 of the Biocarbon project for the Orinoco, which deals with *"...the development of technical assistance activities for the design, establishment and operation of the emission reduction program with a payment by results approach..."*. This component has identified the need to develop an analysis of land ownership and land distribution in the departments that make up the Orinoco, Meta, Casanare, Arauca and Vichada, in order to identify the ownership structure and indicators of the distribution of rural land ownership in the region, their similarities and differences between the 4 departments that make up the region, thus contributing to generate a diagnosis that allows identifying the potentialities or limitations of the region with respect to the implementation of an emissions reduction program.

Under these premises, the first part of this document considers aspects of land ownership from a conceptual approach, to establish how the components of land ownership in Colombia have been delimited and how they are applied in the departments of the Orinoco region. Specifically, it addresses the concept of land ownership as defined by the Food and Agriculture Organization of the United Nations (FAO), and then identifies the actors involved in the ownership structure and their ways of relating to land, differentiating between formal and informal agents.

After addressing the conceptual elements of the ownership structure, it was determined that, in order to achieve the purpose of characterizing the structure of land ownership and land distribution in the Orinoco region, the Rural Agricultural Planning Unit (UPRA in Spanish) methodology would be used, referring to the analysis of rural land distribution, where the cadastral information on the variables associated with properties, such as owners or possessors, area, economic destination, location on the agricultural frontier, classification of the area of the properties with reference to the Family Farming Unit (UAF in Spanish), among other aspects, which characterize the ownership and distribution of land in the territory under study, is addressed.

In this process, a cross-referencing of variables between the typologies of economic destination and the types of ownership identified is carried out, to establish which are the characteristic elements of the different uses that occur in the Orinoco region. This is based on the argument that the economic use of rural land generates different combinations of ownership forms, which could contribute to identify the factors that increase or reduce carbon emissions in the Orinoco region.

To examine this last relationship, this paper will analyse the relationship from two perspectives. The first one characterizes the land ownership structure in the Orinoco region, mainly from the quantitative analysis of the cadastral bases; in addition to considering the central variables, such as area, type of owner, condition of formality or economic destination of the property, among others, other relevant aspects of land ownership are also addressed, referring to environmental and ethnic management figures, condition of rural formality and rural land market.

The second approach seeks to establish a relationship between carbon emissions and land uses in the Orinoco region. The support for this approach is identified in the World Bank document (2012), which reviews the agricultural sector in Colombia and establishes which segments would contribute to the country's sustainable development, increasing carbon sequestration and improving the country's participation in the market for carbon emission reduction certificates. In general terms, the document argues that some traditional land use practices in Colombia do not contribute to reducing carbon emissions, such as extensive cattle ranching or inefficient fertilization techniques, but on the contrary result in high carbon emissions. On the other hand, it highlights the country's potential in the conservation of native forests and the promotion of commercial forestry plantations as a mechanism to increase carbon sequestration and thus increase Colombia's chances of participating in the emissions reduction program.

In this last exercise, the processing of carbon emissions information recorded by the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM in Spanish), between 2010 and 2017, was conducted, associating the net carbon absorption or emission in the productive segments of livestock, forest lands, croplands, pastures, wetlands, settlements and other types of land use, which correspond to the variables that will allow delimiting a relationship between rural land ownership conditions in the Orinoco and carbon emissions, through the economic destination variable of the cadastral base and the land use variable taken from the National Agricultural Census (CNA in Spanish).

Methodologically, the structuring of the document begins with a descriptive analysis of the ownership variables, which seeks to identify differential behaviors and distributions within the Orinoco region, among its departments and among types of owners for agricultural destinations (agricultural, forestry, agro-industrial, livestock, aquaculture).

In addition to presenting the distribution of some ownership and property variables, the document provides a detailed description and analysis of other relevant aspects of land that should be considered prior to the implementation of an emission reduction program, because their presence indicates specific characteristics of the territory. Specifically, individual chapters are dedicated to: i. Addressing the informality of land ownership in the Orinoco region, which may be the subject of potential land use conflicts due to the lack of legal clarity of land ownership. ii. To establish and make an inventory of the environmental figures and ethnic territories present in the region, since a differential approach with these communities must be considered in the ERPD implementation process. iii. Elaborate an analysis of the agricultural frontier and the restrictions on use outside of it.

After consolidating a broad overview of the entire land ownership structure and indicators of the distribution of land ownership in the Orinoco region, the last part of the document returns to the description of net carbon emissions by land use and crop type. In addition, an inferential statistics exercise is carried out to estimate potential relationships between land use and carbon emissions. Two types of log-linear ordinary least squares regressions are implemented. The first one has as dependent variable the net carbon emission, which is a function of the type of land use and the department, while the second one estimates the relationship between net emissions and the type of crop implemented, controlled by the department. Based on the results of the regressions, it is possible to determine the relationship between carbon emissions and land use which, in turn, can be characterized from the previously analyzed cadastral information. In summary, based on the inferential results provided by the regression estimators and complemented with the characterization of rural land ownership in the Orinoco region, the relationship between carbon emissions and ownership conditions is constructed.

Now, in terms of the implications of the ownership document on the BioCarbon ERP (PRE Biocarbono in Spanish), it generates an initial diagnosis on the conditions of land ownership the Orinoco, allowing the identification of the prevailing ownership typologies and the agents interacting in the region, as well as the identification of potential conflicts that could affect the generation of agreements within the framework of the ERP. Specifically, it shows that there is a high degree of informality in land ownership, which in the region is close to 50% of the registered area, and that this can generate conflicts between different agents claiming rights to the same property. Likewise, the diagnosis shows that the ownership structure has high concentration rates, that there is a significant presence of environmental territories and that there is a significant presence of private and collective landholders, together with a production focus centered on the agricultural sector, with some sectors contributing to increase carbon emissions and others contributing to their reduction.

Under these precepts, it is concluded that the effectiveness of the BioCarbon ERP (PRE Biocarbono in Spanish) depends on a broad institutional involvement in the departments that allows progress in processes of formalization of land ownership to mitigate potential conflicts of use, complemented by extensive socialization processes with communities and productive sectors, so as to raise awareness among stakeholders about the benefits of the program and encourage their participation in sustainable forms of production.

In order to achieve the proposed objectives, this document is divided into 7 sections. The first part presents the conceptual framework of the land ownership structure. The second section describes the sources of information and data used to address the different topics of the study. The third section contains the analysis of land ownership and ownership at the regional and departmental levels, with some municipal data.

The fourth section describes the regional agricultural frontier, together with the restrictions on land use outside this frontier. The fifth part analyzes the environmental and ethnic figures present in the Orinoco region. The sixth section considers the conditions of formality with respect to land ownership in the Orinoco region, as well as the analysis of mere tenure. The seventh section deals with the land market. The sixth section deals with carbon emissions and associated land uses. Finally, the seventh part presents the conclusions and recommendations arising from this research.

# 1. CONCEPTUAL FRAMEWORK ON OWNERSHIP FORMS

All the statistical and analytical analyses addressed in this document are framed in the different types of rural land ownership and how their conditions can contribute or limit the implementation of the BioCarbon ERP (PRE Biocarbono in Spanish). Under this precept, the first thing to be addressed is the definition of ownership and its main components, to clearly define the scope of application of the project, from a conceptual approach.

In this regard, following the conceptualization of the (FAO, 2003), land ownership is defined as the *"... relationship, legally or customarily defined, between people, as individuals or groups, with respect to land. Land tenure is an institution, that is, a set of rules invented by societies to regulate behavior. Ownership rules define how land ownership rights can be allocated within societies...".* According to the definition, land ownership involves a subject exercising some kind of dominion over land, where this interaction may or may not have some legal security.

In the same sense, (Machado, 2003) defines land ownership as *"... a system of legal-political relations of dominion over land that adopts different historical forms: some based on ownership (large estates, smallholdings, plantations), others on precarious tenure (sharecropping, leasing, colonization, etc.) ..."*. In turn, the author states that land ownership is one of the components of a broader concept, called agrarian structure, defined by (García, 1967) as an interconditioned sum of elements of economic and social organization of relations with a national structure of political organization, market and culture. Within this structure, ownership represents the basic component that can strengthen or restrict agrarian development.

As a complement to these definitions, (FAO, 2003) defines the categories of ownership, which can be classified as private, communal, free access and State. More specifically, the ownership relationship with the land is classified according to the ownership exercised by the subject, distinguishing between private and public subjects. Likewise, within the first group are individual and collective, while in the second group are fiscal and public use properties. In practical terms, the concept of ownership directly reflects the relationship between people and land, as well as between people and groups of people regarding the management of land and natural resources (Kasimbazi, 2017). Thus, the same author states that ownership conditions and property rights can be used to refer to the rights that individuals, communities, families, companies or other community or corporate structures maintain over land or other natural resources.

From the review of the scope of land ownership and the actors involved in it, it can be inferred that the problem inherent to the application, delimitation or implementation of the concept lies in the security of ownership, which refers to enforceable land claims supported by national regulatory frameworks (UN-HABITAT, 2008). In this regard, several working papers show how stakeholders may have different ways of claiming land, ranging from formal to informal mechanisms. Precisely, (FAO, 2003) defines the first as the property right expressly recognized by the State and that can be protected through legal means, while the second indicates the lack of recognition and social protection, (UN-HABITAT, 2008) states that *"... property rights and land ownership may be formal (life estate, leasehold, among others), customary or of religious origin. They may also include various types of informal ownership. Ownership implies varying degrees of legality depending on the legislative framework...".*

From the above definitions the degree of recognition of some form of land ownership depends on the strength of its legality in the legislative framework of a country. However, in practice there is not always a clear differentiation between formal and informal relationships, thus giving rise to potential land ownership conflicts between different actors claiming rights over the same piece of land. This is due to the continuity of the ownership rights established by (UN-HABITAT, 2008) and summarized in ***Figure 1***.

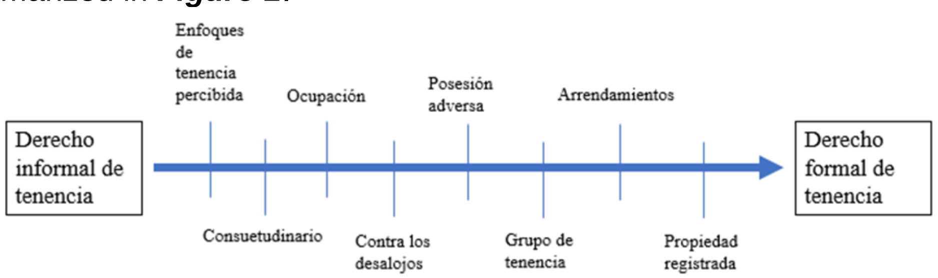



Figure 30. Transition from formality to informality in land ownership
Source: UN-HABITAT 2008

According to the UN-HABITAT document and as explained in ***Figure 1***, the condition of formality in the ownership relationship goes from the most informal schemes, such as ownership perception and customary, to the most formal ones, represented by leases and registered property. Although it is a continuous transition, there are not always clear lines of differentiation between ownership forms, so it is common for ownership conflicts to arise between more formal and more informal ownership holders, mainly in developing countries with institutional weaknesses such as Colombia.

However, although Colombia is no stranger to these potential conflicts generated by the different degrees of security of ownership, its regulations contain the description and delimitation of some of the concepts raised so far, such as:

- **Dominion or property:** According to article 669 of the Civil Code, the concept of dominion is defined as *"...The dominion, which is also called property, is the real right in a tangible thing, to enjoy and dispose of it, not being against the law or against another's right. The property separated from the enjoyment of the thing is called mere or bare ownership...".*
- **Mere possession:** According to article 775 of the civil code *"... mere possession is called to which is exercised over a thing, not as owner, but in place of or on behalf of the owner. The pledgee, the sequestrator, the usufructuary, the user, the one who has the right of habitation, are mere holders of the thing pledged, seized or whose usufruct, use or habitation belongs to him. The above is generally applicable to any other person's domain...".*
- **Possession:** Article 762 of the Civil Code defines that *"...Possession is the ownership of a determined thing with the spirit of lord or owner, whether the owner or the one who is considered as such, has the thing by himself, or by another person who has it in his place and on his behalf. The possessor is reputed owner, if another person does not justify being so...".*
- **Occupancy:** Article 685 of the Civil Code establishes that *"...By occupation the domain of things that do not belong to anyone, and whose acquisition is not prohibited by the laws or by international law, is acquired..."*.

The definitions extracted from the Colombian civil code give an account of the regulations that have been generated for some of the forms of ownership in Colombia, which are much broader than these definitions, but a detailed explanation exceeds the scope of this document.

On the other hand, in the framework of the differentiation between formal and informal relationships, the concepts of property and mere ownership are considered as formal, while possession and occupation can be categorized as informal, following the reasoning in ***Figure 1.*** The above is consistent with (Neva, 2014), where it is argued that one of the main causes of informality in Colombia is that neither occupations nor possessions are found in the databases of the Public Instruments Registry offices.

After conceptually addressing land ownership at a general level, together with an approach to ownership security, differentiating between formal and informal rights, and the description of the main forms of ownership in Colombia, the next point is to specify the importance of the conceptualization of ownership for the BioCarbon project. In the first instance, the existence of formal and informal relationships may generate land ownership conflicts, which may be several, but generally it is a situation where more than one person, whether or not the holder of the land, presents a claim on the same land or territory. These claims may have greater or lesser strength depending on the country's regulatory framework (UN-HABITAT, 2008), but in general, the condition of formality prevails.

Another limitation that arises from the presence of informal rights is that they reduce ownership security and prevent access to credit, the development of long-term sustainable projects and the signing of agreements based on land ownership, generating a greater risk to implement short-term productive projects that lead to greater land degradation (Kasimbazi, 2017). Thus, insecure land ownership contributes to a greater negative impact on the environment.

Within the framework of the PRE Biocarbon, the analysis of land ownership is fundamental since a diagnosis of land ownership will allow an approximation to the degree of formality of ownership relations in the region's rural properties. This delimitation will contribute to decision-making, because it will evidence the management capacity or limitations of the land holders according to their degree of formality, making it possible to identify the scope of the formal land holders with whom agreements could be signed to reduce carbon emissions, together with the size of the informal land holders, for whom a particular analysis will have to be made, in case the need to involve them in the project is identified.

One of the main challenges in the delimitation of ownership relations, both in Colombia and in the Orinoco region, is based on the difficulty of clearly identifying ownership, whether formal or informal, due to the difficulty of arriving at a unified database that collects and classifies all the properties in a territory, which is derived from the costly and complex processes for formalization and the low importance given to it. Given these difficulties, this document follows Rural Agricultural Planning Unit’s (UPRA in Spanish) methodological proposal to identify potential informal properties, which uses various sources of information to infer the degree of formality of the land, as developed in chapter 6 of this document.

The existence of informal ownership relations can lead to conflicts associated with land use, these conflicts involve the interaction between several agents in a territory, with different ownership relations: on the one hand, the formal ones, private owners, collectives, and the State, on the other hand, the informal ones, occupants, possessors, and some others who wish to occupy areas in a territory. For this reason, the inability to provide access to land by the State or to formally demonstrate land ownership by those who consider themselves owners may generate conflicts between formal agents and other actors in the territory, such as occupation of vacant land, colonization of areas outside the agricultural frontier or occupation of legally recognized collective territories.

All the forms of ownership that have been addressed conceptually can be found in the Orinoco, which is a territory characterized by the presence of both formal and informal ownership relationships, with significant participation of private, collective, and state owners, as well as an important presence of environmental protection areas, mainly managed by different state entities. Precisely, the development of the following chapters seeks to generate a diagnosis on the structure of rural land ownership in the Orinoco region and its departments, for which, property distribution variables will be considered, along with a descriptive analysis of the main forms of ownership, ranging from the approximation of a formality indicator to the diagnosis of environmental protection areas, collective territories and border delimitations. All this in order to provide a broad overview of the possibilities and limitations of the Orinoco region for the implementation of the carbon emission reduction program, from different perspectives; the prevailing land uses, the presence of relevant actors in the territory and the possible conflicts related to ownership relations.

## 2. INFORMATION FOR ANALYSIS

The development of this research requires various sources of information to collect data on land ownership, land distribution, rural land use and carbon emission records, among others.
For the first one, the secondary information available at UPRA is taken as a reference base, which compiles information from the cadastral authority, complemented with information available from other entities, such as the registry of public instruments in charge of the Superintendence of Notaries and Registry, the National Land Agency (ANT in Spanish), the Ministry of Environment and Sustainable Development (MADS in Spanish), the IDEAM, among others.[172].
The relevance of cadastral information is expressed in Decree 148 of 2020*, which regulates the specific functions of the Agustín Codazzi Geographic Institute – (IGAC in Spanish)*, where it is specified that the cadastre is "the inventory or census of real estate located in the national territory, public or private domain, regardless of their type of ownership, which must be updated and classified in order to achieve their physical, legal and economic identification based on technical and objective criteria"[173]. By definition, the cadastre is an important source that accounts for ownership in the territory, especially for its legal component in which, in addition to Properties that have a real estate registration, the census includes everything found in the territory with a condition of possession or occupation[174]; additionally, it has a geographic component that allows to know the location of the properties with their characterization.
Although in the framework of the multi-purpose cadastre, about 31 cadastral managers have been appointed, the administration and maintenance of the cadastral information of the municipalities of the Orinoquia region is still under the jurisdiction of the Agustín Codazzi Geographic Institute (IGAC in Spanish).
On the other hand, the Superintendency of Notaries and Registry (SNR in Spanish) is the entity responsible for the real estate registry, which relates the historical-legal information of the real estate through the real estate registration folios, in which the registrations that affect the tenancy relationship with the real estate are recorded, such as the legal acts that confer rights, restrictions, responsibilities, mortgages

**[172] It should be noted that each data source handles geographic information at different scales.**
**[173] Article 2.2.2.2.1.1.1 of Title 2 of Chapter 1 of Decree 148 of 2020. General provisions of the public service of cadastral management.**
**[174] In the cadastral base, the owner field refers to the owner, possessor or occupant of the property according to what is found in the census of the cadastral process.**

and publicity; for this exercise. The SNR currently has 195 Registry Offices of Public Instruments (ORIP in Spanish) throughout the country. In the Orinoco region, the management of registry information is carried out in nine (9) Registry Offices of Public Instrument in the four (4) departments.
It is relevant to specify that the Registry of Public Instruments is the entity that determines ownership, therefore, Rural Agricultural Planning Unit (UPRA in Spanish) has made approaches and institutional efforts to access the information, which has allowed it to have registry acts of the time series 2015 - 2019, to know the dynamics of the formal market in the region. Based on these efforts, an important source of information has been consolidated for the development of the document, since it corresponds to complementary bases from the entities responsible for the management of land ownership information.
In addition, information is available from entities that manage important information for land-use planning, such as the Ministry of Environment and Sustainable Development (MADS) and other entities attached to the Special Administrative Unit of the Natural Parks System (UAESPNN in Spanish), which regulate environmental protection areas through the National System of Protected Areas (SINAP in Spanish); the National Land Agency (ANT in Spanish), which, among its mandated functions, administers the information on collective territories and the management of property regularization, and the National Administrative Department of Statistics (DANE in Spanish) where the information is obtained from the National Agricultural Census (CNA in Spanish) and the National Agricultural Survey (ENA in Spanish).
It is important to note that each source of information handles geographic data at different scales, so the results presented at the property level are indicative in nature, taking into account that, when cross-referencing with the cadastral geographic base, the categories are established based on the presence of more than 50% of the property or by predominant area according to the categories to be evaluated.

## 2.1. Description of the Cadastral information

Considering that cadastral information is the basis for much of the analysis in this document, it is important to know the status of the cadastre of the municipalities that make up the Orinoco region.

In this regard, it was determined that the information available in the rural cadastral database with 2019 validity would be used as input. Information on the area of the property, number of owners / possessors, economic use of the property, and the number of properties in the rural cadastral database is collected for these properties[175], type of owner / holder, and defines the condition of the properties with respect to the Family Farming Unit (UAF in Spanish) calculated by relatively homogeneous zone[176] for each municipality and its location in relation to the agricultural frontier version 2021. The following image shows the status of the updating of the cadastral information by ranges of the updating process every five (5) years:

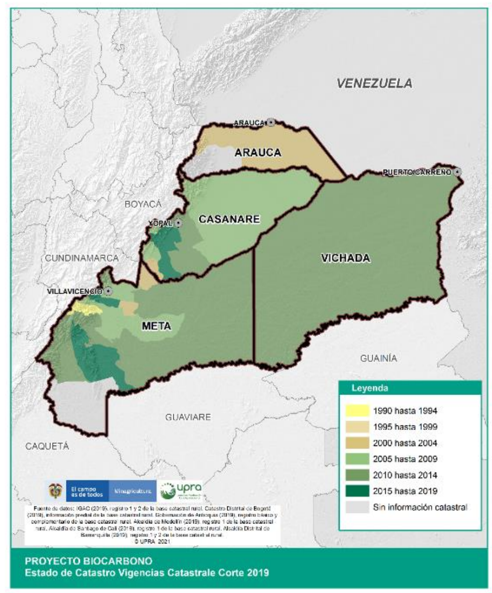



**Figure 31. Status of rural cadastral information for 2019 - Orinoquia**
**Source: UPRA © 2022 based on IGAC 2019 information.**

According to the previous map, by cadastral update year range the following can be observed:

- Range 2015 to 2019: It is considered the most updated, only five (5) municipalities are in this range, Tauramena and Aguazul in the department of Casanare and Vistahermosa, Mesetas and Acacias in the department of Meta.
- Range from 2010 to 2014: nineteen (19) municipalities are in this range, it is important to highlight that all the municipalities of the department of Vichada are in this range, Cumaribo in 2013 and the remaining three in 2014.
- Range from 2005 to 2009: Twenty-two (22) municipalities are in this range.

**[175] According to the IGAC, the economic destination of the land is defined as the classification given to each property as a whole, in accordance with the predominant activity in the area developed on the property. These classifications include residential, industrial, commercial, and agricultural, among others.**
**[176] Relatively homogeneous zones are those with similar agrological, physiographic and socioeconomic conditions, including soils, climate, vegetation, fauna, water resources, and road infrastructure and their interrelationship with the socioeconomic and environmental surroundings.**

- Range from 2000 to 2004: Ten (10) municipalities are in this range; it should be noted that all the municipalities with cadastral formation in the department of Arauca are in force in 2001.
- Ranges from 1990 to 1999: The municipality of Cubarral, located in the department of Meta, is the only municipality with a term prior to the year 2000, exactly 1992.
- The municipalities of La Macarena - Meta and Tame - Arauca do not have a cadastral formation process, that is, activities have not been carried out to identify for the first time the cadastral information in all the properties that make part of the territory.

In Colombia, it is considered a good practice that cadastral information is updated every 5 years; however, for these departments in particular, the information presents a high degree of outdatedness, possibly due to the fact that these are expensive processes in view of the economic dynamics of the municipalities that make up the region. As a result, this situation may make it difficult to know precise data on the number, areas, owners and geographic location of the properties. However, this information is very valuable and approximate to the reality of the municipalities, as it does not ignore the cadastral management of the conservation process.[177]

Another aspect that should be pointed out is that the cadastral formation process has not been carried out in the municipalities of La Macarena - Meta and Tame - Arauca, but there is an inventory of properties in the alphanumeric database provided, especially for tax purposes, which shows the property characterization in these two municipalities.

The following table shows the total number of rural properties registered in the cadastral registry for each of the departments in the region:

Table 24. Number of properties and area per department

| Department | Total Rural properties - Cadastre | | Area of rural properties - Cadastre (ha) | | Rural properties with improvements [178] | % of properties with improvement for each department | Rural geographic area (ha) | |
|---|---|---|---|---|---|---|---|---|
| Arauca | 25.277 | 10% | 2.479.777 | 11% | 265 | 1% | 1.800.598 | 8% |
| Casanare | 71.160 | 30% | 4.310.652 | 20% | 1.201 | 2% | 4.325.915 | 19% |
| Meta | 136.407 | 57% | 6.536.487 | 30% | 6.255 | 5% | 6.681.532 | 29% |
| Vichada | 7.929 | 3% | 8.538.906 | 39% | 1.826 | 23% | 9.912.895 | 44% |

**[177] Article 2.2.2.2.2.2.2. Cadastral management processes. Item C, Decree 148 of 2020. It is the set of actions tending to keep the cadastral base permanently in force, through the incorporation of the changes suffered by the information of a real estate property. Cadastral conservation may be carried out at the request of a party or ex officio, for which cadastral managers must adopt interoperability mechanisms with other entities producing official information.**

**[178] Article. 20, Resolution 70 of 2011. Improvement for constructions and/or buildings on someone else's property is the construction or building installed by a natural or legal person on a property that does not belong to him/her.**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Total Regional** | **240.773** | **100%** | **21.865.822** | **100%** | **9.547** | **4%** | **22.720.940** | **100%** |

Source: UPRA © 2022 based on IGAC 2019 information.

As mentioned above, the legal component of the cadastral census identifies the relationship between the active subject of the right and the real estate, therefore, in addition to identifying the properties that have real estate property registration, it includes everything that is in possession or occupation, for the latter identification another registration is made as a cadastral improvement or "improvement due to constructions and/or buildings on someone else's property" being a construction or building installed by a natural or legal person on a property that does not belong to him/her; 9.547 properties in the region are in this condition, corresponding to 4% of the total number of properties registered in the cadastre.

According to the alphanumeric cadastral database, 881 properties are reported for the municipality of La Macarena - Meta and 8.070 for the municipality of Tame - Arauca. Seventy-one percent of the properties (171.738 properties) in the alphanumeric database coincide with the geographic database, leaving 29% (69.035 properties) without geographic representation, which is mainly due to outdated databases and the lack of geographic information for the Meta municipalities of Uribe and La Macarena and Tame (Arauca). Therefore, it is worth clarifying that when crossings with geographic layers from other information sources are required, these are made on the 171.738 properties for which the crossings can be made.

The table above shows that the department of Vichada is the one with the largest geographical area, with about 9,9 million hectares, equivalent to 44% of the regional total. This result contrasts with its low representation in terms of number of properties, where its share is only 3% of the total number of properties, which is an indication that large properties predominate in Vichada. On the other hand, the department of Meta is the one with the largest number of properties, with a share equivalent to 57% of the total, while the department with the smallest geographic area is Arauca, with nearly 8%.

When considering the number of properties with improvements by department, it is found that Vichada has the highest number with 23% of its properties, indicating, preliminarily, that it is a department where there is possibly a high level of informality in land ownership because this condition is a criterion for determining the presumption of informality, as described in chapter 6 of this document. The opposite happens in the department of Arauca, where the properties with an improved cadastral base represent 1% of the total number of properties in the department, an aspect that can be interpreted, preliminarily, as an indication of low informality in the department.

## 2.2. National Agricultural Census information

As a complementary element to the fulfillment of the objectives set out in this study, the use of micro data from the National Agricultural Census, corresponding to the year 2014, where information is compiled at the departmental, municipal and Agricultural Production Unit (UPA in Spanish) levels on land use, including agricultural and livestock use. In general terms, the information on the area allocated to different agricultural sectors contains 104.959 records.

The relevance of this information is centered on the fact that it serves as a link between the behavior of land ownership and distribution characteristics in the Orinoco region and predominant land uses. Specifically, the processing of the database helps to link land uses (agricultural, forestry or livestock) with the variables of type of owner, farm size and economic use.

In a complementary manner, information from the National Agricultural Survey - ENA for the years 2014 to 2019 is used, in order to approximate the differentiation of the agricultural and livestock subsectors.

## 2.3. Deforestation and carbon emissions information

Another source of information used in this document corresponds to data collected from IDEAM on deforestation and carbon emissions in the Orinoco region.

Regarding the first component, these are geographic images that show the annual change of natural forest cover, where the reduction of cover is typified as deforestation. Under this perspective, a departmental forest cover percentage indicator has been consolidated, together with the deforestation rate, for the years 2012 to 2018.

Regarding the second component, the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM in Spanish) has provided the national and departmental inventory of greenhouse gases - Colombia (INGEI in Spanish), filtered by the 4 departments of the Orinoco region and differentiated by emission source, corresponding to the period between 2000 and 2017. For the purposes of the ownership document, the information corresponding to the period 2010-2017 has been taken, with the objective of analyzing the changes that have been presented in the net Green House Gases (GEI in Spanish) emission and how these are distributed among the departments of the Orinoco, as well as their emission sources, in particular, those linked to livestock uses, forest lands, croplands, pastures, wetlands, settlements and other lands. Likewise, within the croplands, it is possible to distinguish the categories of coffee, palm, cocoa, avocado, orange, rubber, lemon, mandarin, tangelo orange and other crops.

To recapitulate, this study takes as its main source of information the 2019 cadastral base, the National Agricultural Census, together with information on deforestation and carbon emissions, from which a relationship between ownership conditions and carbon emissions has been established, as developed in the following sections.

# 3. LAND OWNERSHIP AND LAND DISTRIBUTION IN THE ORINOQUIA

In order to make an initial approximation to the structure of rural land ownership conditions in the Orinoco region, the 240,773 properties registered in the cadastral base are used as a starting point. A descriptive statistical analysis is carried out on these properties in order to approach the main characteristics of the determining variables of rural properties in the region (economic use, type of owner/holder[179], property size and classification of the area of the property in relation to the size of the Family Farming Unit (UAF in Spanish).

All variables are analyzed as a proportion of landholdings, area and number of owners, in order to identify differences in distribution between each of the units of analysis. In addition, the results are presented for all the properties registered in the region, that is, we do not differentiate between agricultural frontiers, leaving the considerations on this characteristic for chapter 4.

## 3.1. Behavior of property distribution variables in the Orinoco region.

In the first instance, the distribution of the number of landowners and land area is described, as shown in Table 25. According to this information, the Orinoco region has a land area of about 21,8 million hectares, of which the departments of Vichada and Meta show the highest participation, with 39% and 29,9% of the area, respectively. In contrast, the department of Arauca has the smallest share, with only about 2,4 million ha, equivalent to 11,3% of the region's total.

Table 25 also shows that the owners registered in the cadastral bases of the region total 316.992. Of these, the department of Meta has the highest participation with 187.608 owners, equivalent to 59,2% of the total, while the department of Vichada has the lowest participation with 9.025 owners, equivalent to 2,8%.

The amount and proportion of area and owners in Vichada are opposite, in the sense that it contributes with the largest amount of area in the region, but with the

**[179] The certainty of ownership of a property in Colombia is certified by the Superintendence of Notaries and Registry (SNR in Spanish), by certificate of tradition and freedom, however, in this document the cadastral bases are used due to the availability of information in these and the absence of data compiled in the SNR, this field in the cadastral base refers to owner, possessor or holder of the property according to the cadastral process carried out.**

smallest amount of owners. This can be considered as an indication that in Vichada there are large extensions of land in the hands of few people.

**Table 25. Area and owners in the departments of the Orinoco region**

| Department. | Property area (ha) | % Area | Number of owners | % owners |
|---|---|---|---|---|
| Arauca | 2.479.777 | 11,3% | 30.437 | 9,6% |
| Casanare | 4.310.652 | 19,7% | 89.922 | 28,4% |
| Meta | 6.536.487 | 29,9% | 187.608 | 59,2% |
| Vichada | 8.538.906 | 39,1% | 9.025 | 2,8% |
| **Total Regional** | **21.865.822** | **100%** | **316.992** | **100%** |

Source: UPRA © 2022 based on IGAC 2019 information.

Figure 32 shows the percentage distribution of owners (Proportion of owners), area (Proportion of area) and land (Proportion of land) with respect to economic use[180]. This shows that the main economic use in terms of area corresponds to agriculture and livestock, with a share of 95,8% of the area. However, the proportion of owners and properties is lower, representing 57,1% and 59%, respectively, of those registered in the database.

This implies that the agricultural destination, considering all the rural properties in the region, is the most relevant and it can be inferred that the form of production in the Orinoco region is characterized by few owners on large properties. Therefore, the agricultural use should be considered as a central element in the analysis with a focus on carbon emissions, remembering that within this type of use is livestock, considered as one of the main sources of emissions, but this point will be explained further in the last part of this section.

The second most important classification is residential use, which, for the indicators of properties and owners, represent about 25% and 28%, respectively, while its share in the area is 1,6% of the total. Therefore, in this item, it can be said that the plots destined for residential use correspond to those with the smallest area per unit, that is, they correspond to small properties.

On the other hand, when analyzing the distribution of area by economic use excluding collective owners and the State, that is, counting only private owners, a similar proportion is maintained, where the area for agricultural use represents about 96%, followed by housing with 1%. In this sense, the distribution of land use is not affected by the participation of other owners, such as the State or collective territories, at least for the Orinoco region as a whole.

**[180] In Circular 479 of 2007, the IGAC describes the economic destination of the properties as the classification given to each land, constructions and/or buildings, at the time of property identification, in accordance with the predominant activity in the area in which it is developed. In particular, Article 67 of Resolution 2555 of 1988 identifies 11 types of destinations.**

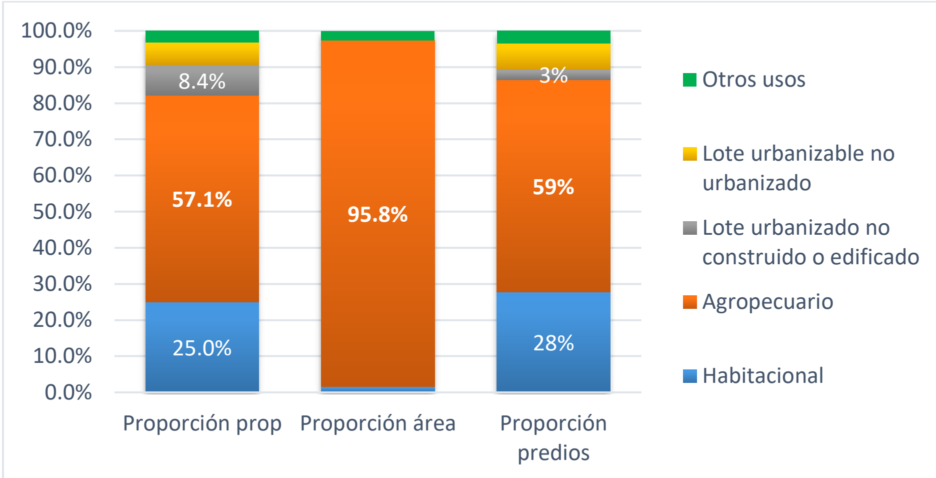



Figure 32. Distribution by economic destination in the Orinoco region
Source: UPRA © 2022 based on IGAC 2019 information.

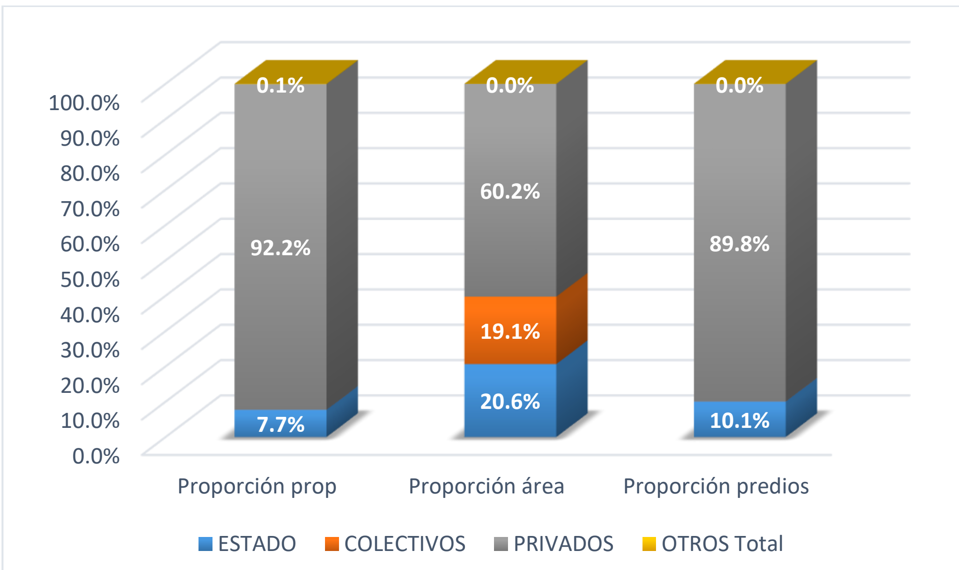



Figure 33. Distribution of properties by type of owner in the Orinoco Region
Source: UPRA © 2022 based on IGAC 2019 information.

The importance of the type of owner can be seen in Figure 33, which shows the distribution of the variable. From the figure it can be seen that the largest proportion of owners and properties in the Orinoco region are private, with 92,2% for the former and 89,8% for the latter, while their representation is reduced to 60,2% when considering the participation in terms of area. The main reason for this difference is that the other actors in the territory, such as the State or collective owners, have a smaller participation in terms of number of owners, but the land owned by these agents is very large, even more so if we take into account that there are areas in the territory destined for conservation uses that occupy a large portion of land and are mainly under the protection of the State[181].

This is evident when looking at the difference in distribution between owners/property and area, both State and collective owners. In the first case, the proportion of State properties represents about 10,1% of the properties registered in the region, while their share increases to 20,6% when viewed from the regional area. In the same sense, the behavior of collective owners shows that they present a significant proportion of 19,1% in the area, but with a low participation for the other variables.

The relationship between land and area of the collective owners and the State shows that both groups have ownership over large landholdings, so that, at the time of making potential agreements for carbon emission reductions, large tracts of land with fewer owners could be covered. This analysis launches a hypothesis about a possible greater impact from the development of sustainable projects on larger extensions of land in the hands of fewer landowners. On the other hand, in the case of private landowners, there is a segment, that of small landowners, on which there would be a greater workload as it would require greater individual agreements, since, in this case, the land areas are smaller in comparison with the number of landowners. However, this is a preliminary analysis that will be checked with the other variables and will be evidenced when dealing with native areas and environmental territories in the Orinoco, because in addition to the potential benefits, the representative participation of these figures and actors, implies a challenge that will demand a detailed review of the permitted uses or legal restrictions that would be associated with the land owned by the State or the collective owners.

A third variable to review in the ownership diagnosis is the size classification of the properties, taken from the property ranges defined by Rural Agricultural Planning Unit (UPRA in Spanish) based on a solid statistical process, in which 16 size intervals were consolidated.

The distribution of these intervals can be seen in Table 26, The distribution of these intervals can be seen in Table 3 for the Orinoco region, which shows that landowners are mainly concentrated in two opposing segments, since 121.862 landowners, equivalent to 25%, are in properties of up to 0,5 hectares, while 111.625 landowners, representing 23,2%, are in properties larger than 1.000 hectares and up to 2.000 hectares. The same table also shows a high proportion of owners of land between 500 and 1.000 ha, with a share of 19,8%. Thus, when adding the 500-1.000 ha interval with the 1.000-2.000 ha interval, it is found that this concentrate 43% of the owners in the Orinoco region, a result that, in general terms, shows owners with large extensions of land.

As a complement, the area by size of landholdings shows that the same interval between 500 and 2.000 ha represents 37,7% of the available area, that is, in the

**[181] Due to the relevance of conservation areas and ethnic territories in the region, chapter 5 of this document addresses in detail the diagnosis and importance of these figures in the territory.**

middle segment there is a relatively proportional correspondence between the number of landowners and the area. On the other hand, the extreme ranges show the greatest asymmetries, as shown by the interval of more than 10,000 ha, which participates with 23% of the available area in the region, but has only 0,5% of the owners. The other extreme shows the opposite distribution, that is, in the range of up to 0,5 ha, 25% of the properties are grouped together, as previously mentioned, with only 0,1% of the total area.

According to the distribution of farm size, it can be seen that the largest farm area in the Orinoco region is concentrated in large farms, since the range between 500 and more than 10.000 hectares accounts for 71% of the available area.

Graphically, the distribution of properties by size in the Orinoco region is shown in Figure 34. The table shows that the largest properties are located in Vichada, especially in the municipality of Cumaribo, where the properties are mainly classified in the range of more than 1.000 ha. In Meta, large properties are found in the municipalities of Vistahermosa and in the high planes subregion, particularly in Puerto Gaitán. Third, the same figure shows that the largest properties in Casanare and Arauca are concentrated in neighboring areas, located in the municipality of Cravo Norte in the case of Arauca and Paz de Ariporo in Casanare.

Table 26. Distribution of properties by property size - Orinoquia

| Predial Size | Number of owners | % Owners | Land area (ha) | % Area |
|---|---|---|---|---|
| A1. Up to 0.5 ha | 157.055 | 49,5% | 5.995 | 0,03% |
| A2. Greater than 0.5 - Up to 1 ha | 9.037 | 2,8% | 5.204 | 0,02% |
| A3. Greater than 1 - Up to 2.5 ha | 14.077 | 4,4% | 16.565 | 0,1% |
| A4. Greater than 2.5 - Up to 3 ha | 3.749 | 1,2% | 7.286 | 0,03% |
| B1. Greater than 3 - Up to 5 ha | 12.003 | 3,8% | 35.167 | 0,2% |
| B2. Greater than 5 - Up to 10 ha | 18.492 | 5,8% | 103.649 | 0,5% |
| C1. Greater than 10 - Up to 20 ha | 22.084 | 7,0% | 237.066 | 1% |
| D1. Greater than 20 - Up to 50 ha | 31.496 | 9,9% | 767.314 | 4% |
| D2. Greater than 50 - Up to 100 ha | 17.457 | 5,5% | 898.755 | 4% |
| D3. Greater than 100 - Up to 200 ha | 10.201 | 3,2% | 975.641 | 4% |
| E1. Greater than 200 - Up to 500 ha | 8.864 | 2,8% | 1.956.568 | 9% |
| E2. Greater than 500 - Up to 1000 ha | 7.409 | 2,3% | 3.425.815 | 16% |
| E3. Greater than 1000 - Up to 2000 ha | 3.738 | 1,2% | 3.660.525 | 17% |
| E4. Greater than 2000 - Up to 5000 ha | 1.367 | 0,4% | 2.349.281 | 11% |
| E5. Greater than 5000 - Up to 10000 ha | 232 | 0,1% | 1.015.132 | 5% |

| | | | | |
|---|---|---|---|---|
| E6. Greater than 10000 ha | 134 | 0,04% | 6.412.039 | 29% |

Source: UPRA © 2022 based on IGAC 2019 information.

The same figure also shows that the smallest properties are located in areas close to the departmental capitals, being clearer in Meta and Casanare, where the map's tonality becomes less intense around Villavicencio and Yopal, respectively.

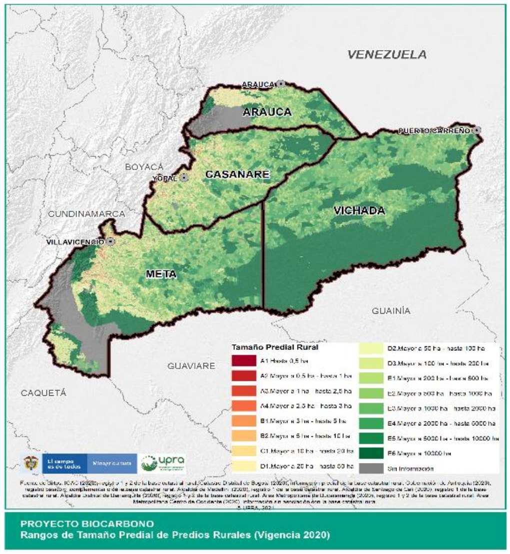



Figure 34. Rural property size in the Orinoco region.
Source: UPRA © 2022 based on IGAC 2019 information.

Within the framework of the Biocarbon project, the distribution of farm size implies some points to be considered:

Agreements with landowners of up to 5 ha have a lower impact in terms of area and require a greater effort to have significant results, in the understanding that the implementation of sustainable development projects on smaller properties would have a lower impact than if they were carried out on larger properties. Likewise, it has been graphically identified that this type of agreements would be concentrated around the municipalities close to the departmental capitals.

On the other hand, agreements with large landowners can generate economies of scale and allow for better results in terms of carbon capture, with fewer individual agreements. However, with large landowners, the productive segment to which they belong and their interest in contributing to sustainable development projects should be analyzed. It was also identified that this type of agreement would be considered in municipalities on the edge of the department, which are located at a greater distance from the most populated centers and may have conflicts of use because they are on the edge of the agricultural frontier.

Now, the results show that in the Orinoco region both types of agreements can be present, because both segments of owners are highly relevant, but the greatest impact could be reflected in the large properties, due to their prevalence, both in terms of owners and area.

Another variable to be analyzed is the classification of farm areas with respect to the size of the Family Farming Unit (UAF in Spanish) calculated by Relatively

Homogeneous Zones (ZRH in Spanish). This analysis identifies whether the area of the property is less than, equal to or greater than a range of the Family Farming Unit (UAF in Spanish), calculated by the Rural Agricultural Planning Unit (UPRA in Spanish) according to the values contained in resolutions 041 of 1996 and 020 of 1998 of the then Incora, adopted by the National Land Agency (ANT in Spanish) in 2012.

The behavior of this analysis is described in Figure 35, in which it can be seen that about 56% of the area is in a classification higher than the Family Farming Unit (UAF in Spanish), 31% in Family Farming Unit (UAF in Spanish) and about 13% is lower than the Family Farming Unit (UAF in Spanish). The distribution of the area of the properties in terms of the Family Farming Unit (UAF in Spanish) range reconfirms the profile of properties in the Orinoco region, in the understanding that the largest proportion of properties have areas that are greater than the Family Farming Unit (UAF in Spanish), while a smaller share is below this indicator. This regional profile shows the possibility of generating significant impacts by formulating fewer agreements and covering a larger territory in a potential emissions reduction program.

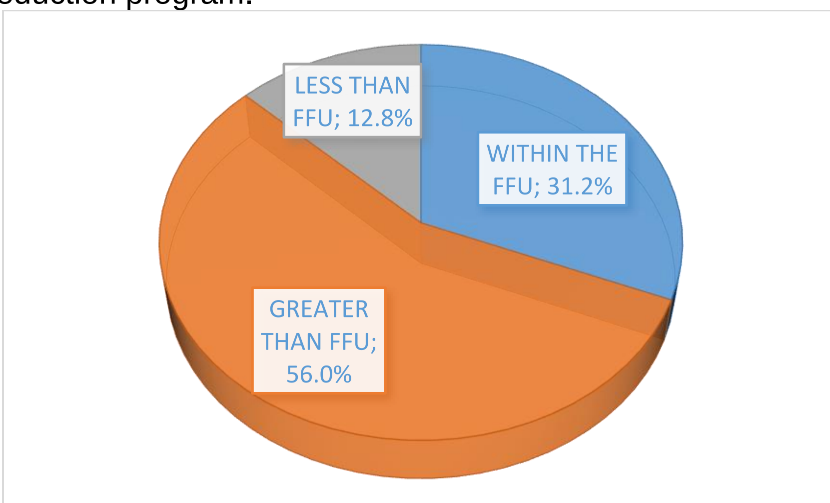



Figure 35. Distribution of areas by UAF classification in the Orinoco region
Source: UPRA © 2022 based on IGAC 2019 information.

Based on the above results, it has been possible to identify that the Orinoco region is characterized by large landholdings, together with small landholdings for many landowners. This initial behavior could indicate an unequal distribution of land in the region and is technically explained and supported by the distribution indicators that will be analyzed below.

Another issue that has emerged in the characterization of rural land ownership conditions in the Orinoco region is that this region has an agricultural and conservation vocation developed in large properties, with a majority participation of private owners, although with relevant areas belonging to the State and collective properties. Given these characteristics, it is pertinent to conduct a more detailed analysis of land use that characterizes the region, to identify which is the predominant form of production on rural land, its relationship with the regional diagnosis of ownership and how these can contribute to or diminish the impact of the BioCarbon ERP (PRE Biocarbono in Spanish). To achieve this approach, the following section uses information from the 2014 National Agricultural Census, together with the 2019 National Agricultural Survey (ENA in Spanish), which contains the distribution by hectares among the main general uses, in the case of the Census, and a detail of the main agricultural uses taken from the National Agricultural Survey (ENA in Spanish).

## Land uses in the Orinoco region

The identification of the predominant land uses in the Orinoco region is based on information from the National Agricultural Census (CNA in Spanish), as previously mentioned. Specifically, Table 27 shows that, in 2014[182], the accumulated area of uses reached 24,6 million hectares, distributed in 8 land uses, with the prominence of; agricultural use, with about 12.5 million ha, which represented 50,7% of the area, the use in natural forests, with about 9,4 million ha and 38,4% share, and the use in stubble, with about 2 million ha and proportion of 8,3% in total.

Table 27. Land uses in the Orinoco Region

| Type of use | Area (ha) | % Area |
|---|---|---|
| Agriculture and Livestock | 12.515.465 | 50,7% |
| Fallow | 60.310 | 0,2% |
| Resting | 151.424 | 0,6% |
| Stubble | 2.044.192 | 8,3% |
| Natural forests | 9.477.654 | 38,4% |
| Agricultural infrastructure | 14.427 | 0,1% |
| Non-agricultural infrastructure | 21.057 | 0,1% |
| Other uses | 393.755 | 1,6% |
| **total uses** | **24.678.284** | |

Source: UPRA © 2022 based on CNA 2014 information.

The above distribution confirms that the region is mainly agricultural, although to a lesser extent than previously indicated, where with cadastral information the agricultural use accounted for more than 90% of the area. In this sense, the National Agricultural Census (CNA in Spanish) is a better instrument for estimating agricultural and natural cover uses, such as the use of natural forests, which is mainly grouped in the departments of Vichada and Meta, which participate with 49,2% and 36,7% of the hectares (ha) destined to forest, respectively.

The use distributions obtained based on the National Agricultural Census (CNA in Spanish) can be approximated in greater detail, particularly by disaggregating the agricultural sector, with the results of the National Agricultural Survey (ENA in Spanish), although with a couple of clarifications; i. The National Agricultural Survey (ENA in Spanish) is a sampling instrument, while the National Agricultural Census (CNA in Spanish) is a population-based one, which can generate

[182] **The latest available census is for 2014.**

significant differences in absolute values. ii. As it is a sampling instrument, the results of the National Agricultural Survey (ENA in Spanish) are subject to a level of uncertainty associated with sampling error. iii. The ENA is applied to the rural sector; therefore, its results do not include urban properties.

With these precisions in mind, the average proportion of area represented by the agricultural and livestock subsector within the agricultural sector for the years 2014 to 2019 is estimated, according to the results of the ENA. In this regard, it is estimated that the average area of the agricultural sector in the Orinoco region represents about 5,5% of the total area allocated to agriculture and livestock, leaving the remaining 95,5% for livestock. According to this distribution, it is evident that the rural sector of the Orinoco is characterized by a high preponderance of land use for the livestock sector.

The relevance of the livestock sector for the Orinoco region is reflected in the fact that it is the third region with the largest number of livestock in the country, representing about 21,8% of the national total for 2019, and lagging behind the Andean and Caribbean regions, whose shares were 35,6% and 27,6%, respectively (UPRA, 2019). On the other hand, the same document also shows that the Orinoco region was the region that dedicated the largest area to livestock use in 2019, with an area that represented about 37% of the national total, followed by the Andean region with 29% and the Caribbean with 21%. As a complement to these results, the cattle animal density indicator, estimated by the (UPRA, 2019), shows that the Orinoco region presented a value of 0,4 animals per hectare for 2019, while the national average is 0,7, therefore, it can be stated that the Orinoco region practices more extensive cattle raising than the rest of the country.

The above, coupled with the characteristics of land ownership, which is made up of large properties in the hands of few owners, allow inferring that there may be a bias towards extensive cattle raising in the Orinoco, since the region is characterized by having the largest proportion of area allocated to livestock use at the national level, but its representation is not the highest in terms of heads of cattle, that is, it seems to be allocating a greater amount of area per unit of species. This production approach may be concentrating the area in the larger ranges and could contribute to justify the significant participation of farms above the Family Farming Unit (UAF in Spanish).

For the context of the BioCarbon ERP (PRE Biocarbono in Spanish), the result of land use represents one of the main challenges, because extensive livestock farming is, together with deforestation, which is often associated with livestock farming, one of the main factors responsible for carbon emissions. Therefore, the results allow us to identify that the impact and viability of the program depend on the capacity to modify this form of production, generating substitution towards sustainable agricultural or intensive livestock segments.

In the segment of opportunities for the BioCarbon ERP (PRE Biocarbono in Spanish), the significant participation of natural forests represents an aspect to be strengthened due to their capacity to capture carbon emissions. This is where

conservation agreements with private parties, the State and collective territories, each with their own particular interests, become important.
In order to know in greater detail the behavior of rural property variables and their relationship with land use, the following section addresses the analysis of ownership variables by department, with the purpose of identifying differentiating elements with respect to regional values and generating departmental profiles of land ownership conditions.

## 3.2. Descriptive analysis of the distribution of land ownership by department.

The descriptive analysis shown for the whole Orinoco region as a whole has been replicated for each of the departments that make up the region, in order to identify in more detail, the characteristics of the distribution of rural land ownership in each department.

# 4. Arauca

Based on the previous premise, when reviewing the data of the department of Arauca, it is found that, according to cadastral information, the main economic destination is agriculture, with a participation that does not have great variability between characteristics of property structure, that is, it maintains a proportion of more than 90% in number of properties, owners and area (Figure 36a). In part b of the same figure it can be seen that private companies represent more than 90% in terms of properties and owners, while their representativeness in area is 87%. (Figure 36b).

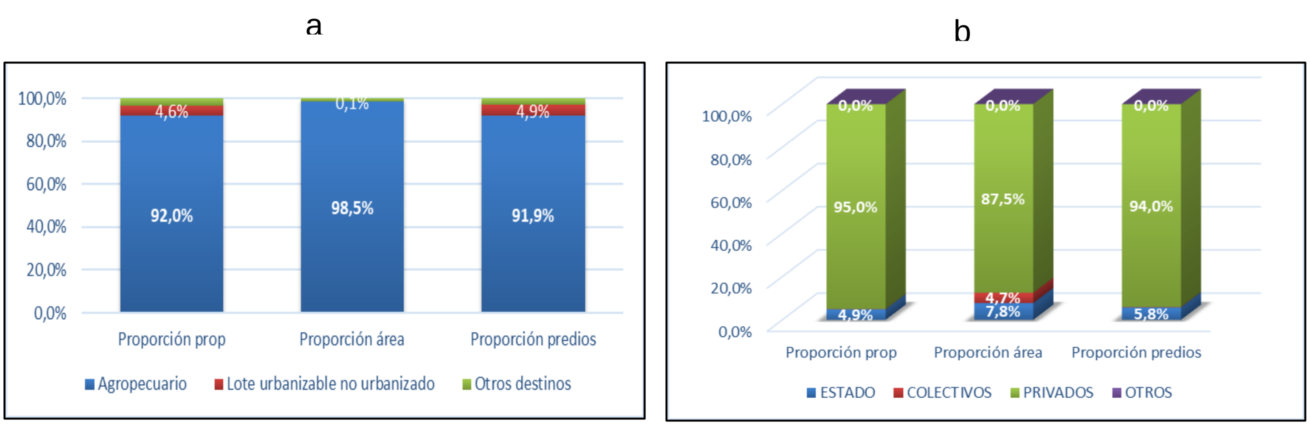



Figure 36. Distribution of properties by economic destination and type of owner in Arauca
Source: UPRA © 2022 based on IGAC 2019 information

The predominant destination in Arauca is agriculture, with almost 99% of the available area. In a complementary way, unlike the regional value, the owners of Arauca are essentially private, with about 88% of the area, while in the Orinoco it was estimated at 60%.
Based on these distributions, emission reduction projects in Arauca would have to be focused on agreements with private landowners for sustainable projects in the agricultural sector, or addressing other forms of production to replace land uses that generate high carbon emissions.

Table 28. Distribution of landholdings by size in Arauca

| Predial Size | Number of owners | % Owners | Land area (ha) | % Area |
|---|---|---|---|---|
| A1. Up to 0.5 ha | 4.795 | 16% | 232 | 0,01% |
| A2. Greater than 0.5 - Up to 1 ha | 520 | 2% | 350 | 0,01% |
| A3. Greater than 1 - Up to 2.5 ha | 912 | 3% | 1.399 | 0,1% |
| A4. Greater than 2.5 - Up to 3 ha | 327 | 1% | 817 | 0,03% |
| B1. Greater than 3 - Up to 5 ha | 1.304 | 4% | 4.714 | 0,2% |
| B2. Greater than 5 - Up to 10 ha | 2.966 | 10% | 19.429 | 0,8% |
| C1. Greater than 10 - Up to 20 ha | 4.334 | 14% | 54.697 | 2% |
| D1. Greater than 20 - Up to 50 ha | 7.686 | 25% | 215.298 | 9% |
| D2. Greater than 50 - Up to 100 ha | 3.505 | 12% | 195.993 | 8% |
| D3. Greater than 100 - Up to 200 ha | 1.501 | 5% | 153.505 | 6% |
| E1. Greater than 200 - Up to 500 ha | 1.192 | 4% | 291.259 | 12% |
| E2. Greater than 500 - Up to 1000 ha | 923 | 3% | 424.137 | 17% |
| E3. Greater than 1000 - Up to 2000 ha | 396 | 1% | 324.347 | 13% |
| E4. Greater than 2000 - Up to 5000 ha | 59 | 0,2% | 166.860 | 7% |
| E5. Greater than 5000 - Up to 10000 ha | 11 | 0,04% | 67.497 | 3% |
| E6. Greater than 10000 ha | 17 | 0,1% | 559.344 | 23% |

Source: UPRA © 2022 based on IGAC 2019 information.

Continuing with the variable classification by property size, Table 28 shows that the category of properties with the highest participation by area is the E6 typology (greater than 10.000 ha), with 23% of the property area of the department. Conversely, the number of owners for the same typology is only 0,1%.

Other relevant groups are those of typologies E1 to E3, whose combined area represents about 42% of the total and 8,2% of the owners. On the other hand, the first interval (up to 0.5 ha) accounts for only 0,01% of the area, distributed among 15,7% of the owners.

The asymmetry between area and landowners in Arauca is indicative of unequal land distribution in the department. Likewise, it again presents potential disjunctions in the application of emission reduction agreements, in the sense that a greater impact would be obtained if agreement processes are advanced with large landowners, with a distribution of benefits for a few.

At the other extreme, agreements with small landowners involve a greater effort in consolidating alliances for a smaller amount of area, which generates less impact, but can benefit a larger population.

From this perspective and considering the high participation of private landowners in Arauca, it is advisable to structure sustainable development projects for both types of landowners, because they encompass different forms of benefits. Large landowners, if they restructure their production methods, mainly extensive livestock farming, could have a high impact on emissions reduction, while small landowners could be encouraged to undertake sustainable development projects if they perceive some benefit, although the impact may not be as high, due to the size of their farms.

On the other hand, the analysis of the areas of properties crossed with the Family Farming Unit (UAF in Spanish) classification shows that the proportion of area below UAF is only 14,8% approximately, while the share of area classified within or above UAF represents 40,1% and 45,1%, respectively. These proportions, compared to the results for the Orinoco region, are 11 percentage points lower for the portion greater than UAF and nearly 9 percentage points higher for the portion within Family Farming Unit (UAF in Spanish).

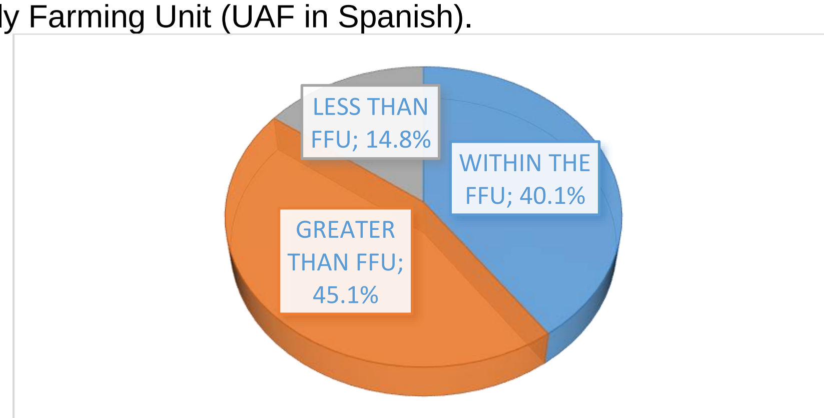



Figure 37. Distribution of landholdings by UAF classification by HRZ in Arauca
Source: UPRA © 2022 based on IGAC 2019 information.

In addition to what is shown in the other variables, the behavior of the area of the properties with respect to the calculated ranges of Family Farming Unit (UAF in Spanish) contributes to demonstrate that the department is characterized mainly by large properties, to the extent that the largest proportion of the area is categorized as greater than Family Farming Unit (UAF in Spanish).

The distribution of property variables seems to indicate that Arauca presents similar opportunities and challenges to those presented for the Orinoco region in general. However, to support the argument, it is appropriate to use again the land use information from the National Agricultural Census (CNA in Spanish) and the National Agricultural Survey (ENA in Spanish), as shown in Table 29. According to the latter, the predominant uses are agriculture and forestry, with a representation of 68,4% and 24,6% of the total hectares, respectively. Therefore, the department of Arauca presents a use structure like that of the Orinoco region, with a predominance of agricultural and livestock use, which, in the departmental case, represents a greater share than the regional distribution.

Table 29. Land uses in the department of Arauca

| Type of use | Area (ha) | % Area |
|---|---|---|
| Agriculture and Livestock | 1.583.275 | 68,4% |
| Fallow | 6.190 | 0,3% |
| Resting | 16.108 | 0,7% |
| Stubble | 102.352 | 4,4% |
| Natural forests | 568.276 | 24,6% |
| Agricultural infrastructure | 850 | 0,0% |
| Non-agricultural infrastructure | 2.266 | 0,1% |
| Other uses | 34.974 | 1,5% |
| **Total uses** | **2.314.290** | |

Source: UPRA © 2022 based on CNA 2014 information.

As a complement to the previous comparison, and using the average participation obtained in the National Agricultural Survey (ENA in Spanish), it is possible to affirm that about 96% of the agricultural use in the rural area of Arauca corresponds to the livestock subsector, while the remaining 4% is for agricultural use. One way of justifying this distribution is that Arauca, according to data from (UPRA, 2019), had a participation of 4% within the national livestock herd during 2019, ranking as the tenth producer at the national level, and in that it was the fifth department in area destined for livestock use with 1.9449.454 hectares, being surpassed only by the departments of Meta, Casanare, Vichada and Antioquia. Now, with respect to the cattle animal density indicator, for Arauca (UPRA, 2019) estimated an indicator of 0,61, ranking 22nd at the national level, with the highest number of animals per hectare in the San Andres archipelago with about 3,12 head of cattle per hectare.

In summary, as was identified in the Orinoco region, the behavior of land ownership variables and the predominant land uses in Arauca, allow for a diagnosis of the potential and challenges of the department for the promotion of agreements under a carbon emissions reduction program. Specifically, what we have is that it is a department with large landholdings in the hands of few private owners, focused on agricultural land use, more specifically in the livestock sector, which shows the preponderance of extensive cattle raising in the department. Under this description, it is clear that Arauca replicates the regional approach, which established the need to mitigate the impacts of extensive cattle ranching, promoting other forms of production that are sustainable and can benefit both large and small landowners, as well as the need to promote the use and forests conservation.

## 5. Casanare

In the data for the department of Casanare, according to the cadastral information, the main economic destination, as in Arauca, is agriculture and livestock, although with a dissimilar participation between area, properties, and owners. In the first type, that is, with respect to area, **Error! Reference source not found.** shows a participation of 94,8%, while in terms of landholdings and owners it is below 60%. The distribution of the variable indicates that the agricultural use has large plots with a smaller number of plots or owners. In addition to the agricultural use typology, the destination for urbanized lots[183] has a significant participation, with just over 20% of the owners and properties in the sample belonging to this typology. However, participation in the area is of little relevance, being less than 1%.

In the economic destination variable, the distribution in Casanare indicates that the efforts of the BioCarbon ERP (PRE in spanish) to reduce emissions should focus on promoting activities in the agricultural sector that contribute to reduce emissions and reduce high emission activities, such as extensive livestock farming, an activity of particular relevance in Casanare, which has about 2,2 million head of cattle, equivalent to 8,3% of the national total, placing the department as the second largest producer in the country. (UPRA, 2019).

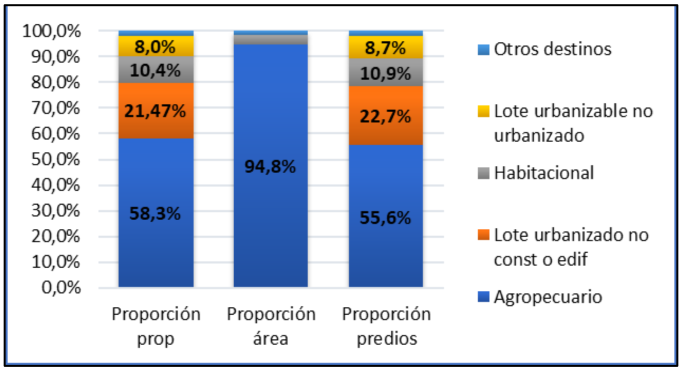
In section b of Figure 9, the type of owner variable shows a more homogeneous behavior, since the main type of owner is private, with a representation of 85,8% in

**[183] According to paragraph 3 of Article 86 of Resolution 070 of 2011, an unbuilt or built-up urbanized lot is defined as those unbuilt properties that have some type of urban development work.**

area, 95,5% in owners and 94,3% in properties. The second most representative typology is State ownership, with a share in area of about 15% of the total.

Figure 38. Distribution of land by economic use and type of owner in Casanare

a

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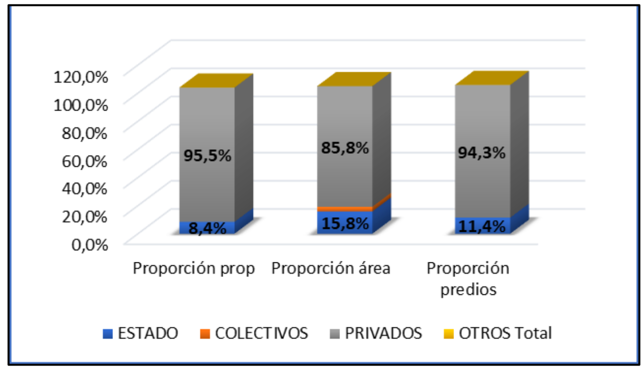



Source: UPRA © 2022 based on IGAC 2019 information.

The proportion of private owners per area is the most relevant, but its proportion is lower than in Arauca, although higher than in the Orinoco region. In this sense, the State should be an agent to consider in the processes of emission reduction agreements in Casanare, due to its participation as a relevant owner in the departmental area, but it is important to notice that the conservation areas in the hands of the State should be considered, which will be analyzed later on.

Based on the results, it is feasible to state that in Casanare it is necessary to consider private and state-owned agricultural activities within sustainable development projects.

Continuing with the variable classification by property size, Table 30 shows that, from the area approach, the largest share is found in the E2 interval (greater than 500 ha and up to 1.000 ha), with a representation of 28%, followed by the E1 interval (greater than 200 ha and up to 500 ha), equivalent to 15% of the area. In sum, both intervals represent 43% of the area, distributed among about 5% of the landowners.

At the other extreme, the same Table 30 shows the opposite effect for the A1 interval (up to 0,5 ha), many owners (45%) with little area (less than 1%).

Table 30. Distribution of properties by property size in Casanare

| Predial Size | Number of owners | % Owners | Land area (ha) | % Area |
|---|---|---|---|---|
| A1. Up to 0.5 ha | 40.941 | 46% | 1.541 | 0,04% |
| A2. Greater than 0.5 - Up to 1 ha | 2.139 | 2% | 1.444 | 0,03% |
| A3. Greater than 1 - Up to 2.5 ha | 4.189 | 5% | 5.648 | 0,1% |

| | | | | |
|---|---|---|---|---|
| A4. Greater than 2.5 - Up to 3 ha | 1.109 | 1% | 2.196 | 0,1% |
| B1. Greater than 3 - Up to 5 ha | 3.627 | 4% | 10.849 | 0,3% |
| B2. Greater than 5 - Up to 10 ha | 5.747 | 6% | 33.302 | 1% |
| C1. Greater than 10 - Up to 20 ha | 6.909 | 8% | 75.266 | 2% |
| D1. Greater than 20 - Up to 50 ha | 9.849 | 11% | 239.762 | 6% |
| D2. Greater than 50 - Up to 100 ha | 6.007 | 7% | 304.883 | 7% |
| D3. Greater than 100 - Up to 200 ha | 3.605 | 4% | 337.456 | 8% |
| E1. Greater than 200 - Up to 500 ha | 3.032 | 3% | 667.190 | 15% |
| E2. Greater than 500 - Up to 1000 ha | 2.228 | 2% | 1186.561 | 28% |
| E3. Greater than 1000 - Up to 2000 ha | 324 | 0,4% | 340.001 | 8% |
| E4. Greater than 2000 - Up to 5000 ha | 185 | 0,2% | 461.760 | 11% |
| E5. Greater than 5000 - Up to 10000 ha | 45 | 0,1% | 237.721 | 6% |
| E6. Greater than 10000 ha | 24 | 0,03% | 405.665 | 9% |

Source: UPRA © 2022 based on IGAC 2019 information.

In the distribution of landholding size in Casanare, the pattern of the Orinoco in general, and Arauca in particular, is reiterated, where there is a high proportion of owners with very little land and few owners with large amounts of land, which is indicative of inequality in the distribution of land in the department, although less marked at the upper end and concentrated in the intermediate ranges.

Regarding the analysis of the areas of the properties with respect to the Family Farming Unit (UAF in Spanish) ranges, **Error! Reference source not found.** shows that about 49% of the property area registered in the cadastral base is greater than the range calculated for the UAF, followed by the area within Family Farming Unit (UAF in Spanish), with 39% of the registered area. As in Arauca, the area below Family Farming Unit (UAF in Spanish) represents the smallest proportion, with about 12% of the total.

Therefore, in terms of the regional comparison, the area of farms larger than or within Family Farming Unit (UAF in Spanish) represents about 88% of the departmental total, which is very similar to the regional result and to that of Arauca, confirming that these are large farms.

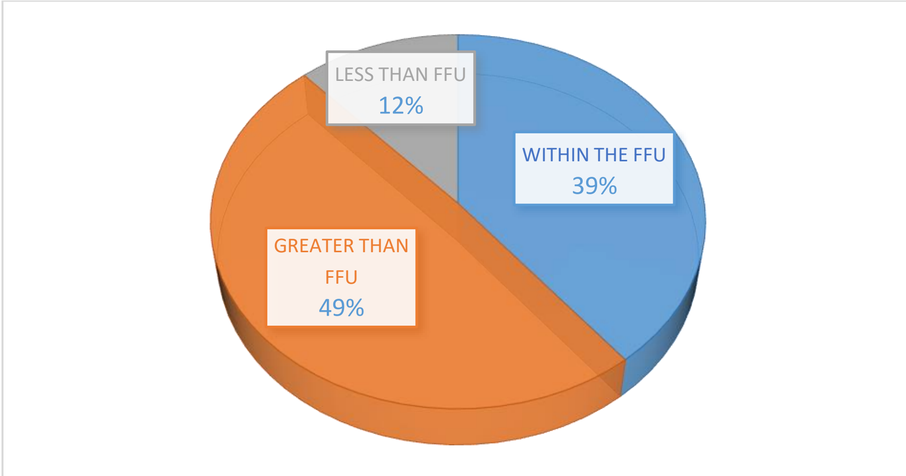



Figure 39. Distribution of land area by Family Farming Unit (UAF in Spanish) classification by ZRH - Casanare
Source: UPRA © 2022 based on IGAC 2019 information.

In order to characterize the department of Casanare based on the variables analyzed, it can be affirmed that the predominant economic use of the land is agriculture and livestock, with mostly private owners, although with a significant presence of the State, where large plots distributed among a few owners predominate, as well as a large number of owners with little available area, and with land areas above the Family Farming Unit (UAF in Spanish) range. All these characteristics point to the potential of future sustainable development projects and their consequent carbon reduction agreements, which could focus on promoting sustainable activities in the agricultural sector, with agreements between private parties, both large and small, and a need to explore some alternatives with State-owned land.

When contrasting this diagnosis with the results of the National Agricultural Census (CNA in Spanish) and the National Agricultural Survey (ENA in Spanish), it is found that agricultural and livestock use registered in the first one about 2,8 million hectares, equivalent to 73% of the total. The second use category is natural forest, with a share of about 19,5% Table 31. Likewise, an unbundled analysis of the agricultural sector based on the average distribution assumption of the ENA between 2014 and 2019, in which a livestock use of 93,7% is calculated within the agricultural sector. This result is in line with the department's participation in the national cattle herd, which, as mentioned in previous paragraphs, ranked as the fourth national bovine producer in 2019. In the same sense, the results of (UPRA, 2019) shows that Casanare is the third department that destined the largest area to livestock use in 2019, with 3.438.658 hectares.

Regarding the indicator of animal density of cattle per hectare, (UPRA, 2019) estimated a value of 0,66 animals per hectare for Casanare in 2019, placing it 21st out of the 32 departments in this section.

Table 31. Land use distribution in Casanare

| Type of use | Area (ha) | % Area |
|---|---|---|
| Agriculture and Livestock | 2.885.399 | 72,9% |
| Fallow | 13.078 | 0,3% |
| Resting | 31.849 | 0,8% |
| Stubble | 199.049 | 5,0% |
| Natural forests | 773.937 | 19,5% |
| Agricultural infrastructure | 2.398 | 0,1% |
| Non-agricultural infrastructure | 6.339 | 0,2% |
| Other uses | 48.663 | 1,2% |
| **Total uses** | **3.960.712** | |

Source: UPRA © 2022 based on CNA 2014 information.

In general terms, the description of ownership conditions in Casanare, together with the representativeness of livestock farming, allows us to consolidate a diagnosis of the department, according to which it is characterized by large estates with few owners, although they are not located in the extreme segment of size ranges. Under these conditions, the department is dominated by agricultural use, centered on the livestock sector, mainly extensive cattle raising, as shown by the department's national importance in cattle production. With this diagnosis, the same regional conclusion is maintained for the effects of the carbon emissions reduction program, that is, it is required to generate agreements with large landowners to consolidate a greater impact, advancing a process that involves the department's livestock guild, to mitigate the effects of this activity and promote other forms of production that are sustainable.

## 6. Meta

In the Meta department it can be evidenced that, based on cadastral information, the main economic use of the land continues to be agriculture, as in the other departments; in addition, there is a dissimilar participation between area, land, and owners. With respect to area, **Error! Reference source not found.**a shows a share of 96.9%, while in terms of plots and owners, the proportion is around 50%. Together with the agricultural and livestock use typology, residential use is the second most important, from the point of view of properties and owners, with just over 35% of the owners and properties in the sample belonging to this typology, but with a participation in the area little relevance and less than 1%. This shows changes in use in Meta, where, unlike the other departments, rural housing uses account for more than a third of the owners and properties analyzed.

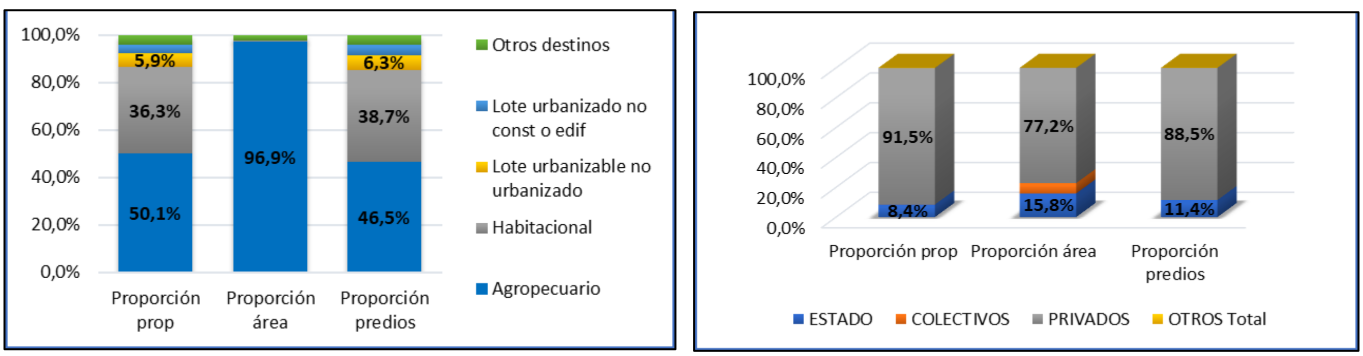
Once again, it is shown that the biocarbon should focus on taking advantage of the potential and mitigating the negative impacts of the agricultural sector in the department.

In the latter, the livestock subsector stands out, in which Meta is the third largest producer of livestock, with nearly 2,1 million animal heads, representing 7,8% of the national total (UPRA, 2019). There is no certainty as to the actual areas occupied by extensive cattle raising. The above value, together with the department's animal density index, estimated at 0,46 cattle per hectare, while the national figure is 0,7 (UPRA, 2019), The report notes that Meta is characterized by extensive cattle ranching, which represents an unsustainable production problem that must be modified to reduce carbon emissions.

On the other hand, in section b of **Error! Reference source not found.**, the characteristic of type of owner shows a more homogeneous behavior, since the main type of owner is private, with a representation of 77,2% in area, 91,5% in owners and 88,5% in properties. The second relevant aspect of this variable is the representativeness of the State, which has a participation in the area of about 15% of the total. As in Casanare, the relevance of the State in Meta indicates that it is an agent that should be considered in the BioCarbon ERP (PRE Biocarbono in Spanish) as a potential beneficiary or regulatory agent, always considering that the areas dedicated to conservation in Colombia generally have the State as owner, with few exceptions.

Figure 40. Distribution of properties by economic use and type of owner - Meta
Source: UPRA © 2022 based on IGAC 2019 information.

a b




In the classification of properties, areas and owners by property size, Table 32 shows that, from the area approach, the largest share is found in property size type E6 (greater than 10.000 ha), with a share of 20%, followed by E2 (greater than 500 ha and up to 1.000 ha), E3 (greater than 1.000 ha and up to 2.000 ha) and E4 (greater than 2.000 ha and up to 5.000 ha), with a share of 18%, 15% and 11%, respectively. Thus, the 4 intervals add up to 64% of the area, distributed among 3% of the landowners.

At the other extreme, the same Table 32 shows the opposite effect for the A1 range (up to 0,5 ha), which has 58% of the owners, but only 0,06% of the available area.

Table 32. Distribution of properties by size in Meta

| Predial Size | Number of owners | % Owners | Land area (ha) | % Area |
|---|---|---|---|---|
| A1. Up to 0.5 ha | 108.211 | 58% | 4.134 | 0,06% |
| A2. Greater than 0.5 - Up to 1 ha | 6.232 | 3% | 3.311 | 0,1% |
| A3. Greater than 1 - Up to 2.5 ha | 8.806 | 5% | 9.251 | 0,1% |
| A4. Greater than 2.5 - Up to 3 ha | 2.278 | 1% | 4.186 | 0,1% |
| B1. Greater than 3 - Up to 5 ha | 7.016 | 4% | 19.396 | 0,3% |
| B2. Greater than 5 - Up to 10 ha | 9.680 | 5% | 50.324 | 1% |
| C1. Greater than 10 - Up to 20 ha | 10.754 | 6% | 106.084 | 2% |
| D1. Greater than 20 - Up to 50 ha | 13.816 | 7% | 308.168 | 5% |
| D2. Greater than 50 - Up to 100 ha | 7.765 | 4% | 385.659 | 6% |
| D3. Greater than 100 - Up to 200 ha | 4.667 | 2% | 430.905 | 7% |
| E1. Greater than 200 - Up to 500 ha | 3.424 | 2% | 659.389 | 10% |
| E2. Greater than 500 - Up to 1000 ha | 3.268 | 2% | 1.169.561 | 18% |
| E3. Greater than 1000 - Up to 2000 ha | 1.163 | 1% | 994.568 | 15% |
| E4. Greater than 2000 - Up to 5000 ha | 708 | 0% | 688.978 | 11% |
| E5. Greater than 5000 - Up to 10000 ha | 127 | 0% | 372.668 | 6% |
| E6. Greater than 10000 ha | 44 | 0% | 1.334.126 | 20% |

Fuente: UPRA © 2022 based on IGAC 2019 information.

With the distribution of landholding size in Meta, in line with what was shown in Orinoquia, Arauca and Casanare, a high proportion of owners with very little land and few owners with large amounts of land is reiterated, being an indication of inequality in the distribution of land in the department, highly marked at the upper end of the landholding size ranges.

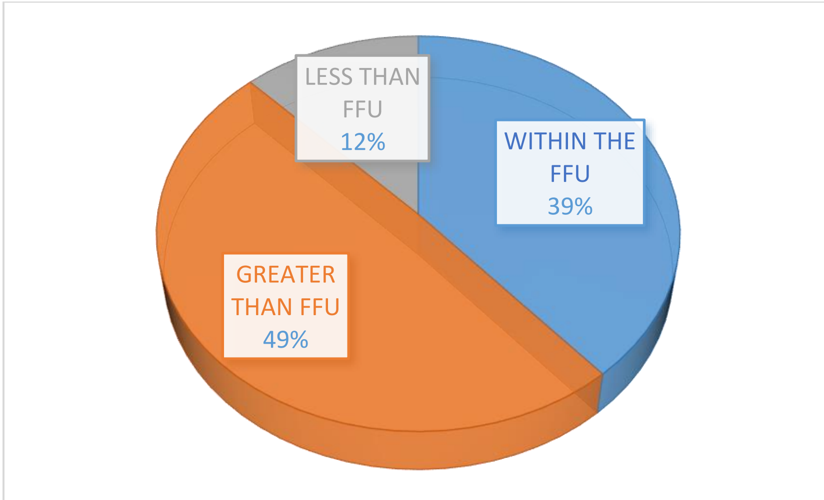



Figure 41. Distribution of landholdings by UAF classification by ZRH - Meta
Fuente: UPRA © 2022 con base en información IGAC 2019

The figure shows the persistent prevalence of large properties in Meta, reflected in the greater representation of properties with areas greater than the maximum Family Farming Unit (UAF in Spanish) range, with a 49% share of the area registered in the cadastral base. The opposite occurs in the segment of properties whose area is less than the minimum range of UAF, where the area is equivalent to 12.1%. In third place, within the Family Farming Unit (UAF in Spanish) range is 38,6% of the cadastral property area.

In summary, the characterization of the department of Meta, based on the variables analyzed, indicates that the predominant economic use of the land is agriculture and livestock, with mostly private owners, although with a significant presence of the State, which will later be identified as the owner of conservation areas, where large plots distributed among a few owners predominate, as well as a large number of owners with little available area, and with plots whose areas exceed the maximum range of Family Farming Unit (UAF in Spanish).

All these characteristics allow us to approach the potential of future sustainable development projects and their carbon reduction agreements, which could focus on promoting sustainable activities in the agricultural sector, with agreements between private parties, both large and small, and a need to explore some alternatives with State lands whose use is not for conservation. In addition, it is clear that one of the main subsectors to work on is extensive cattle ranching, which has a high presence in Meta and generates high carbon emissions, as demonstrated in the last section of this document.

The latter becomes more evident when considering the National Agricultural Census (CNA in Spanish) data, summarized in According to this, the main land use in Meta is agriculture and livestock, with about half of the available hectares. However, contrary to what was presented in the other departments, there is a high proportion of land destined to natural forests, which corresponds to about 41% of the territory, which is an indication that the analysis approach of Meta must take

into account the impact of protected areas as well as the forestry sector in the reduction of carbon emissions and, in addition, must directly involve the State, which has a significant participation seen both in the cadastral bases and in the areas of the protection figures, specifying that the lands of this agent are traditionally areas of environmental protection.
Table 33. According to this, the main land use in Meta is agriculture and livestock, with about half of the available hectares. However, contrary to what was presented in the other departments, there is a high proportion of land destined to natural forests, which corresponds to about 41% of the territory, which is an indication that the analysis approach of Meta must take into account the impact of protected areas as well as the forestry sector in the reduction of carbon emissions and, in addition, must directly involve the State, which has a significant participation seen both in the cadastral bases and in the areas of the protection figures, specifying that the lands of this agent are traditionally areas of environmental protection.

Table 33. Land use distribution in Meta

| Type of use | Area (ha) | % Area |
|---|---|---|
| Agriculture and Livestock | 4.192.411 | 50,0% |
| Fallow | 29.321 | 0,3% |
| Resting | 34.012 | 0,4% |
| Stubble | 537.394 | 6,4% |
| Natural forests | 3.473.611 | 41,4% |
| Agricultural infrastructure | 7.593 | 0,1% |
| Non-agricultural infrastructure | 10.309 | 0,1% |
| Other uses | 96.137 | 1,1% |
| **Total uses** | **8.380.790** | |

Source: UPRA © 2022 based on CNA 2014 information.

In addition to agricultural and livestock use, the average distribution between agricultural and livestock use, according to the proportion given by the ENA for 2014 to 2019 for this use, shows that 92% of agricultural use is destined to the livestock subsector, that is, about 46% of the departmental area, leaving the remaining 8% (4% departmental) for agriculture[184]. This distribution maintains the regional profile and is consistent with the hypothesis of extensive cattle raising identified for the department, although Meta has a higher proportion for agricultural use compared to the regional level and the other departments.
In sum, from the diagnosis carried out for the department of Meta it is concluded that it presents similar characteristics to those observed for the region and the other departments, that is, large private landowners with a focus on agricultural production, determined by the relevance of extensive livestock farming, which reconfirms that this is one of the production segments that must be reformulated to

**[184] It is reiterated that this proportion corresponds to an approximation from the distribution presented in the National Agricultural Survey, extrapolated to the proportions of the National Agricultural Census.**

achieve significant impacts on emissions reduction. In addition to the typical regional features, the department of Meta is characterized by its significant presence of natural forests and by the entry of the State as a determining agent in the process of emission reduction agreements. For this reason, it is necessary to make a detailed identification and description of the environmental management figures that exist in the territory, as discussed in later sections of this document.

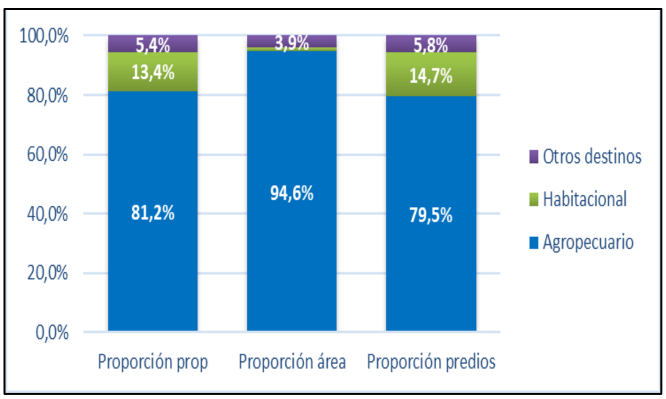
## 7. Vichada

To conclude the departmental analysis, we proceed to analyze the ownership and ownership variables in the department of Vichada. In this regard, the economic use variable maintains the same behavior

Figure 42. Distribution of landholdings by economic use and type of owner in Vichada
Source: UPRA © 2022 based on IGAC 2019 information.

as in the rest of the Orinoco region, where the area of agricultural use corresponds to 94,6% of the total, the owners associated with this use represent 81,2% of all

a

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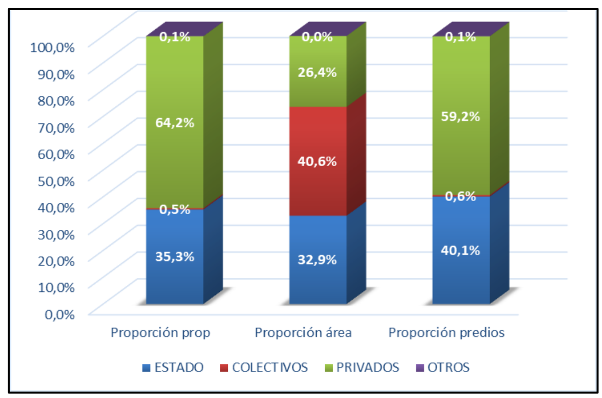



owners and the properties are equivalent to 79,5% of those registered (**Error! Reference source not found.**a). In addition to agricultural and livestock use, housing is the second most important use, from the perspective of properties and owners, with a 13,4% and 14,7% share, respectively, although with a share in the area of only 3,7%.

The results of Vichada, together with those of the other departments of the Orinoco and the regional performance, consolidate the conclusion that the PRE Biocarbon should focus on enhancing the sustainable development of the agricultural sector in the Orinoco and promote the reduction of high emission activities, such as extensive cattle raising, although in the case of Vichada it is a small participation, with 260.796 head of cattle, representing 0,9% of the national inventory. (UPRA, 2019).

On the other hand, in section b of **Error! Reference source not found.**, the variable of type of owner presents a more diverse behavior in comparison with the other departments, due to the fact that the main type of owners in terms of area is the collective, with a representation of 40,6%, followed by the State, whose participation is 32,9%, and ending with the private owners who have 26,4% of the available area in the department. This composition is very different from that of the other departments, where private property was predominant, and is a characteristic that generates a change in the approach to emissions reduction, since potential agreements and sustainable projects must be agreed with 3 different agents, in such a way that implies different forms of agreement, ranging from the review of the collective owners present in the territory to promote this type of project with these collectives, to the generation of agreements with large landowners and the articulation with the State to have a greater impact on carbon emissions reduction. In the classification variable by farm size, shows the opposite effect for category A1 (up to 0,5 ha), which has 34% of the owners, but only 0,001% of the available area. Table 34 shows that, from the area approach, the largest share is found in the E6 type interval (greater than 10.000 ha), with a share of 48%, followed by E3 (greater than 1,000 ha and up to 2,000 ha) and E4 (greater than 2.000 ha and up to 5.000 ha), with a share of 23% and 12%, respectively. Thus, the 3 intervals add up to 84% of the area, distributed among 26% of the owners. At the other extreme, shows the opposite effect for category A1 (up to 0,5 ha), which has 34% of the owners, but only 0,001% of the available area.

Table 34 shows the opposite effect for category A1 (up to 0,5 ha), which has 34% of the owners, but only 0,001% of the available area.

Table 34. Distribution of properties by property size in Vichada

| Predial Size | Number of owners | % Owners | Land area (ha) | % Area |
|---|---|---|---|---|
| A1. Up to 0.5 ha | 3.108 | 34% | 88 | 0,001% |
| A2. Greater than 0.5 - Up to 1 ha | 146 | 2% | 99 | 0,001% |
| A3. Greater than 1 - Up to 2.5 ha | 170 | 2% | 267 | 0,003% |
| A4. Greater than 2.5 - Up to 3 ha | 35 | 0,4% | 87 | 0,001% |
| B1. Greater than 3 - Up to 5 ha | 56 | 1% | 207 | 0,002% |
| B2. Greater than 5 - Up to 10 ha | 99 | 1% | 594 | 0,01% |
| C1. Greater than 10 - Up to 20 ha | 87 | 1% | 1.019 | 0,01% |
| D1. Greater than 20 - Up to 50 ha | 145 | 2% | 4.085 | 0,05% |
| D2. Greater than 50 - Up to 100 ha | 180 | 2% | 12.220 | 0,1% |
| D3. Greater than 100 - Up to 200 ha | 428 | 5% | 53.776 | 1% |
| E1. Greater than 200 - Up to 500 ha | 1.216 | 13% | 338.730 | 4% |
| E2. Greater than 500 - Up to 1000 ha | 990 | 11% | 645.556 | 8% |

| | | | | |
|---|---|---|---|---|
| E3. Greater than 1000 - Up to 2000 ha | 1.855 | 21% | 2.001.610 | 23% |
| E4. Greater than 2000 - Up to 5000 ha | 415 | 5% | 1.031.683 | 12% |
| E5. Greater than 5000 - Up to 10000 ha | 49 | 1% | 337.246 | 4% |
| E6. Greater than 10000 ha | 49 | 1% | 4.112.904 | 48% |

Unlike the other departments, Vichada has a slightly more equitable distribution, characterized by a significant number of owners with large landholdings at the upper end, that is, although the landholdings are large, they are distributed among a larger number of owners. In contrast, there are a significant number of owners at the lower end, but their share is irrelevant.

According to the preponderant sizes in Vichada, it is pertinent to suggest that sustainable projects could have a greater impact because they involve a smaller number of landowners, thus reducing the wear and tear of consultation, to cover a large amount of land and generate a relatively equitable benefit among landowners.

Lastly, the variable of classification in Family Farming Unit (UAF in Spanish), represented by **Error! Reference source not found.** shows that about 68% of the area registered in the cadastral base is greater than Family Farming Unit (UAF in Spanish). On the other hand, in the segment of less than Family Farming Unit (UAF in Spanish), the area is equivalent to 13.3%. In third place, within UAF is 18,8% of the cadastral area. Unlike the other departments in the region, Vichada shows a clear preponderance of properties larger than Family Farming Unit (UAF in Spanish), since their proportion is much higher than the other categories.

The characterization of the department of Vichada, following the behavior of the variables analyzed, indicates that the predominant economic destination of the land is agriculture and livestock, with collective owners, mostly, with a significant presence of the State and a smaller presence of private owners, where large properties are more evenly distributed among them, as well as a large number of those who have little available area, and with properties categorized within or greater than Family Farming Unit (UAF in Spanish).

The variation of Vichada with respect to the behavior of the other departments in the region is that most of its properties are large and that there are 3 types of owners in the territory (private, State and collective).

All these characteristics allow us to approach the potential of future sustainable development projects and their carbon reduction contracts, which could focus on promoting sustainable activities in the agricultural sector, with three types of agreements: with collective territories, with the State and with large private landowners.

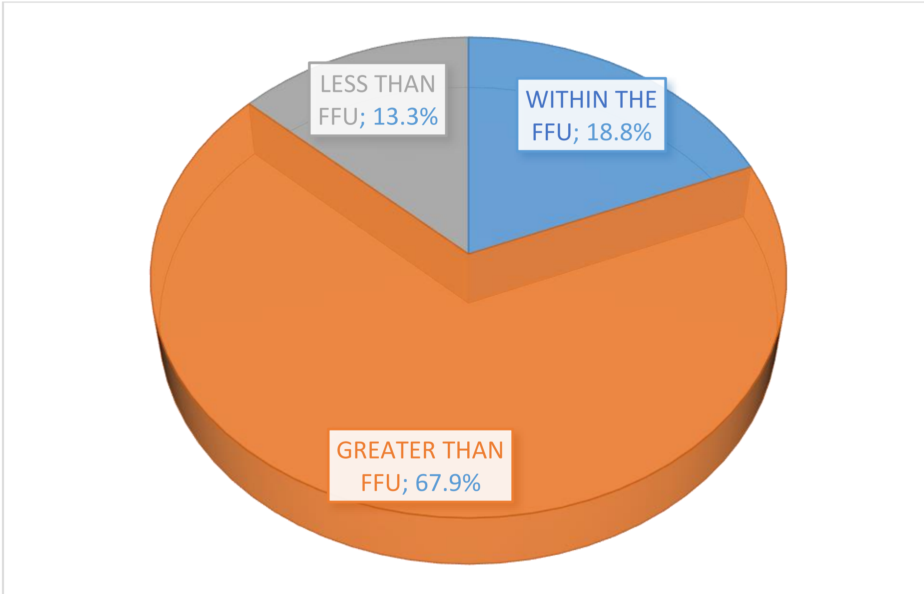



Figure 43. Distribution of landholdings by UAF classification by ZRH and agricultural frontier in Vichada
Source: UPRA © 2022 based on IGAC 2019 information.

Another characteristic that differentiates Vichada is that agricultural use has the lowest participation, compared to the regional average, since it participates with about 44% of the uses registered in the department by the National Agricultural Census (CNA in Spanish). On the other hand, forests are more relevant with about 40% and stubble use with 13,8% (In addition, within the agricultural use, the department's activities are basically concentrated in the livestock subsector, with 99% of the sector. Thus, the agricultural subsector accounts for less than 1% of the area registered for the agricultural sector.
Table 35). In addition, within the agricultural use, the department's activities are basically concentrated in the livestock subsector, with 99% of the sector. Thus, the agricultural subsector accounts for less than 1% of the area registered for the agricultural sector.

Table 35. Land use distribution in Vichada

| Type of use | Area (ha) | % Area |
|---|---|---|
| Agriculture and Livestock | 3.854.380 | 44,16% |
| Fallow | 11.722 | 0,1% |
| Resting | 69.455 | 0,8% |
| Stubble | 1.205.397 | 13,8% |
| Natural forests | 3.473.611 | 39,8% |
| Agricultural infrastructure | 7.593 | 0,1% |
| Non-agricultural infrastructure | 10.309 | 0,1% |
| Other uses | 96.137 | 1,1% |
| **Total uses** | **8.728.605** | |

Source: UPRA © 2022 based on CNA 2014 information.

On the other hand, Vichada has a significant commitment to forestry use, as can be seen in the 2021 forestry statistics bulletin published by Rural Agricultural Planning Unit (UPRA in Spanish). According to this bulletin, Vichada is the second department in Colombia with the second largest area planted in commercial forestry plantations, with an area of 110.589 ha in 2020, equivalent to 20% of the national area (UPRA, 2021).

In general terms, the results of Vichada show reveal that it is a different territory compared to the other departments of the Orinoco, reflected in the fact that it is a department with large extensions of land distributed more equitably among a greater proportion of owners, that its agricultural production is eminently livestock, with the presence of collective territories, private owners and the State, and with a productive focus on commercial forestry crops.

Considering this differential behavior, a carbon emission reduction program has another approach in Vichada, which could focus on continuing to exploit the reduction potential through forest plantations, mitigating the impact of extensive cattle ranching and formulating agreements with collective landowners, considering the production restrictions that may exist in these territories.

Throughout this section it has been inferred that, based on the accumulation of area and owners in the upper and lower extremes of the size intervals, there is an unequal distribution of land in the departments that make up the Orinoco region. In the following section we will test this assertion statistically, by estimating and analyzing the Gini, Theil, lower disparity, and upper disparity indices.

## 7.1. Distribution indicators

In the characterization of land ownership and land ownership indicators in the Orinoco region, different aspects have been analyzed that have made it possible to account for the current status of issues such as the distribution of land size, the economic use or classification of land within the Family Farming Unit (UAF in Spanish), among others. To complement the description of land ownership conditions, the next step is to consider the inequality indicators, represented by the Gini, Theil, Lower Disparity and Upper Disparity indices, which generate an approximation of the way in which the area of rural land is distributed among a given number of owners, which can be large extensions of land in a few hands, small extensions in many hands or an equal distribution among area by owners. The importance of these indicators for the Biocarbon project lies in the fact that their magnitude may have implications for the subscription of carbon emission reduction agreements, which can be seen from two different perspectives. On the one hand, a high degree of inequality would indicate that there are few landowners in a given territory, which would imply that a reduced number of agreements could be signed to affect large tracts of land, benefiting a limited number of landowners

and reflecting the inequitable distribution of land in a territory. On the other hand, the same scenario of high concentration could generate greater impacts when subscribing carbon emission reduction contracts, in the sense that, in the case of large extensions of land, the implementation of sustainable production schemes would generate a greater capture of carbon emissions due to scale effects. The opposite effect would be generated with a better distribution, benefiting a greater number of owners, with a greater number of agreements signed and with fewer individual impacts due to the size of the properties.
To measure the degree of inequality, heterogeneity, or disparity in each of the indicators, the classification ranges defined by the UPRA are used as a reference to determine whether the indicator is low, medium or high, as shown in the following table:

Table 36. Ranking ranges for the distribution indicators

| Dimension | Indicator | Level | Classification Ranges |
|---|---|---|---|
| Inequality | Gini Index | High Gini | From 0 to 0,3, low inequality; from 0,3 to 0,6, medium inequality, and from 0,6 to 1, high inequality. |
| Heterogeneity | Theil Index | Theil Medium | From 0 to 0,06, low dispersion; 0,06 to 0,18, medium dispersion, and from 0,18 to 1, high dispersion. |
| Lower Disparity | Lower disparity indicator | High Disparity | From 0 to 0,055, high lower disparity; from 0,055 to 0,231, medium lower disparity, and from 0,231 to 1, low lower disparity. |
| Superior Disparity | Superior disparity indicator | High Disparity | From 0 to 2,7, low superior disparity; from 2,7 to 5,2, medium superior disparity, and from 5,2 to 10, high superior disparity. |

Fuente: UPRA © 2022

From this perspective, the analysis of the Gini, Theil, lower disparity and upper disparity indices for the departments and municipalities of the Orinoco region is presented.

## 8. Gini Index

The first indicator analyzed corresponds to the Gini index, which is between 0 and 1 and measures the degree of inequality of land ownership, where those closer to zero indicate an equitable distribution between owners and area, while those closer to 1 indicate an inequitable distribution. In formal terms, the estimated Gini index is defined as follows:

$$Gini = 1 - \sum_{i=1}^{n} (X_i - X_{i-1})(Y_i + Y_{i-1})$$

Where:

$X_i$= The cumulated proportion of the population variable.
$Y_i$= The cumulated proportion of the income variable.
n= Number of observations (Total population).

This general expression is reformulated in the following equation:

$$Gini = \frac{2}{n}\sum_{i=1}^{n} \frac{i}{n} - Y_i$$

Graphically, Figure 44 conceptually represents the Gini index. There is a perfect line of equality, where the accumulated percentage of the variable to be distributed is equal to the accumulated percentage of the target population (green line). At the other extreme is the line of total inequality, where a single individual accumulates the totality of the variable to be distributed, in this case land. Finally, the third component of Figure 44 is the so-called Lorenz curve, which represents the effective distribution between the population and the accumulated variable. Thus, the Gini index is measured as the distance between the Lorenz curve and the perfect line of equality, i.e., the greater the distance between these curves, the greater the inequality in the distribution of the variable considered.

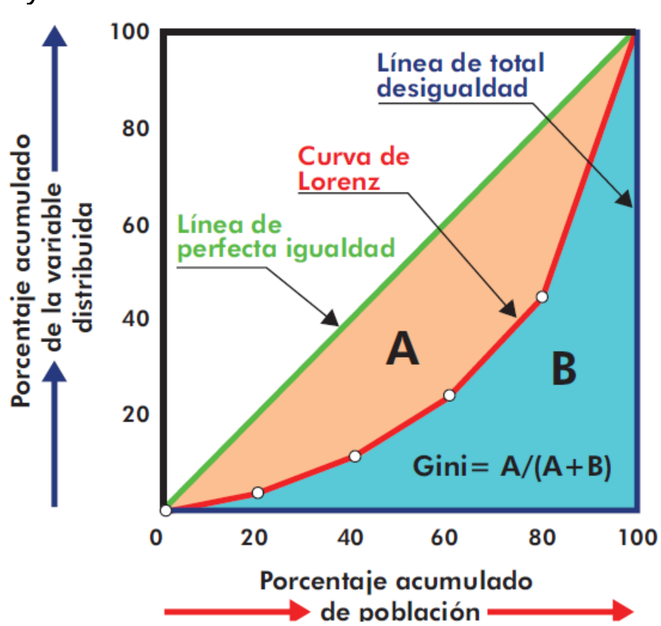



**Figure 44. Lorenz curve and Gini index.**
Source: UPRA © 2017

## 9. Gini Index by department

The Gini index in the four Orinoco departments shows that three of them are in a segment of high inequality, above 0,8, indicating that Meta, with 0,87, Casanare, with 0,84, and Arauca, with 0,81, are departments characterized by few owners with large landholdings, as can be seen in Figure 45.

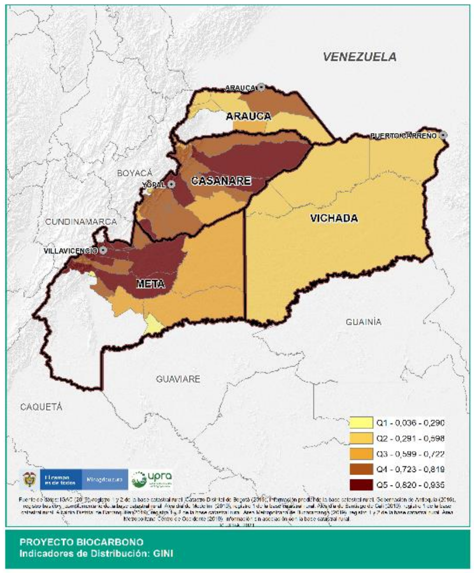



Figure 45. Gini Index by Department
Source: UPRA © 2022 based on IGAC 2019 information.

The department with the lowest inequality is Vichada, with 0,53, which shows that in this department there is a more proportional distribution between owners and land areas, although with a value that is still high, but which places it in medium inequality, according to the cut-off points defined in the Rural Agricultural Planning Unit (UPRA in Spanish) classification.

The results of the index are those that had been advanced in the previous section from the analysis of size ranges, in the sense that, at the upper end of the range, that is, more than 100.000 ha, Arauca has 22,6% of the area in 0,06% of owners, Casanare 9% in 0,02% of owners, Meta 20% in 0,02% of owners and Vichada 48% in 0,5% of owners, reflecting an unequal distribution in departmental rural land ownership.

For Vichada, the extreme range does not seem to reflect the average nature of its index, but in the range between 1.000 ha and 5.000 ha, 36% of the area is accumulated among 25% of owners, which becomes an indication of a more equitable distribution.

As you may notice, the results of the departmental index are consistent with the distribution by size ranges. However, although this index shows similar behaviors in most of the Orinoco departments, except for Vichada, this is not a standardized value among the municipalities of each one, so it is pertinent to make an approach to the indicator in each municipality, to identify those that are or are not in the departmental average.

## 10. Gini Index in Vichada

Within Vichada, the municipalities of Cumaribo, Santa Rosalía and La primavera are below the departmental value, with an index of 0,44, 0,48 and 0,5, respectively, which places them in the medium inequality segment, set by the Rural Agricultural Planning Unit (UPRA in Spanish) between 0,3 and 0,6. On the other hand, the highest indicator is presented by the capital of the department, Puerto Carreño, with 0,62, which is above the departmental average and is located in the high inequality segment. In sum, the municipalities present a similar indicator, with a greater deviation in Puerto Carreño, where the most unequal distribution segments can be seen in the range of more than 10.000 ha and in the range from 1.000 to 2.000 ha. The former groups 13,3% of the area distributed among 0,1%, while the latter accumulates 43% of the area among 19% of the owners. In addition, at the lower end, 33,1% of the owners own 0,004% of the area.

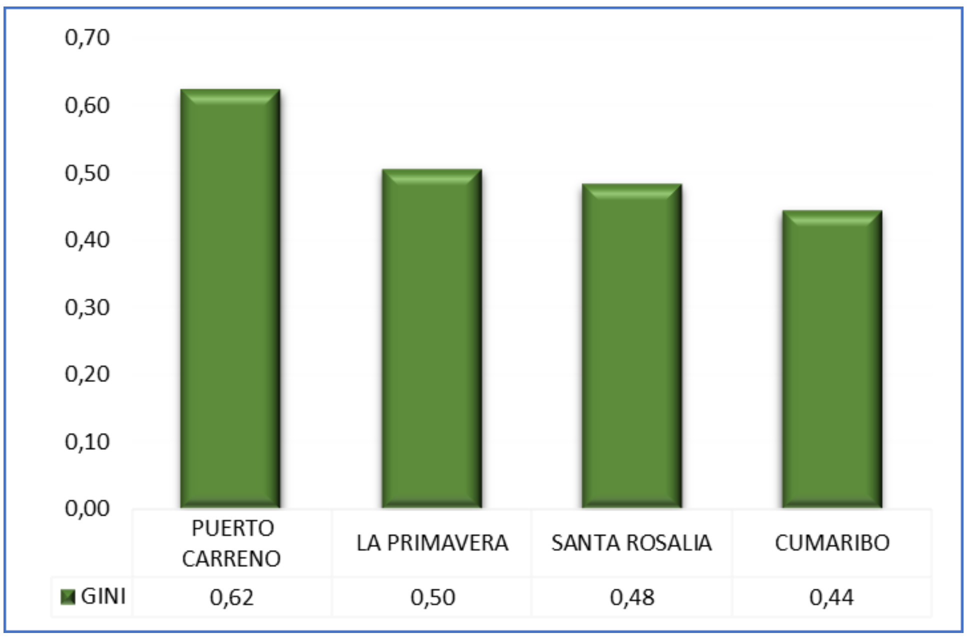



**Figure 46. Gini index by municipalities in Vichada**
Source: UPRA © 2022 based on IGAC 2019 information.

## 11. Gini Index in Arauca

The Gini index in the municipalities of Arauca has a majority with an indicator below the departmental value, where the municipalities of Arauquita (0,56), Cravo Norte (0,55), Fortul (0,54), Puerto Rondón (0,63) and Saravena (0,55), present values below the departmental value and are typified as medium inequality, according to the UPRA classification. At the other extreme, the municipality of Arauca, which in turn is the largest and has the largest number of inhabitants, has index 0,81, that is to say, the municipality has a high indicator.

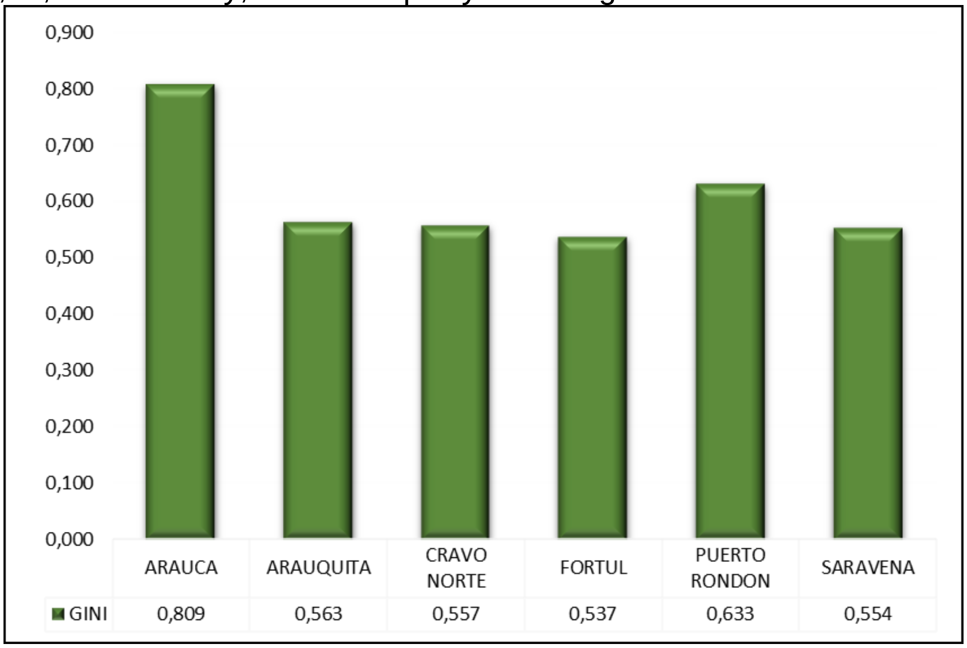



Figure 47. Gini index by municipality in Arauca
Source: UPRA © 2022 based on IGAC 2019 information.

The level of the index in the municipality of Arauca is justified by the fact that the smaller property ranges are characterized by a greater proportion of owners than area, and conversely, in the larger ranges there is a greater proportion of area than owners. Specifically, in the range larger than 10.000 ha, 10,7% of the area is distributed among 0,1% of the owners, while in the range up to 5 ha the proportions are reversed, with the area now representing about 0,01% of the total, distributed among 18,7% of the owners. Combining these distributions with other ranges, such as the one between 200 and 500 ha, which groups 11,9% of landowners in 20,1% of the area, it is possible to justify the index for Arauca.

## 12. Gini Index in Casanare

The department of Casanare is characterized by high Gini indices in most of its municipalities, except for Chameza, which has a value of 0,57, classified as medium. Then, those above 0,6 and below 0,7 are Recetor (0,63), Sabanalarga (0,68) and Samacá (0,64). In the next segment, between 0,7 and 0.8, are the municipalities of Aguazul (0,7), Hato Corozal (0,76), La Salina (0,75), Monterrey (0,74), Nunchía (0,71), Orocué (0.74), Paz de Ariporo (0,78), Pore (0,72), San Luis de Palenque (0,78), Tamara (0,74) and Tauramena (0,77). Finally, 4 municipalities are above the indicator of 0,8: Yopal (0,82), Maní (0,8), Trinidad (0,86) and Villanueva (0,88).

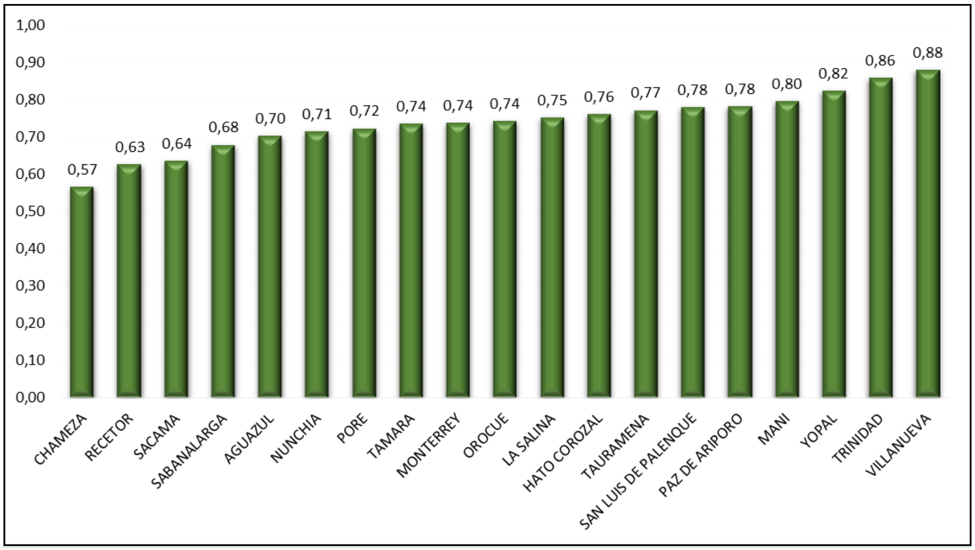



Figure 48. Gini Index by municipality in Casanare
Source: UPRA © 2022 based on IGAC 2019 information.

Taking the index with the highest value, registered in Villanueva, and comparing it with the size ranges analyzed in the previous section, we find that the greatest inequality is in the ranges 200 to 500 ha, 500 to 1.000 ha and 2.000 to 5.000 ha, whose total area participation is equivalent to 48,3% of the area, which is distributed among 2,6% of the landowners. At the lower end of the scale, landholdings of up to 0,5 ha account for 32,6% of the landowners, who distribute 0,05% of the area.

## 13. Gini Index in Meta

For the department of Meta, there is a dissimilar behavior of the Gini index among municipalities.

The municipalities with medium inequality, that is, between 0,5 and 0,6, are Vistahermosa (0,6) between 0,5 and 0,6, are Vistahermosa (0,6), La Uribe (0,59), Mesetas (0,57), El Castillo (0,58) and El Calvario (0,59), These municipalities are characterized by being among the most distant and isolated in the department, In a third segment, between 0,61 and 0,8, are the municipalities of San Juanito (0,62), San Juan de Arama (0,68), San Carlos de Guaroa (0,8), Puerto Rico (0,64), Puerto Lleras (0,71), Puerto López (0,77), Puerto Gaitán (0,64), Puerto Concordia (0,66), Lejanías (0,61), Mapiripán (0,71), Guamal (0,77), Granada (0,75), Fuente de Oro (0,72), Granada (0,75), El Dorado (0,61), Cubarral (0,74), and Cabuyaro (0,74).

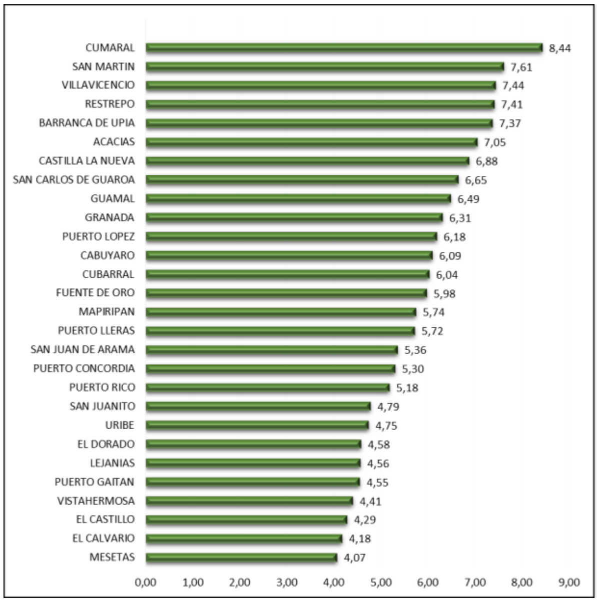


Figure 49. Gini index by municipality in Meta
Source: UPRA © 2022 based on IGAC 2019 information.

Finally, the municipalities with the highest concentration are: Restrepo (0,84), Cumaral (0,9), Castilla la Nueva (0,81), Barranca de Upía (0,83), Acacías (0,81) and Villavicencio (0,84). These municipalities, except for Barranca de Upía and Castilla la Nueva, are characterized for being the main municipalities of the Department and those with the largest population.

The highest departmental index corresponds to Cumaral, whose main characteristic is that in the range of more than 10.000 hectares there is close to 80% of the total area, distributed among 0,03% of the population, that is, it corresponds to a municipality of high inequality, even more so if we consider that 62% of the owners own only 0,1% of the area.

In conclusion, the Gini index in the Orinoco municipalities shows variable levels, although always above 0.5, that is, it is located between medium and, mainly, high levels of classification, showing a panorama of potential agreements for carbon emission reduction among few owners for large areas, that is, the behavior of the indexes provides statistical evidence to pursue agreements with a smaller number of owners. The problem with this vision is that, from the point of view of socioeconomic benefit, it would be generating an incentive to benefit few landowners to the detriment of those with small landholdings, under the argument that the presence of economies of scale would contribute to greater carbon sequestration.

To mitigate the bias towards large landowners, it is recommended that the BioCarbon ERP (PRE Biocarbono in spanish) has differential approaches to allow both large and small landowners to participate in the benefits, focusing those of high impact towards large landowners and concentrating those of community impact among small landowners.

## 14. Theil's index

The second relevant statistical instrument used in the UPRA methodology corresponds to the Theil index, which refers to a value between 0 and 1, which measures the heterogeneity of the distribution of the property, in which the more diverse the observed values of the variable to be distributed and the further away they are from the reference value, the closer it is to one, or the more heterogeneous it is. Formally, the index is estimated under the following formulation:

$$IT = 1 - \frac{1}{\ln(n)} \sum_{i=1}^{n} \frac{Y_i}{Y} ln\left(\frac{1}{Y_i/_Y}\right)$$

Where:

$$Y = \sum_{i=1}^{n} Y_i$$

n = number of individuals.

$Y_i$ = Reference variable.

### 15. Departmental Theil Index

In general terms, the Theil index in the Orinoco departments shows a dispersion between medium and high, that is, they show a relatively heterogeneous behavior with respect to the average property. The department with the greatest heterogeneity is Arauca with an indicator of 0,22, followed by Meta, with about 0,2, thus typifying a high dispersion, according to the classification defined by the Rural Agricultural Planning Unit (UPRA in Spanish).

At the bottom of the index are the departments of Casanare and Vichada with 0,17 and 0,064, respectively, which shows an average performance with respect to the limits defined by the Rural Agricultural Planning Unit (UPRA in Spanish).

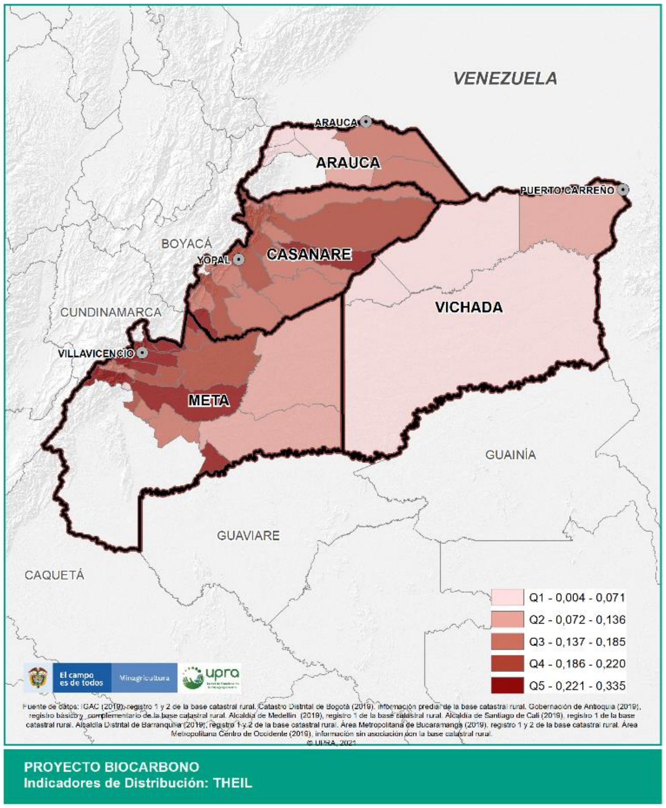



Figure 50. Theil index by department.
Source: UPRA © 2022 based on IGAC 2019 information.

The graphical results presented in Figure 50 shows that the department of Vichada is characterized by low heterogeneity, that is, the area of the properties is relatively homogeneous, which is justified by the fact that the department has mainly large properties, with Puerto Carreño being the most heterogeneous municipality in Vichada.

The figure also shows that the greatest heterogeneity is found in the municipalities of San Martín, Puerto Concordia and Villavicencio, in Meta, together with Trinidad, in Casanare.

## 16. Theil index in Vichada

The behavior of the Theil index in the municipalities of Vichada is similar to the departmental estimator, with the exception of the municipality of Puerto Carreño, with a value of 0.11, much higher than the estimator of La Primavera (0,06), Santa Rosalía (0,08) and Cumaribo (0,05). As in the Gini index, the municipality of Puerto Carreño is the one with the highest value in the department, which makes it possible to identify that the capital of Vichada is the most unequal and heterogeneous municipality.

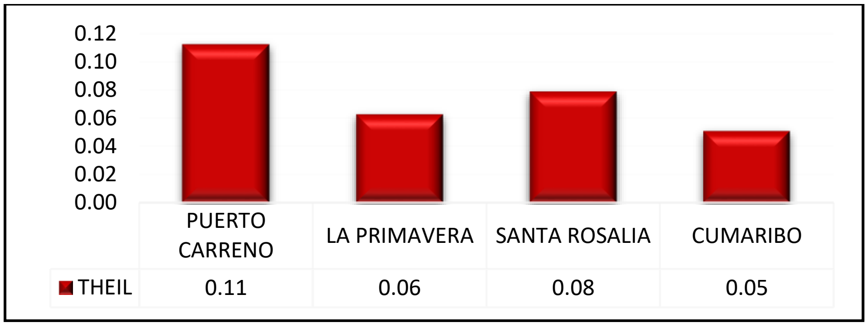



Figure 51. Theil index by municipality in Vichada
Source: UPRA © 2022 based on IGAC 2019 information.

For the purposes of the Biocarbon project, the values estimated for the Theil index allow proposing that Vichada is a department where it is recommended that the emission reduction agreements be concentrated in large landowners, since they are the ones that predominate in their municipalities and, due to their degree of homogeneity, include most of their properties.

## 17. Theil Index in Arauca

The behavior of the Theil index at the municipal level shows that most municipalities in Arauca are below the value of the departmental indicator, including the municipalities of Arauquita (0,07), Cravo Norte (0,11), Fortul (0,07), Puerto Rondón (0,11) and Saravena (0,07). On the other hand, the municipality above the value of the indicator at the departmental level is Arauca, with 0,22.
In general terms, the municipalities of Arauca have medium dispersion, according to the limits defined in the Rural Agricultural Planning Unit (UPRA in Spanish) methodology, except for the municipality of Arauca, which is classified as having high dispersion.

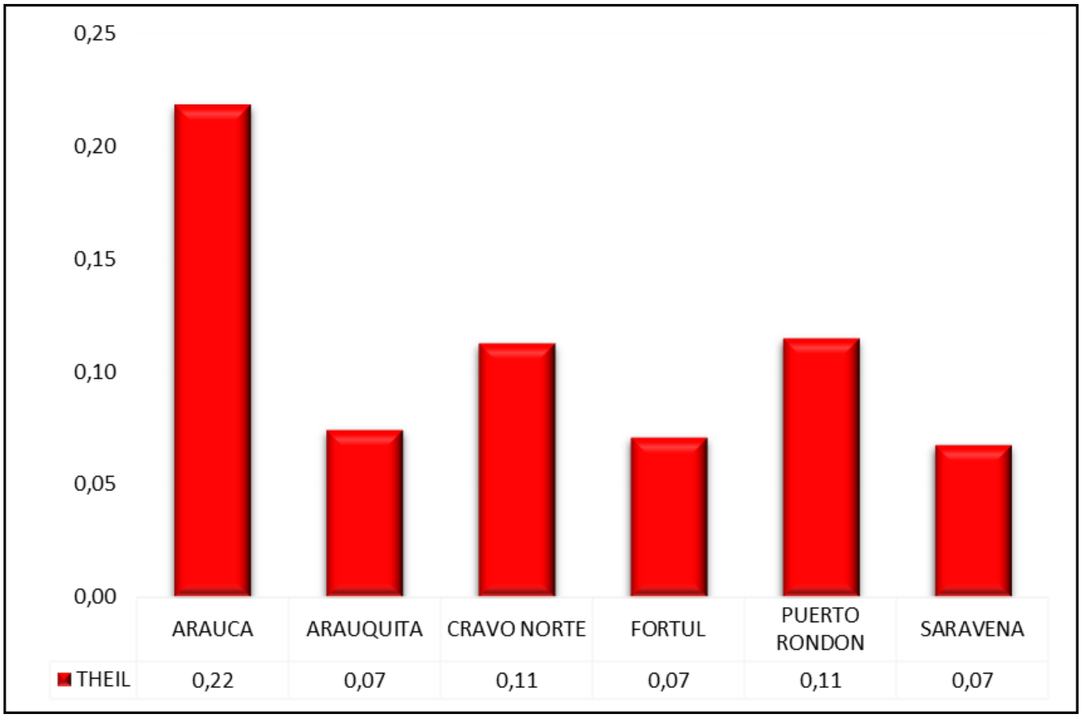



Figure 52. Theil index by municipality in Arauca
Source: UPRA © 2022 based on IGAC 2019 information.

Based on the municipal indicator in Arauca, it is pertinent to state that, since these are municipalities with medium heterogeneity, except for Arauca, which is classified as high, the formulation of the BioCarbon ERP (PRE Biocarbono in spanish) will require a differentiated approach that provides opportunities according to large and small landowners.

## 18. Theil index in Casanare

Contrary to what happens in the departments of Vichada and Arauca, in Casanare the behavior between municipalities is relatively stable, with a maximum difference of 0,14 units between the maximum value, Villanueva (0,31), and the departmental indicator.

In the other municipalities, the index below the departmental estimate is found in Aguazul (0,14), Chameza (0,09), Monterrey (0,16), Nunchía (0,16), Pore (0,16), Recetor (0,12), Sabanalarga (0,14), Sácama (0,15) and Tamara (0,15). This group is characterized by being classified as medium dispersion.

The departmental values include Hato Corozal, Orocué and Paz de Ariporo, which, with an indicator of 0,17, are categorized as medium dispersion.

Lastly, the municipalities that pull the departmental indicator upwards are: La Salina (0,21), Maní (0,18), Yopal (0,19), San Luís de Palenque (0,19), Tauramena (0,19), Trinidad (0,27) and Villanueva (0,31), all located in the high dispersion segment.

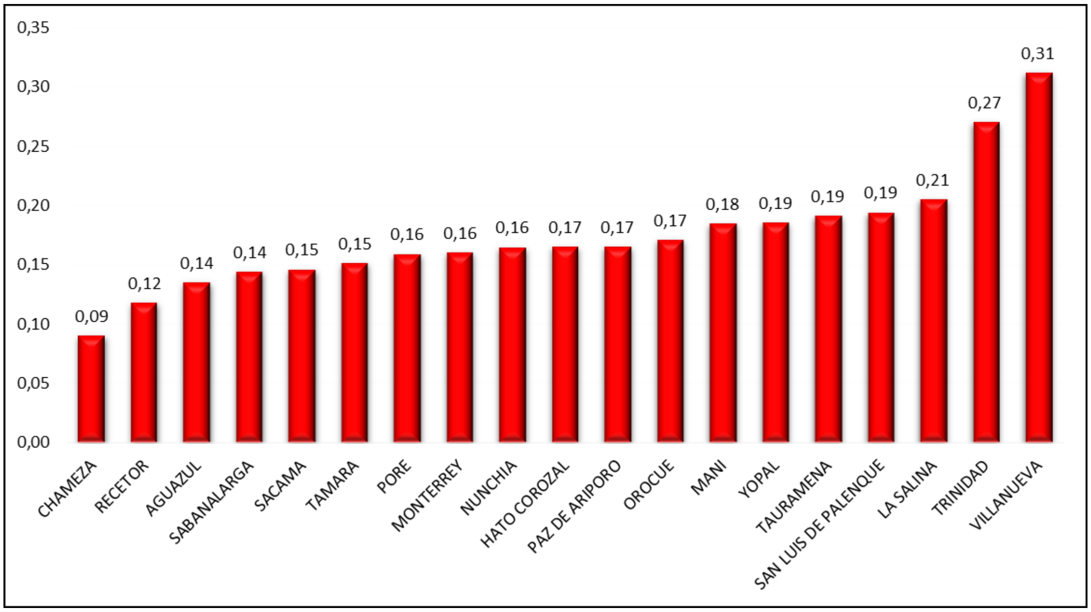



Figure 53. Theil index by municipality in Casanare
Source: UPRA © 2022 based on IGAC 2019 information.

## 19. Theil Index in Meta

The comparison of the Theil index in Meta is made by type of dispersion between low, medium and high, given the number of municipalities in the department. In the group of municipalities that are in the low dispersion category, Meta has none. The medium dispersion group includes the municipalities of Guamal, Mapiripán, Cabuyaro, Granada, Cubarral, Puerto López, Fuente de Oro, Puerto Lleras, Uribe, Puerto Concordia, San Juan de Arama, San Juanito, Puerto Gaitán, Puerto Rico, El Dorado, Vistahermosa, Lejanías, El Calvario, Mesetas and El Castillo. On the other hand, in the high dispersion group (greater than or equal to 0.18) are Villavicencio, Acacías, San Carlos de Guaroa, Restrepo, Castilla la Nueva, San Martín, Cumaral and Barranca de Upía.

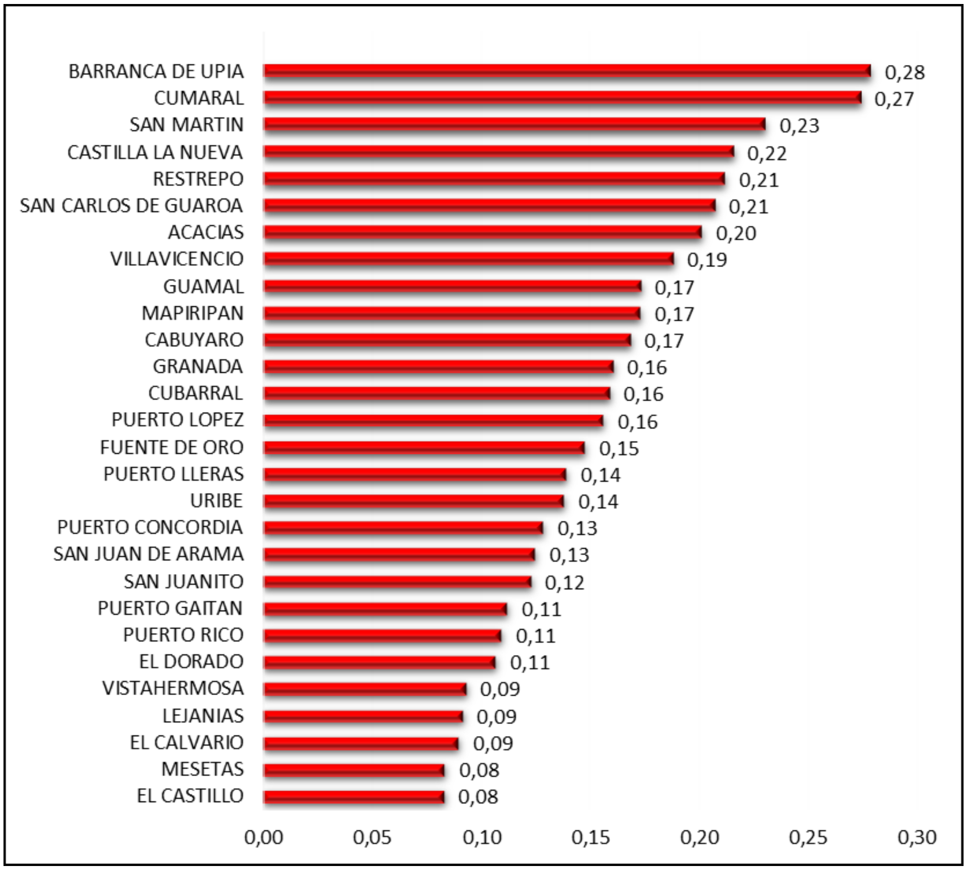



Figure 54. Theil index by municipality in Meta
Source: UPRA © 2022 based on IGAC 2019 information.

The results of the Theil index for the Orinoco region show departments and municipalities with medium to high heterogeneity, that is characterized by the existence of properties with very dissimilar areas between owners. Based on this identification, it is important to reaffirm the approaches to carbon emission reduction agreements that have been defined throughout the document, in the sense that the success of the scope of the BioCarbon ERP (PRE Biocarbono in Spanish) will depend on the ability to distribute the potential benefits among a greater number of landowners, which will require the formulation of agreements with large landowners with high impact in terms of reduction.

Collective agreements can also be reached with small landowners to ensure that the benefits of the program are distributed more equitably and still achieve a positive and significant impact on the reduction of carbon emissions in the Orinoco region. The above indicates a mixed agreement approach depending on the type of landowners for most of the region, except for Vichada, where large landowners prevail in a relatively homogeneous way and, therefore, corresponds to a department where the approach of agreements with large landowners should be encouraged.

# 20. Lower disparity indicator

The lower disparity index measures the difference between the lower end of the distribution for a specific sample and an equal distribution. Specifically, it takes the 10th percentile of the sample and measures it under the argument that the area of the bottom 10% of owners should be equal to 10% of the total area of the sample. Formally, this ratio is defined as:

$$DI = \frac{a_{10}}{a * 0{,}1}$$

Where the lower disparity, DI, is measured as the ratio between the area of 10% of the owners, $a_{10}$, and 10% of the total area of the sample, $a * 0{,}1$.
Regarding the interpretation of the index, it is understood that the closer DI is to 1, the more egalitarian is the distribution of ownership, to the extent that 10% of the area of the sample belongs to 10% of the owners. In the opposite case, when DI tends to zero, the distribution becomes more unequal because the proportion of area of the 10% of the owners has little participation in the 10% of available area.
To measure the magnitude of the lower disparity index, UPRA has generated cut-off points, where an indicator greater than or equal to 0,231 is considered low, medium if it is greater than 0,055 and less than or equal to 0,231, and high when the level of the indicator is less than 0,055.

## 20.1. Lower departmental disparity indicator

In general terms, the lower disparity index in the Orinoco departments presents a value very close to zero, that is, the area of 10% of the owners has little participation within the 10% of the land area in each department, or in other words, there is an unequal distribution in the lower part of the sample.
Now, with regard to the performance by department, Figure 55 shows that those with the lowest inequality are Casanare and Meta, with values of 0,0008 and 0,0005, respectively, while Vichada and Arauca show a better performance, although still very close to zero, with values of 0,002 for the former and 0,003 for the latter. In any case, considering the classification defined by the Rural Agricultural Planning Unit (UPRA in Spanish), all the departments of the region are located in the high disparity range, which is a clear indication that the owners at the lower end have a very small share of the land area in each department.

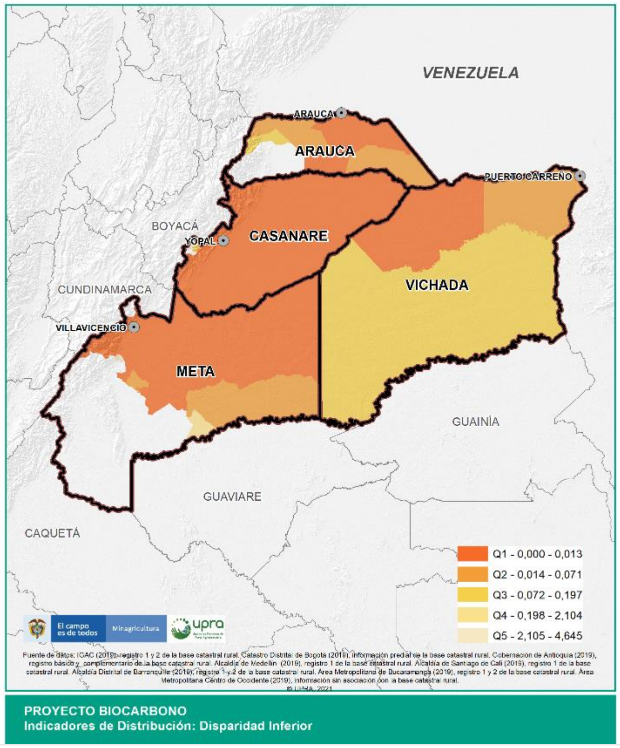



Figure 55. Lower disparity indicator in the Orinoco Departments.
Source: UPRA © 2022 based on IGAC 2019 information.

Graphically, Figure 55 shows that the majority of Casanare is colored with the lowest indicator, while the highest disparity in the other departments can be seen in La Primavera, in the case of Vichada, Arauca and Puerto Rondon in Arauca, and the entire the plains foothillsand highlands area in Meta, which includes important municipalities such as Puerto Gitán and Puerto López.

## 20.2. Lower disparity indicator in Vichada

When considering the behavior of the Lower Disparity indicator in the municipalities of Vichada, it is found that the one with the greatest disparity corresponds to Puerto Carreño, with 0,0004, which is the one that ends up pulling the departmental indicator down. The above becomes more evident when contrasted with the performance of the other municipalities, which shows a less unequal result for the municipalities of La Primavera and Rosalía, with 0,01 and 0,04, respectively, but whose greatest difference is seen with the municipality of Cumaribo, which reaches an indicator of 0,1, that is, the area of 10% of the owners in the municipality have one tenth of the area they should have for the distribution to be equal.

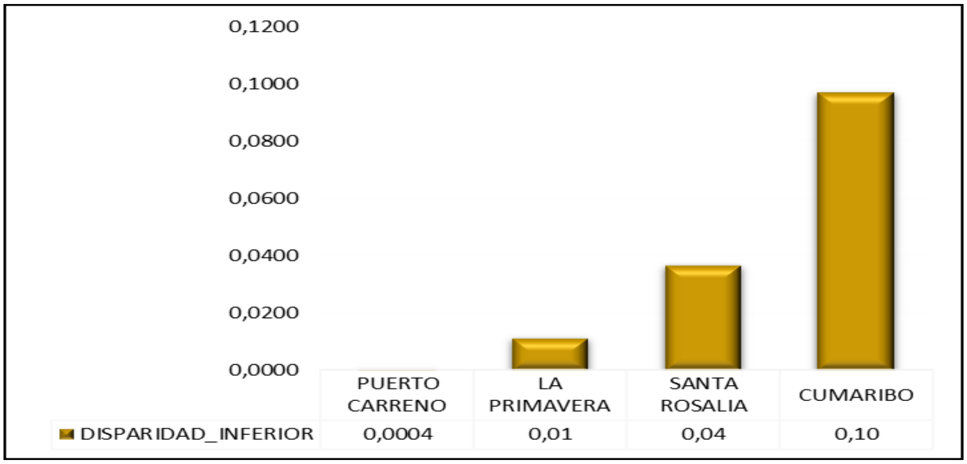



Figure 56. Lower Municipal Disparity Indicator in Vichada
Source: UPRA © 2022 based on IGAC 2019 information.

In terms of ranking, all the municipalities, with the exception of Cumaribo, have a high disparity indicator. Cumaribo's indicator is at the medium level.

## 20.3. Lower disparity indicator in Arauca

The Lower disparity indicator at the municipal level show that the majority of municipalities in Aurauca have higher indexes than the departamental index. In this group are: Arauquita (0,05), Cravo Norte (0,01), Fortul (0,04) and Saravena (0,07) which, in general terms, present a smaller disparity at the lower end, compared to the result for the Department. This group is classified in the high level of the indicator, except for Arauquita, which is in the middle, according to the Rural Agricultural Planning Unit (UPRA in Spanish) classification.

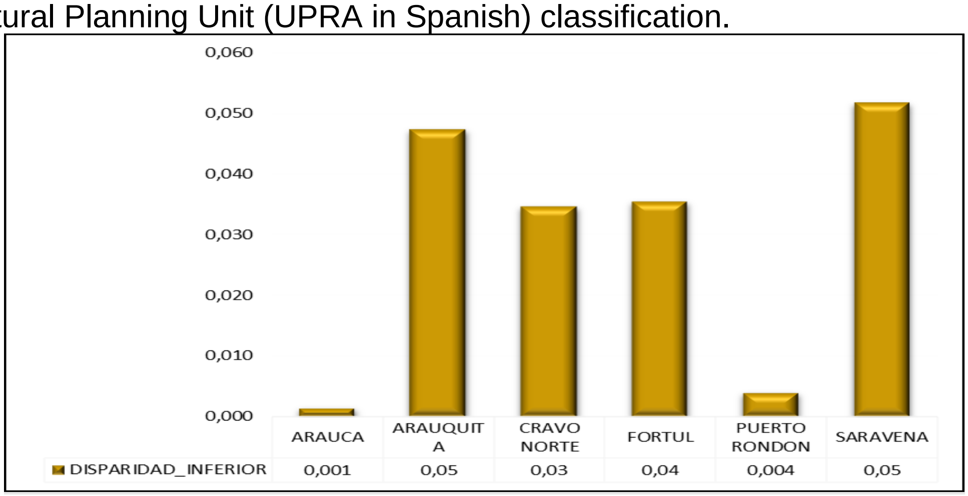



Figure 57. Arauca Municipal Lower Disparity Indicator
Source: UPRA © 2022 based on IGAC 2019 information.

On the other hand, the municipalities that show an indicator below or very similar to the departmental estimator, and which are also classified as high disparity, are Arauca, with 0,001, Puerto Rondón, with 0,0004 and Tame, with 0,0002, indicating that these municipalities are the determining factors for the indicator to be so close to 0 in Arauca.

## 20.4. Lower disparity indicator in Casanare

Unlike the evidence found for the departments of Vichada and Arauca, in Casanare the behavior among municipalities is relatively similar, with marked differences in the municipalities of Chameza, with an indicator of 0,07, and Recetor, with 0,021, which are the furthest from the departmental indicator, estimated at 0,003.
In the other municipalities, the index below the departmental estimator is found in Yopal (0,001), Maní (0,001), Paz de Ariporo (0,001), Trinidad (0.0001) and Villanueva (0,001). In this group, the one with the greatest distance from the mean is Trinidad, with a difference of 0,0029.
Tauramena is located in the departmental average.

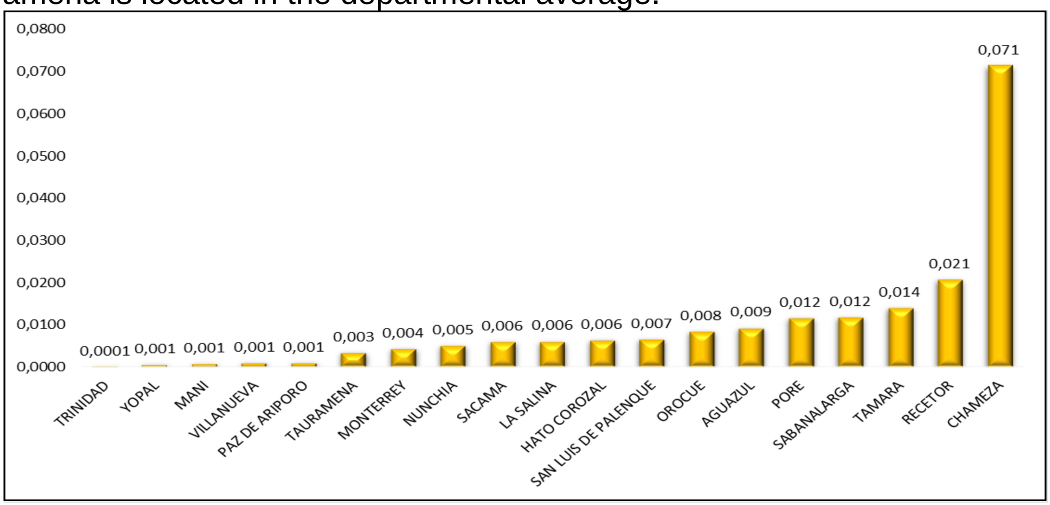


Figure 58. Casanare Municipal Lower Disparity Indicator
Source: UPRA © 2022 based on IGAC 2019 information.

Lastly, the municipalities that pull the departmental indicator upwards are; Aguazul (0,009), Hato Corozal (0,006), La Salina (0,006), Monterrey (0,004), Nunchía (0,005), Orocué (0,008), Pore (0,012), Recetor (0,021), Sabanalarga (0,012), Sacama (0,006), San Luís de Palenque (0,007) and Tamara (0,014). Strictly speaking, this group of municipalities, without presenting a lower parity indicator, are the best performers in the department of Casanare.

In sum, the lower disparity indicator in all the municipalities of Casanare is classified at a high level, a result that is consistent with the intensity of colors that was presented in the Figure 58.

## 20.5. Lower target disparity indicator

The results of the lower disparity index, shown in Figure 59, show that the municipalities with lower performance, but with indicator values significantly higher than the Meta average (0,0005), are Vistahermosa (0,04), Puerto Rico (0,049), Lejanías (0,05), Mesetas (0,05), El Castillo (0,069), San Juanito (0,046), San Juan de Arama (0,022), Puerto Lleras (0,016), Puerto Concordia (0,032), Uribe (0,026), Mapiripan (0,023), Fuente de Oro (0,02), El Dorado (0,038) and Cabuyaro (0,024), San Martín (0,006), Restrepo (0,0064), Puerto López (0,0008), Guamal (0,009). Granada (0,003), Cubarral (0,004), Castilla la Nueva (0,0028), Barranca de Upía (0,0011), Acacías (0,0073) and Villavicencio (0,0008).
Finally, the municipalities with an indicator below the departmental average are San Carlos de Guaroa (0,0001), Puerto Gaitán (0,0002) and Cumaral (0,0005). Despite the disparity shown by the indicator at the municipal level, all are within the high disparity category, according to the limits defined by the Rural Agricultural Planning Unit (UPRA in Spanish).
As with the general results of the indicators analyzed previously, the lower disparity is an indication that small landowners in the region own a small portion of the registered area, since the 10th percentile landowners are occupying much less than 10% of the area and, on the contrary, have lower values, which in the best of cases represent only about 0,6% of the area, as is the case of El Castillo. Therefore, for the purposes of the Biocarbon project, it would be relevant to promote collective agreements with this type of landowners, with the objective of reaching agreements of significant scope that would benefit a significant portion of landowners.

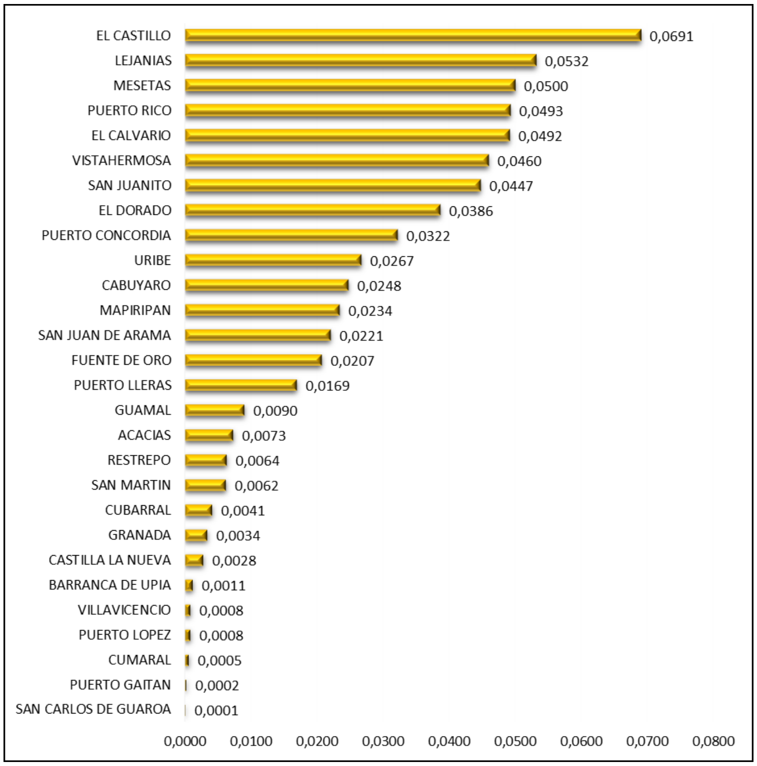



Figure 59. Lower Disparity Indicator at the municipal level in Meta
Source: UPRA © 2022 based on IGAC 2019 information.

## 20.6. Superior disparity indicator

The upper disparity indicator measures the difference between the upper end of the distribution for a geographic sample and an equal distribution. Specifically, the last decile of the sample is taken and measured under the argument that the area of the top 10% of the owners should be equal to 10% of the total area of the sample. Formally, this ratio is defined as:

$$DI = \frac{a_{10+}}{a * 0{,}1}$$

Where the upper disparity, SD, is measured as the ratio between the area of the 10% of owners who own the most (decile 10), $a_{10+}$, and the 10% of the total area of the sample, a*0.1, which represents the area that owners should have in an equal scenario.
Based on these precepts, it is determined that the indicator can take a number between 1 and 10, where 10 represents a high concentration of land by the highest decile of owners, to the extent that 10% of owners accumulate more than 10% of the land, while an indicator of 1 shows an equal distribution of land.

As with the other indicators, UPRA has defined classification ranges for the superior disparity indicator, where the low level corresponds to an indicator between 0 and 2,7, medium when it is between 2,7 and 5,2, and high when it is greater than 5,2.

## 20.7. Departmental superior disparity indicator

The upper disparity index presents a similar result, conceptually speaking, to that of the lower segment, that is, in 3 of the 4 departments of the Orinoco region, the value is closer to 10 than to 1, which is an indication that the area of the 10% of the owners with the largest amount of land has a high concentration of land, much higher than 10% of the registered area in each department, or, in other words, there is a high accumulation of area in the upper part of the sample.
Specifically, Figure 60**Error! Reference source not found.** shows that the department with the highest concentration of land by the top 10% of landowners is Meta, with a higher disparity indicator of 8.2, i.e., in this department the large landowners have 7 times more land than would be equal. Something similar occurs with Arauca (7,43) and Casanare (7,53), whose results show an excess of land in the order of 6,5 times in large landowners. With these results, the 3 departments are classified in high superior disparity, according to the intervals defined by Rural Agricultural Planning Unit (UPRA in Spanish).
In contrast to these departments, in Vichada a higher disparity of 3,34 is estimated, such that, in this department, the segment of large landowners has about 2,3 times the amount of land that theoretically would be equal. Although the indicator continues to show disparity at the upper end, it allows arguing that Vichada has a better distribution in the segment of large properties, which, in turn, is classified in a medium disparity.

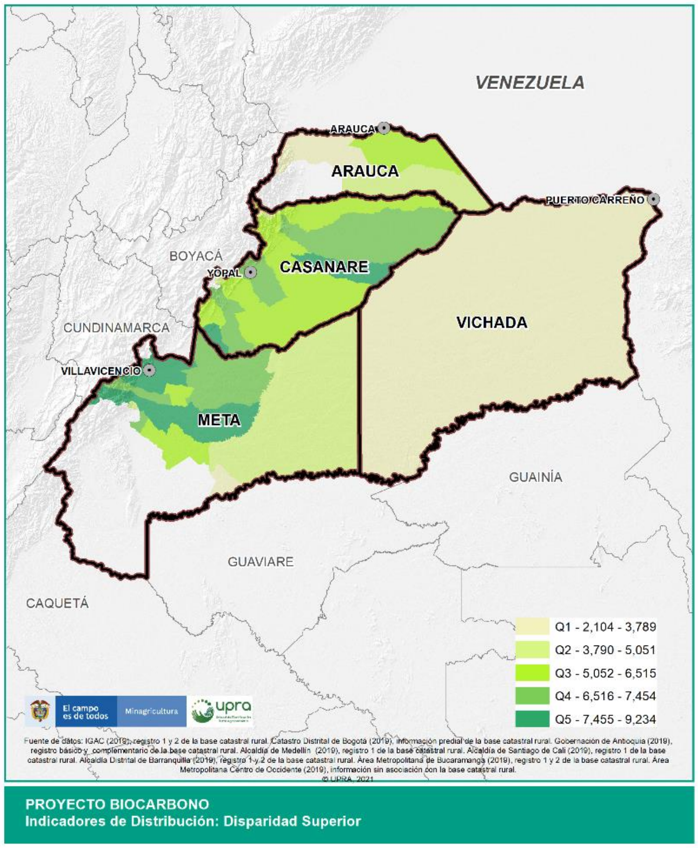



Figure 60. Departmental Higher Disparity Indicator
Source: UPRA © 2022 based on IGAC 2019 information.

As shown in  Figure 60 it is evident that the highest degree of disparity is in the municipalities of San Martin and Villavicencio in Meta, Trinidad in Casanare and Arauca in Arauca. As a complement, the intensity of colors shows that Vichada is in the lower ranges of the distribution, demonstrating that it is the department with the lowest disparity at the upper end of area and owners.

## 20.8. Higher disparity indicator in Vichada.

The indicator of superior disparity in the municipalities of Vichada, as shown in Figure 61, indicates that the least disparate distribution in the superior decile is in Cumaribo, with  2,83, while the one with the greatest disparity is Puerto Carreño, with 3,7, with the municipalities of La primavera (3,13) and Santa Rosalía (3,04). These indicators reveal that the highest disparity in all the municipalities is in the

medium category, in accordance with the limits defined by the Rural Agricultural Planning Unit (UPRA in Spanish).
In general terms, the result of the indicator in the department is relatively homogeneous among municipalities, with which, it can be concluded that, in the segment of large entrepreneurs, although it is not equal to 1, they can be classified as having a lower concentration, compared to the other departments. This is the opposite effect to the result for the lower disparity indicator, where small landowners owned very small portions of land. Likewise, the higher disparity result may be caused by the ownership conditions in Vichada, which is characterized by large landholdings.

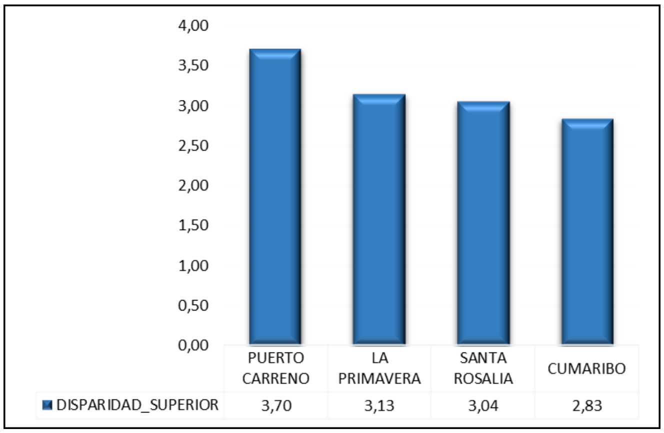



Figure 61. Municipal Superior Disparity Indicator in Vichada
Source: UPRA © 2022 based on IGAC 2019 information.

## 20.9. Indicator of superior disparity in Arauca

The behavior of the Superior Disparity indicator at the municipal level shows that most municipalities in Arauca are below the departmental indicator, except for Arauca, which has a value of 6,82, which in turn is classified as high disparity.
On the other hand, the other 5 municipalities are classified at a medium level of the indicator, since it remains relatively homogeneous, between 3,76 and 4,20. With these results, it can be affirmed that the high disparity classification for Arauca is due to the value presented in the municipality of Arauca, therefore future policy efforts to improve it should focus on the redistribution of the upper end of the property ranges in the municipality of Arauca.

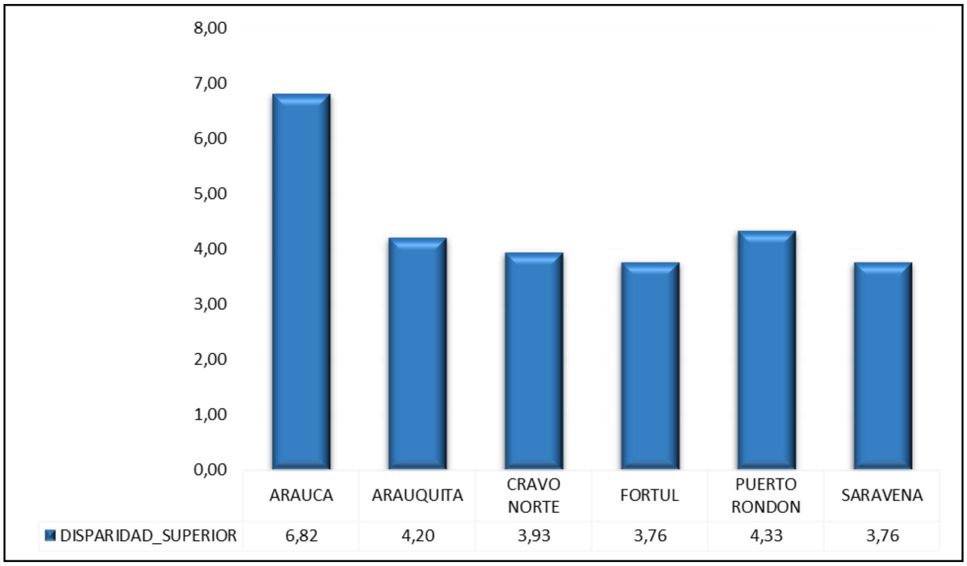



Figure 62. Higher Municipal Disparity Indicator in Arauca.
Source: UPRA © 2022 based on IGAC 2019 information.

## 20.10. Higher disparity indicator in Casanare.

In Casanare, the behavior between municipalities is relatively stable, although with significant differences between the extremes, where Villanueva is estimated to have an indicator of 8,2, which classifies it as a municipality of high disparity, while the municipality with the lowest indicator is Chameza, with 4,06, which allows it to be categorized as a municipality of medium disparity.

The other municipalities have indicators in the high range of the limit, set as greater than or equal to 5,2 by the Rural Agricultural Planning Unit (UPRA in Spanish), with the exception of the aforementioned Chameza, Recetor, with a disparity of 4,65, and Sacama, with 4,77. In this sense, the departmental classification of high superior disparity is caused by a generalized behavior in all the municipalities that compose them, except for 3 that are at a medium level of disparity. Here it is clear that the large landowners in Casanare own the largest amount of area in most of its municipalities, therefore, a land redistribution policy could be focused on the upper end of landowners and areas.

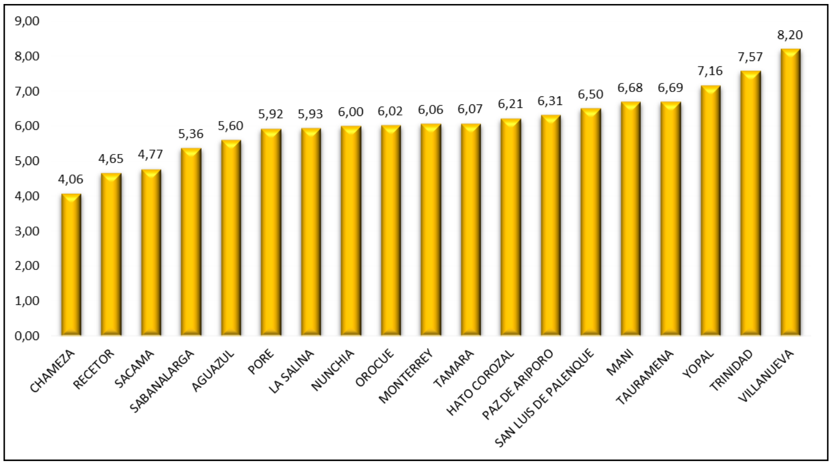



Figure 63. Indicator of superior disparity in Meta
Fuente: UPRA © 2022 con base en información IGAC 2019

## 20.11. Indicator of superior disparity in Meta

The results of the upper disparity index, shown in Figure 64, show that the municipality with the lowest inequality at the upper end is Mesetas, with 4,16, which also happens to be the lowest indicator among the 59 municipalities out of the 4,07. This municipality, together with Calvario, el Castillo, Vistahermosa, Puerto Gaitán, Lejanías, el Dorado, la Uribe, San Juanito and Puerto Rico, register a disparity indicator higher than 2,7 and lower than 5,2, so they are classified in medium disparity, indicating that about 36% of the municipalities of the department are in the medium classification segment.

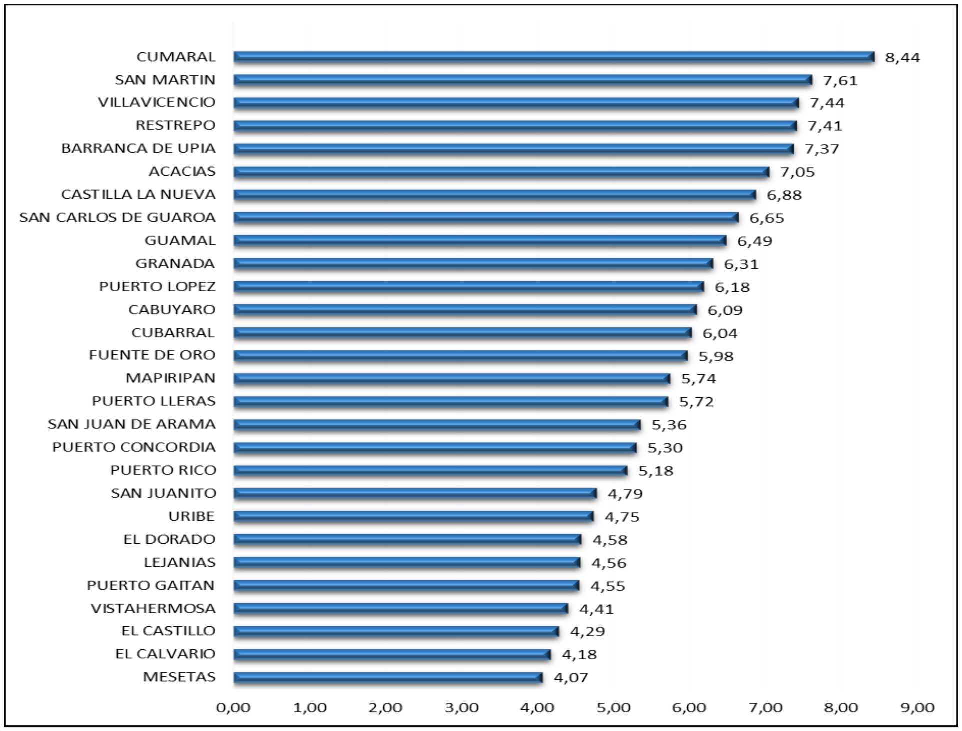



Figure 64. Higher Municipal Disparity Indicator in Goal
Fuente: UPRA © 2022 con base en información IGAC 2019

In the remaining 18 municipalities, not counting La Macarena for which no cadastral information is available, the estimated indicator places it in the high disparity segment at the upper end.

In conclusion, the indicator of superior disparity in the Orinoco region shows varying differentiating elements in the departments. In the first instance, the department of Vichada is the one with the best performance, located in the middle level of the indicator, which is reflected in all the municipalities. Another element is that the classification of high disparity in Arauca is caused by the performance of the municipality of Arauca, with the understanding that the other municipalities are in the medium level of disparity. The third element is that Casanare has a generalized behavior of high disparity, except for 3 municipalities. Finally, in the department of Meta there is a mixed behavior of the indicator, where 36% of its municipalities have a medium superior disparity, while the remaining 64% have a high disparity.

Under the Biocarbon project, the results of the superior disparity indicator lead to the following conclusion:

In Vichada, the relevance of focusing carbon emission reduction agreements on large landowners has been identified, since they are the predominant type of landowners in the area and their average degree of disparity allows inferring that the benefits of sustainable development projects would generate a high impact that would be distributed more equitably among the landowners in the department.

In Casanare it is clear that the focus of carbon emission reduction agreements centered on large landowners would generate a benefit concentrated in few hands, so it becomes relevant to complement high-impact individual agreements with collective agreements of small landowners. However, the reality of the department also indicates that a land redistribution policy should be formulated and advocated to mitigate the higher degree of disparity.

A redistribution policy would also be relevant for Arauca, particularly in the municipality of Arauca, which is the municipality with the highest disparity. On the other hand, in the other municipalities it would be interesting to implement reduction agreements with large landowners, because they are categorized in the medium level of disparity, and the promotion of these agreements would benefit a significant group of landowners without biasing towards a highly unequal distribution and, on the other hand, a greater impact could be achieved.

Finally, in the department of Meta there was evidence of medium and high disparity, so that in municipalities with medium disparity, it would be appropriate to focus emission reduction agreements on large landowners, while for municipalities with high disparity, special emphasis could be given to collective agreements with small landowners. All this in order to generate benefits to a greater number of owners and maintain the expectation of a high impact on the reduction of carbon emissions in the region.

Throughout this chapter a diagnosis of the ownership and ownership structure of the Orinoco region has been structured, presenting an analysis discriminated by departments, where it has been identified that the region is characterized by few owners in large estates and many owners with small estates, thus typifying it as a region of high inequality in land distribution, as demonstrated by the Gini index, with the exception of the department of Vichada, whose inequality is at the medium level. In addition, it was found that regional production is biased towards the agricultural sector, with a greater incidence of the livestock subsector, associated with extensive cattle raising. A third part of the diagnosis focuses on the fact that it is a region of mainly private landowners, although in the department of Vichada the State and the collective landowners, who have a high level of influence in the departmental area, must be considered.

Based on the diagnosis generated, it has been proposed that the region has high potential for the implementation of carbon emission reduction agreements, for which 2 approaches have been proposed, the first being the promotion of agreements with large landowners to consolidate large impacts in terms of emission reductions, while the second corresponds to the structuring of collective agreements with small landowners to promote smaller impacts but benefiting a greater number of landowners.

So far, several possibilities have been proposed for the region, indicating that the two main sectors to intervene are livestock and forestry, the former to mitigate the effect of extensive livestock farming, and the latter to promote reforestation and planting of commercial forests to increase regional carbon sequestration. However, for potential agreements to be implemented, landowners should have legal clarity about their rights on the land, as well as the limitations that may be generated by the presence of environmental management figures or collective territories that would limit the possibilities of impacting with the BioCarbon ERP (PRE Biocarbono in spanish).

In response to these concerns, in the following sections a diagnosis is made on the conditioning factors of the region, represented by potential conflicts in the land ownership structure, by limitations to land use and by the presence of collective agents, which could affect the scope of the BioCarbon ERP (PRE Biocarbono in spanish). The above is fundamental to delimit the ERP scope, because it will generate a panorama of the type of properties that could be chosen for the implementation of the agreements.

To achieve this objective, the uses outside the agricultural frontier are discussed, along with the participation of this concept in the region. This is followed by a description of the environmental management figures that are present in the territory and that limit land use. In the next segment, a diagnosis is made of the conditions of informality in the region. Finally, potential conflicts in land ownership, such as mere ownership and presumed wastelands, are addressed.

## 21. AGRICULTURAL FRONTIER

During the characterization of rural land ownership and distribution conditions in the Orinoco region, the general universe of registered properties has been considered, ignoring that there are some special characteristics that regulate the exploitation and use of the land allowed in certain properties. To approach these, it is relevant to consider the concept of frontier, which according to (UPRA, 2018), is defined as: "the limit of rural land that separates the areas where agricultural activities are allowed, from protected areas, those of special ecological importance, and other areas where agricultural activities are excluded by mandate of Law or regulation". According to this definition, agricultural activities are permitted within the agricultural frontier, while protected areas outside the frontier are areas where such activities are not permitted or, in some cases, regulated forestry activities are contemplated.

The importance or benefits obtained by having a clearly defined agricultural frontier is focused, according to the (UPRA, 2018) in that it allows identifying areas suitable for agricultural production, reduces conflicts due to inappropriate land use, reduces occupation in areas that are subject to environmental zoning and contributes to curb deforestation associated with the uncontrolled expansion of the agricultural frontier in areas or ecosystems of environmental importance, among others.

In this sense, for the purposes of the BioCarbon ERP (PRE Biocarbono in Spanish), it is relevant to analyze the distribution of land within the agricultural frontier, in order to identify differential applications that may arise in the generation of agreements for carbon emissions reduction. In practical terms, the purpose is to present a diagnosis of the distribution of rural properties in the Orinoco region according to their classification within or outside the agricultural frontier. This will make it possible to establish the magnitude of the properties on which sustainable agricultural and livestock schemes that contribute to the reduction of carbon emissions could be implemented, in the case of the properties on the frontier, together with an approximation of the properties on which environmental management and reforestation programs could be promoted, as would be the case of the properties outside the frontier.

The characteristics of the agricultural frontier under analysis are shown in **Error! Reference source not found.**, where it can be seen that about 53% of the properties and landowners in the Orinoco region are within the agricultural frontier, with an area equivalent to 69,2% of the total.

Land and landowners outside the agricultural frontier represent about 53% of the total in the region, with an area that participates with 30,8%.

The results presented in Figure 65 include the participation of all types of owners, that is, private, collective and the State. However, if we exclude collective owners and the State, leaving only private owners, we find that 87,2% of the cadastral area of the properties is located within the border, while the remaining 12,8% is outside. This implies that the area of land outside the border is mainly registered in the name of collective owners and the State, since private owners in the Orinoco region have a higher proportion of land in the border.

From this perspective, when considering potential agreement processes with private agents to promote emission reduction instruments, the Orinoco region presents a favorable scenario for the implementation of sustainable agricultural and livestock programs, since the private land area is located mainly within the agricultural frontier. For private landowners outside the border, each case would have to be analyzed to determine the relevance of entering into an agreement with these agents or if, on the contrary, they should be subject to other types of programs, such as relocation or the generation of incentives for reforestation. It is also evident that the State and collective landowners are relevant actors in the region for the management of areas outside the border, therefore, potential environmental conservation benefits and reforestation programs could be analyzed with these agents.

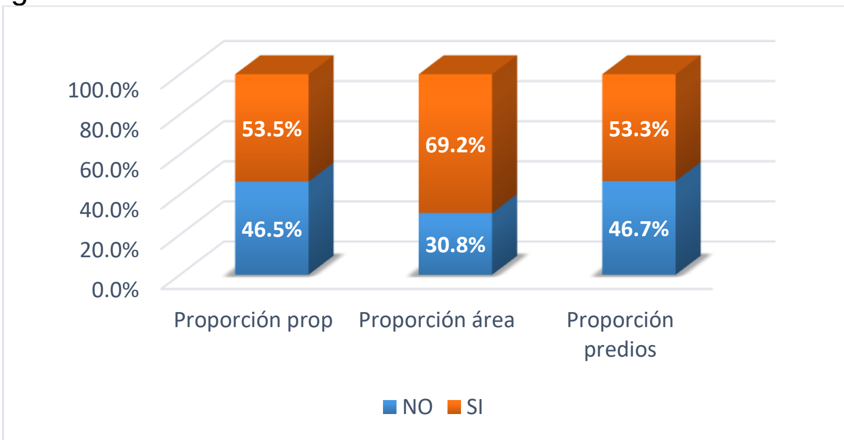



Figure 65. Distribution of land within (yes) and outside (no) agricultural frontier in the Orinoco region
Source: UPRA © 2022 based on IGAC 2019 information.

Another aspect that must be considered when dealing with landowners outside the agricultural frontier is that these territories are distributed, for the region, between natural forests and non-agricultural areas, with about 7,8 million hectares, equivalent to 30% of the territory.
To precisely identify the elements that are outside the agricultural frontier in the Orinoco, Table 37 shows that these segments include natural forests and non-agricultural areas, together with legal exclusions. In the regional total, about 7,8 million hectares are categorized as natural forests and non-agricultural areas, equivalent to 30,8% of the regional area. In the second component, legal exclusions, there are about 2,8 million hectares, which account for 11,2% of the regional territory.

Table 37. Agricultural Frontier 2021 - Orinoco

| Departament. | Natural forest and non-agricultural areas – area (ha) | Legal exclusions - area (ha) | National agricultural frontier - area (ha) | Grand total - area (ha) |
|---|---|---|---|---|
| Arauca | 539.769 | 214.335 | 1.629.032 | 2.383.135 |
| Casanare | 977.273 | 19.130 | 3.437.737 | 4.434.139 |
| Meta | 1.575.848 | 2.053.790 | 4.925.386 | 8.555.025 |
| Vichada | 4.736.026 | 560.209 | 4.712.522 | 10.008.757 |
| **Regional Total** | **7.828.916** | **2.847.463** | **14.704.677** | **25.381.056** |

Source: UPRA © 2021

**Now, with respect to the distribution of the agricultural frontier, both within and outside it, between departments, there are important differences. In Arauca, natural forests represent about 22,6% of the departmental area, while legal exclusions account for about 8,9%, leaving the remaining 68% in the national agricultural frontier. For the department of Casanare, the forests maintain a similar participation,**

**with 22% of the area, but the legal exclusions represent only 0,4%, therefore, the frontier area represents 77,5% of the total. In the department of Meta is where legal exclusions are more important, with about 2 million ha, representing 24% of the department's area, leaving the forest area with about 18% and the agricultural frontier with 57,5%. Finally, in Vichada there is clearly a greater presence of forests with 47,3%, which is equal to the area of the agricultural frontier, which with about 4,7 million ha, participates with 47% of the department's area.**

**The distribution of areas outside and inside the agricultural frontier in the Orinoco region shows what was mentioned at the beginning of this section, with the understanding that the departments of Meta and Vichada are the ones with the greatest presence of areas outside the agricultural frontier; therefore, for the ERPD implementation, a detailed analysis of the land outside the frontier, its relevance and possible limitations of use to participate in the emission reduction agreements must be made.**

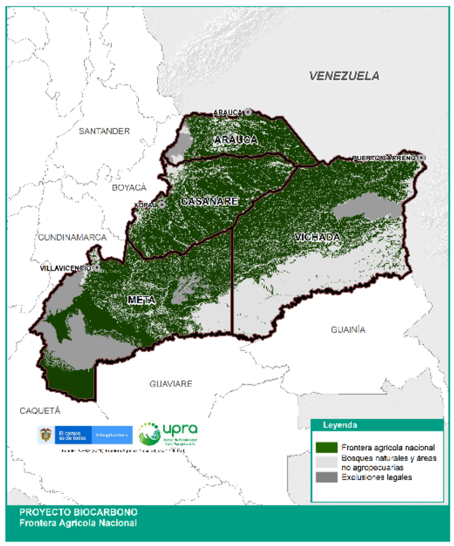



Figure 66. Agricultural frontier in the Orinoco Region
Source: UPRA © 2021

**At the municipal level, Figure 66 shows that the municipality of Cumaribo in Vichada is categorized as an area of natural forests and non-agricultural areas. It also shows that legal exclusions are relevant in the municipalities of Mesetas, La Uribe and Vistahermosa in the Department. This validates that in these departments special attention should be paid to the conditions of use outside the border, such as those present in the environmental protection areas, to ensure greater effectiveness of the ERPD.**

**On the other hand, there are conditions within the agricultural frontier that may restrict land use in the Orinoco departments, as shown in**

**Figure *67*.**

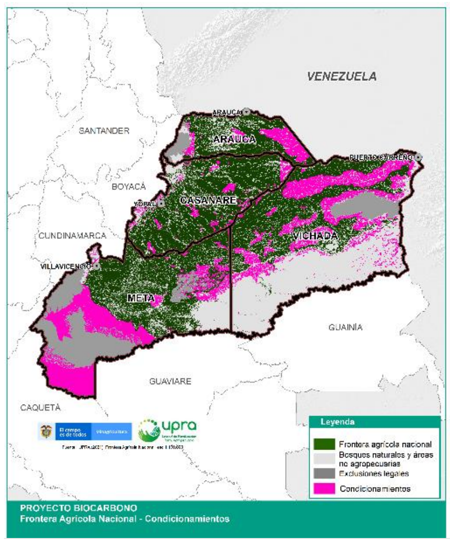



Figure 67. Agricultural frontier conditions in the Orinoco region
Source: UPRA © 2021

The colors in Figure 66 show that in the departments of Meta and Vichada there are a significant number of properties with particular conditions, especially in the Macarena area in Meta and the regions of Puerto Carreño and La Primavera in Vichada.
To measure the importance of the border conditions, the cadastral information shows that they represent about 32,6% of the border area in the Orinoco region, although with varying proportions between departments, as follows: in Arauca they represent about 26,6%, in Casanare 9,2%, in Meta 42,4% and in Vichada 41,4% (Table 38).

Table 38. Conditions within the agricultural frontier - Orinoquia

| Department | Boundary area with conditions - area (ha) | Agricultural border area - area (ha) | Proportion of agricultural frontier conditioning - % |
|---|---|---|---|
| Arauca | 432.954 | 1.629.032 | 26,6 |
| Casanare | 316.827 | 3.437.737 | 9,2 |

| | | | |
|---|---|---|---|
| Meta | 2.087.292 | 4.925.386 | 42,4 |
| Vichada | 1.951.922 | 4.712.522 | 41,4 |
| Regional total | **4.788.995** | **14.704.677** | **32,6** |

Source: UPRA 2021

Likewise, within the main conditioning factors by department, the Regional Integrated Management District (DMI in Spanish) is the main conditioning factor in Arauca with 69.2% of the conditioned area. In Casanare, the main conditioning factors are the areas of indigenous reserves and the natural reserve of civil society with 30% and 25% of the conditioned area, respectively. For Meta, the greatest conditioning factor is represented by the Macarena Special Management Area (AMEN in Spanish), which has an area equivalent to 62,5% of the conditioned area. Finally, the main conditioning factor in Vichada is the indigenous reserves with 45% of the conditioned area.

To complement the frontier analysis, an approach is made to the distribution of the departmental agricultural frontier, where Arauca shows a relatively stable distribution among properties, owners, and area, taking into account that about 80% of all units of analysis are located within the agricultural frontier, leaving the remaining 20% for the sample outside the frontier (Figure 39a). Excluding collective and state landowners and leaving only private landowners, the distribution of the agricultural frontier by area varies slightly, with 88,9% within the agricultural frontier and 11,1% outside, as shown in Table 39.

Table 39. Distribution of area in agricultural frontier for private landowners - Arauca

| Departament | Location in agricultural frontier | Area | Proportion |
|---|---|---|---|
| Arauca | Outside the agricultural frontier | 151.540 | 11,1% |
| | Inside the agricultural frontier | 1.216.069 | 88,9% |

Source: UPRA 2021

The distribution of the agricultural frontier for Arauca, along with the greater representation of private landowners in the area of registered land in the department, as well as a mainly agricultural land use, as identified in chapter 3 of this document, allows proposing that emission reduction projects should focus on projects within the agricultural frontier with private landowners that promote agricultural use. This is based on the diagnosis that most of the registered area of the department is privately owned and, in turn, this is mostly located within the agricultural frontier, so that, if emission reduction projects are focused on this group of properties and owners, a larger area could be covered and a greater impact of the program in the department could be achieved.

On the other hand, in the frontier distribution for the department of Casanare,

Figure 68 shows that most of the cadastral area (86.4%) is within the agricultural frontier, while the remaining 13.6% is classified outside the frontier.

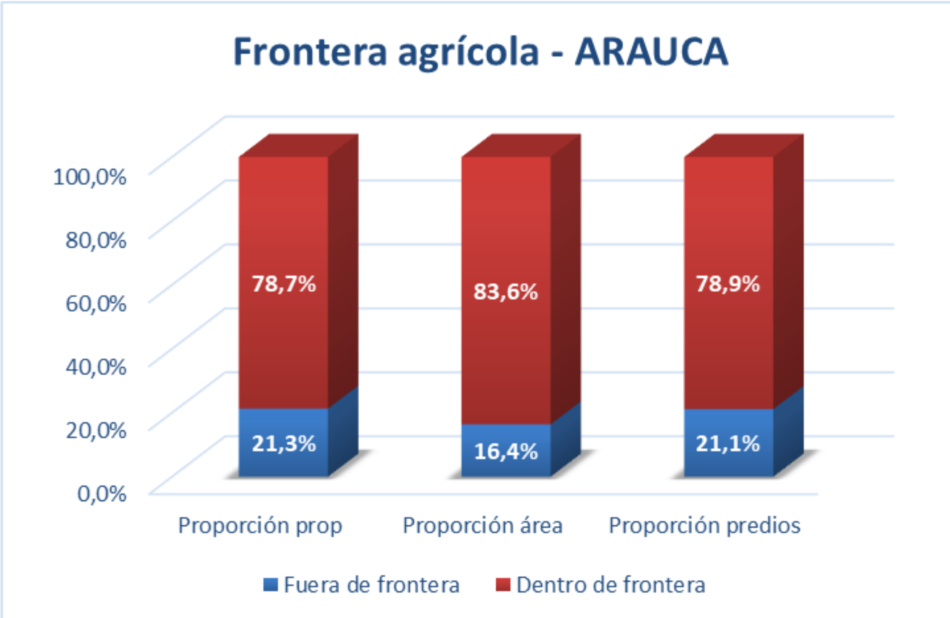



Figure 68. Area and properties of the Agricultural Frontier Zone in Arauca
Source: UPRA © 2021 based on IGAC 2019 information.

If neither the State nor the collective owners are included, the distribution in area of the agricultural frontier is 88,1% in the frontier and 11,8% outside, that is, a very similar result to that presented in the original distribution (Table 40). In the same way that was concluded for Arauca, in Casanare, emission reduction agreements would be strengthened through the management of sustainable agricultural projects in border areas with private agents.

Table 40. Distribution of agricultural frontier area for private landowners - Casanare

| Department | Location in agricultural frontier | Area | Proportion |
|---|---|---|---|
| Casanare | Outside the agricultural frontier | 846.961 | 17,4% |
| | Inside the agricultural frontier | 4.011.534 | 82,5% |

Source: UPRA 2021

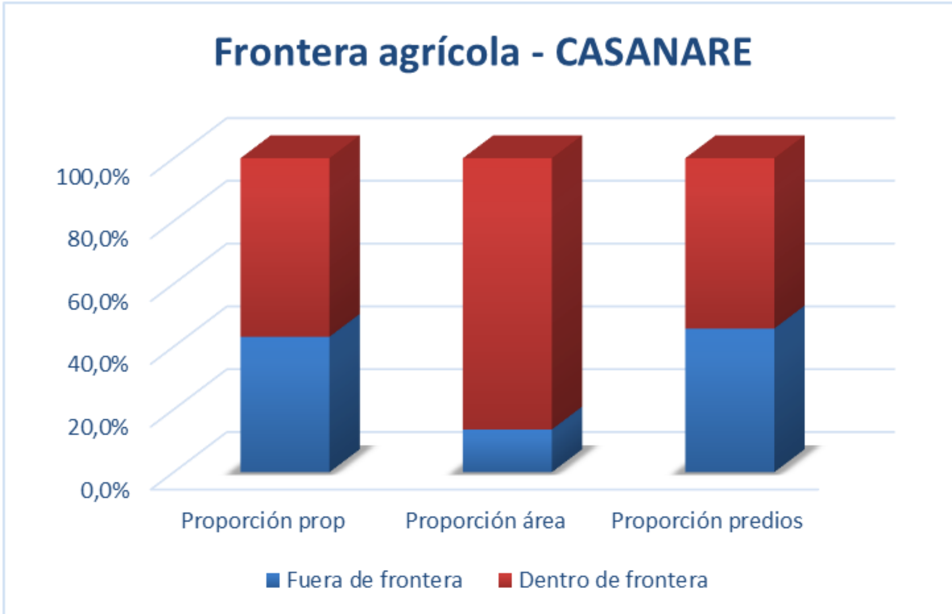



Figure 69. Distribution of properties by agricultural frontier in Casanare
Source: UPRA © 2021 based on IGAC information.

Turning to the distribution of the agricultural frontier in the department of Meta, it is found that, according to
Figure *70*, is within the agricultural frontier, while the remaining 30% is classified outside the frontier, this result has the greatest difference with respect to the other departments of Arauca and Casanare, but is closer to the regional results. This indicates that in Meta there is a greater use of the agricultural frontier, with the impacts that this represents on the conservation of environmental figures and ethnic reserves. However, when applying the filter by private owners/holders, there is a significant reduction in the proportion, since the area outside the agricultural frontier is reduced to 17,4%, indicating that, in this department, there is indeed a greater use of land outside the agricultural frontier, but with a lower impact than initially presented (Table 41).

Table 41. Distribution of area in agricultural frontier for private landowners - Meta

| Department | Location in agricultural frontier | Area | Proportion |
|---|---|---|---|
| Meta | Outside the agricultural frontier | 846.961 | 17,4% |
| | Inside the agricultural frontier | 4.011.534 | 82,5% |

Source: UPRA 2021

Now, although the effect is minor, it does represent a more intensive use of these types of spaces, which are mainly intended for conservation or ethnic reserves. Therefore, the agricultural frontier is central to indicate carbon emission reduction mechanisms in Meta, under the understanding that there is a significant portion of landowners who have restricted land use, thus the relevance of implementing agreements with landowners outside the frontier with the uses according to the legal conditions or restrictions.

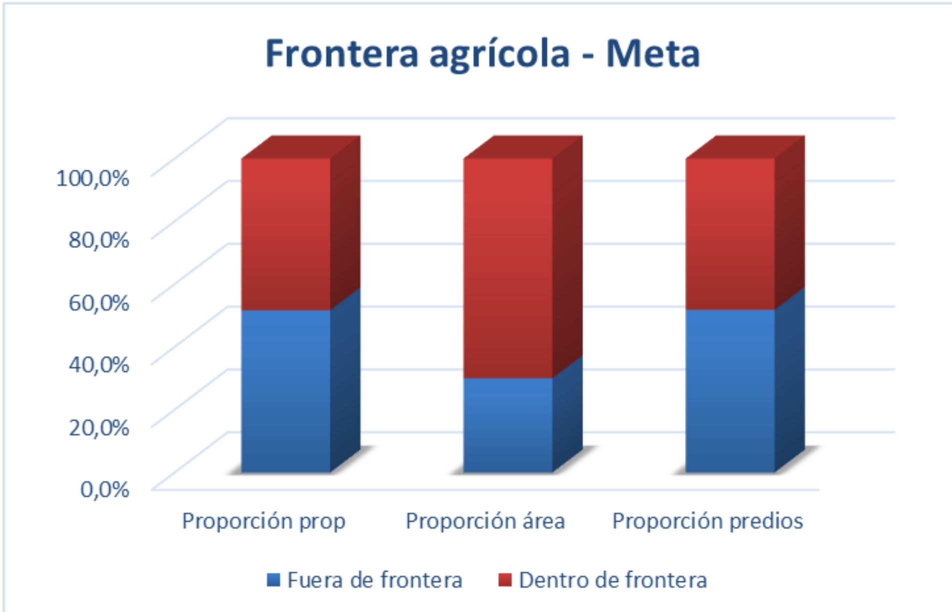



**Figure 70. Distribution of properties by agricultural frontier in Meta**
Source: UPRA © 2021 based on IGAC 2019 information.

Finally,
Figure 71 shows that the distribution of area between farms inside and outside the agricultural frontier for the department of Vichada is very similar, since 57,9% are classified as inside the frontier, while the remaining 42,1% are outside. The result of
Figure 71**Error! Reference source not found.** is determined by the collective and state property, whose use is found in areas outside the agricultural frontier, so that, when excluding both types of owners, about 94% of the private area is found in the agricultural frontier and only the remaining 6% outside (Table 42).

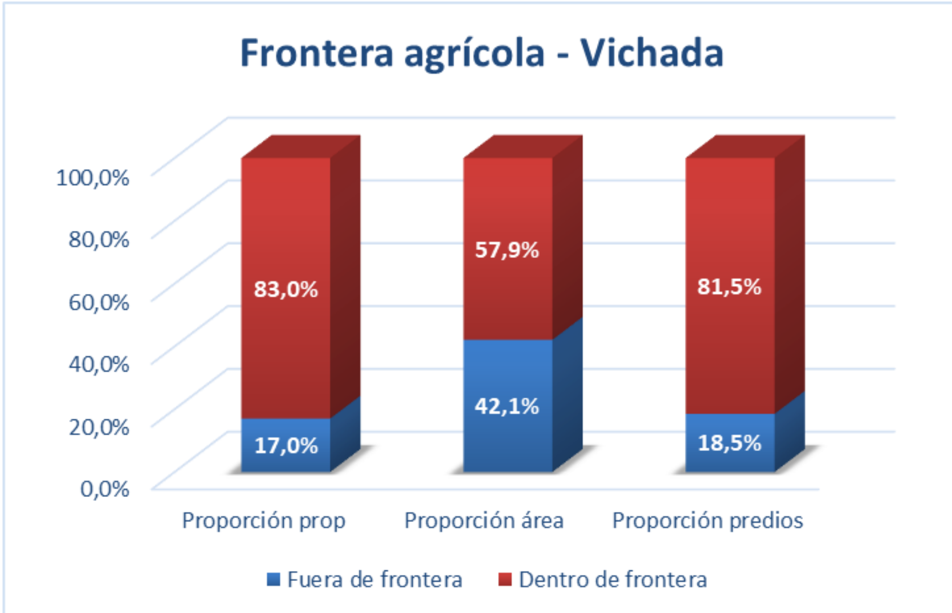



Figure 71. Distribution of properties by agricultural frontier in Vichada
Source: UPRA © 2021 based on IGAC 2019 information.

**Table 42.** ***Distribution of area in agricultural frontier for private landowners*** **– Vichada**

| Departament | Location in agricultural frontier | Area | Proportion |
|---|---|---|---|
| vichada | Outside the agricultural frontier | 112.932 | 5,2% |
| | Inside the agricultural frontier | 2.071.830 | 94,8% |

**Source: UPRA 2021**

The above result, together with the fact that State and collectively owned lands have a share of about 40% of the department's land area, as identified in chapter 3 of this document, leads to the need to formulate a differential strategy to promote a carbon emissions reduction program, which in the case of Vichada should include the formulation of agreements with ethnic groups and the State on lands that are located both within and outside the agricultural frontier, with the restrictions that this may imply.

The data presented in this chapter provides greater clarity on potential limitations to the implementation of the BioCarbon ERP (PRE Biocarbono in Spanish), due to the importance and border restrictions in some departments of the region. In particular, for the departments of Meta and Vichada it has been shown that nearly half of their territory is outside the agricultural frontier and, in addition, that of the lands that are on the frontier, nearly 40% have some type of conditionality,

representing a panorama in which a little more than two thirds of the lands on the frontier do not have conditionalities and would be the direct object of the BioCarbon ERP (PRE Biocarbono in Spanish), as long as they have legal certainty.
For the remaining properties, an analysis of titles and permitted uses must be carried out in each case to determine whether these properties are susceptible to undertaking sustainable projects to contribute to the reduction of carbon emissions or, on the contrary, whether it would be preferable to maintain these properties unaltered as a way of contributing to this objective.
At the other extreme are the departments of Arauca and Casanare, especially the latter, which has most of its lands within the agricultural frontier, which could be associated with a greater margin of applicability to the PRE BioCarbon, in the sense that they are properties without the constraints of areas outside the border or with some limitation, on which a wide range of sustainable projects could be implemented in accordance with the potential uses of the department.
After diagnosing the agricultural frontier in the Orinoco and indicating its potential effects on the ERPD, the following chapter discusses the land use planning figures in the Orinoco in order to identify those that predominate in the territory, together with their potential impact on the Biocarbon project.

# 22. LAND SURVEY PLANNING FIGURES IN THE ORINOCO TERRITORY

When analyzing the distribution of rural land in the Orinoco region, it is necessary to consider the different types of land use planning that exist in the territory, since their existence and extent could be taken into account in carbon emission reduction contracts in the Orinoco region. In this sense, a review is made of the environmental, ethnic and other social property management figures (farmers reserve zones, rural, economic and social development zones and business development zones), in order to generate a diagnosis of their relevance in the Orinoco departments.

## 22.1. Environmental Management Figures

The analysis of the concept of environmental management figures is framed within the denominated Protected Areas System (SINAP in Spanish), which corresponds to an area conservation strategy by the State and private parties, defined by Article 2 (numeral 2.2.2.2.1.1.3) of Decree 1076 of 2015 as "...the set of protected areas, the social and institutional actors and the management strategies and instruments that articulate them, which contribute to the fulfillment of the general conservation objectives of the country...". This spectrum includes all protected areas of public, private or community governance, as well as the national, regional and local management scope.

In general terms, the figures contemplated in the Protected Areas System (SINAP in Spanish) are summarized in Table 43. Of these, in the Orinoco region there are environmental areas of different categories, so it is important to describe them to identify the potential restrictions faced by the region.

**Table 43. Protected Areas System in Colombia**

| Category of planning environmental | Area of environmental interest | Management scope |
|---|---|---|
| **Areas of the National Natural Park System (PNN in Spanish)** | National Parks | National |
| | Nature Reserves | |
| | Unique Natural Areas | |
| | Flora and Fauna Sanctuaries | |
| | Parkways | |
| **Strategic Ecosystems** | Paramo Complexes | National |
| | Subparamos, Water Springs, Water Recharge Zones | Local |
| | Natural Forests | National |
| | Tropical Dry Forest | National |
| | Mangroves | National |
| | Inland Wetlands | Regional |
| | RAMSAR Wetlands | National |
| **Complementary Conservation and Sustainable Development Strategies** | Special Management Areas | Regional |
| | World Heritage Sites | National |
| | Important Bird Conservation Areas – AICAS in Spanish | Regional |
| | Conservation protection soils (D3600/07) | Regional |
| | Forestry Reserve Zones Law 2 of 1959 | National |
| | Biosphere Reserves | National |
| **Other Categories – Protected Areas System (SINAP in Spanish)** | Regional Natural Parks | Regional |
| | National Protective Forest Reserves | National |
| | Regional Protective Forest Reserves | Regional |
| | National Integrated Management Districts | National |
| | Regional Integrated Management Districts | Regional |
| | Soil Conservation Districts | Regional |
| | Recreation Areas | Regional |
| | Civil Society Nature Reserves | Local |

Source: UPRA © 2022 based on SINAP information.

In the beginning, Table 44 shows that the net area of environmental figures presents a greater participation in the department of Meta with 55% of the total area registered for it, together with Vichada, where the proportion is 31%.

In this analysis process, reference is made to the net area, since there may be overlaps between the different figures, to the extent that the result is obtained from the cartographic processing of the different sources of information, with 25% of the region's area having this characteristic. Another indication of the relevance of environmental figures in the Orinoco region, especially in Meta and Arauca, can be seen when considering the participation of these figures in the departmental territory, where for the department of Meta they represent 41% of its territory, while in Casanare the proportion is 5%, as shown in Table 44.

**Table 44. Environmental Figures Area - Orinoquia**

| Department | Net Area Environmental Figures (ha) | % Net Area Environmental Figures | % Net Area Environmental Figures in each Department. |
|---|---|---|---|
| Arauca | 640.074,22 | 10% | 27% |
| Casanare | 225.254,96 | 4% | 5% |
| Meta | 3.527.573,40 | 55% | 41% |
| Vichada | 1.995.659,20 | 31% | 20% |
| **Total Regional** | **6.388.561,79** | **100%** | **25%** |

Source: UPRA © 2022 based on SINAP information.

In a more detailed look at the environmental figures, Table 45 shows the areas of environmental interest present in the region, where it is highlighted that the National Natural Parks (PNN in Spanish) have the highest representation followed by the Macarena Special Management Area (AMEN in Spanish).

**Table 45. Environmental Figures - Orinoquia**

| Environmental Management Category | Area of Environmental Interest | | Arauca Area (ha) | Casanare Area (ha) | Meta Area (ha) | Vichada Area (ha) | Total |
|---|---|---|---|---|---|---|---|
| Areas of the National Natural Park System (PNN in Spanish) | PNN | | 173.337 | 1.970 | 1.213.764 | 560.206 | 1.949.277 |
| Strategic Ecosystems | Paramos | | 68.157 | 12.980 | 140.388 | | 221.525 |
| | RAMSAR Wetlands | | | | 25 | 877.214 | 877.239 |
| Complementary Conservation and Sustainable Development Strategies | Macarena Special Management Areas | Conditioned | | | 1.653.981 | | 1.653.981 |
| | | Legal exclusion | | | 1.761.688 | | 1.761.688 |
| | Important Bird Conservation Areas (AICAS in Spanish) | | 171.569 | 60.580 | 1.028.286 | 557.000 | 1.817.435 |
| | Forestry Reserve Zones Law 2 of 1959 | A Category | 35.639 | 506 | | 3 | 36.148 |
| | | Previous Decision | 188.427 | 1.330 | | | 189.757 |
| | | B Category | 5.076 | | | 15 | 5.091 |
| | | C Category | 52.221 | | | | 52.221 |
| | Biosphere Reserves | | | | | 1.095.869 | 1.095.869 |
| | Regional Natural Parks | | | 3.379 | 24.408 | | 27.787 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Other Categories – Protected Areas System (SINAP in Spanish) | National Protective Forest Reserves | 5.812 | 2.680 | 2.029 | | 10.521 |
| | National Integrated Management Districts | 333.403 | | | | 334.403 |
| | Regional Integrated Management Districts | | 35.280 | 15.113 | 17.153 | 67.546 |
| | Soil Conservation Districts | | | 294 | | 294 |
| | Recreation Areas | | | 278 | | 278 |
| | Civil Society Nature Reserve | 3.442 | 123.732 | 6.567 | 24.053 | 157.794 |

Source: UPRA © 2022 based on SINAP information.

Graphically, Figure 72 shows the geographic distribution of the environmental management figures, which evidences their significant presence in the Macarena sector in the Department of Meta, covering municipalities such as Macarena, Uribe, Vistahermosa, Meseta and Puertos Rico. Likewise, in Vichada they are present in the municipalities of Puerto Carreño and La Primavera. Thirdly, the marking of figures in Arauca can be seen in Arauca and Cravo Norte, on the one hand, along with Saravena and Fortul at the other end of the department.

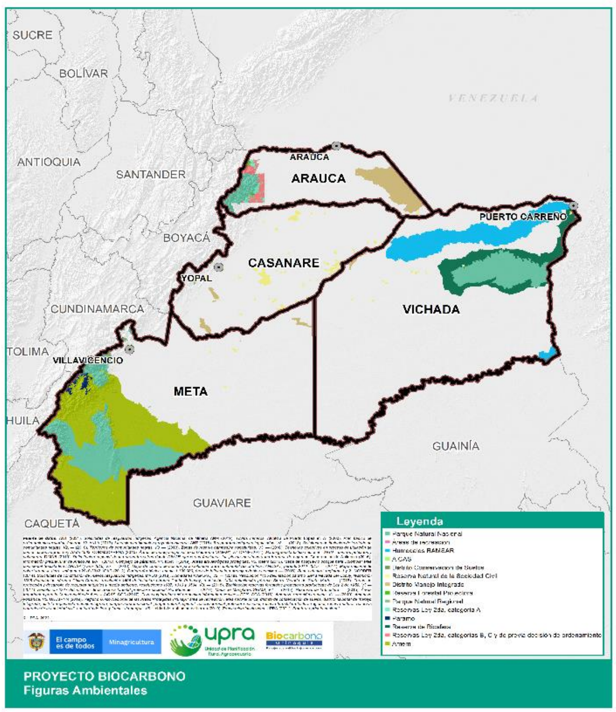



**Figure 72. Environmental Figures - Orinoquia**
**Source: UPRA © 2022 based on SINAP information.**

In order to achieve a more precise characterization of the environmental figures in the Orinoco region, the information on these figures is cross-referenced with the cadastral property information, specifically the relationship with the variables of rural land ownership and tenure that were presented in chapter 3 of this document. Based on this contrast, 55% of the properties are larger than 5 ha up to 100 ha, while 42% of the area of the properties in environmental figures is found in 33 properties larger than 10.000 ha, as shown in Table 46, where it is important to remember that the information from Tame (Arauca), La Macarena and Uribe (Meta) is not included.

**Table 46. Property size environmental figures - Orinoquia**

| Predial Size | Number of properties | % properties | Properties area (ha) | % PropertyArea |
|---|---|---|---|---|
| A1. Up to 0.5 ha | 4.049 | 14% | 335 | 0.01% |
| A2. Greater than 0.5 - Up to 1 ha | 684 | 2% | 514 | 0.01% |
| A3. Greater than 1 - Up to 2.5 ha | 1.751 | 6% | 3.015 | 0.1% |
| A4. Greater than 2.5 - Up to 3 ha | 556 | 2% | 1.530 | 0.03% |
| B1. Greater than 3 - Up to 5 ha | 1.996 | 7% | 7.934 | 0.2% |
| B2. Greater than 5 - Up to 10 ha | 3.495 | 12% | 25.596 | 0.5% |
| C1. Greater than 10 - Up to 20 ha | 4.123 | 14% | 59.803 | 1% |
| D1. Greater than 20 - Up to 50 ha | 5.260 | 18% | 169.715 | 3% |
| D2. Greater than 50 - Up to 100 ha | 2.959 | 10% | 207.934 | 4% |
| D3. Greater than 100 - Up to 200 ha | 1.446 | 5% | 198.826 | 4% |
| E1. Greater than 200 - Up to 500 ha | 935 | 3% | 284.843 | 6% |
| E2. Greater than 500 - Up to 1000 ha | 520 | 2% | 385.844 | 8% |
| E3. Greater than 1000 - Up to 2000 ha | 606 | 2% | 784.019 | 16% |
| E4. Greater than 2000 - Up to 5000 ha | 150 | 1% | 446.934 | 9% |
| E5. Greater than 5000 - Up to 10000 ha | 41 | 0% | 279.846 | 6% |
| E6. Greater than 10000 ha | 33 | 0% | 2.038.936 | 42% |
| **Total** | **28.604** | **100%** | **4.895.625** | **100%** |

Source: UPRA © 2022 based on IGAC 2019 information.

On the other hand, from the perspective of the type of owner variable, 78% of the properties are privately owned and that these cover about 38% of the registered property area. On the other hand, the environmental properties owned by the State represent about 21%, but among these about 58% of the area of the properties is distributed. Based on this distribution, it can be inferred that the largest landholdings are owned by the State, while the smaller ones are distributed among private owners/possessors.

**Table 47. Type of owner environmental figures - Orinoquia**

| Type of Owner | No. of Properties | % Properties | Area (ha) properties | % Area properties |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1. STATE | 6.085 | 21% | 2.853.504 | 58% |
| 2. COLLECTIVES | 16 | 0,1% | 158.793 | 3% |
| 3. PRIVATES | 22.417 | 78% | 1.870.730 | 38% |
| 4. OTHER | 4 | 0,01% | 19 | 0.0004% |
| No information | 82 | 0,3% | 12.580 | 0.3% |
| **Total** | **28.604** | **100%** | **4.895.625** | **100%** |

**Source: UPRA © 2022 based on IGAC 2019 information.**

Likewise, the cadastral database allows us to know the economic use of the properties, for the region we find that 86% of these in environmental figures have an agricultural economic use corresponding to 73% of the total area of the properties, followed by housing with 9%, as can be seen in the following table.

**Table 48. Economic destination environmental figures - Orinoquia**

| Economic Destination | No. of Properties | % Properties | Area (ha) properties | % Area properties |
|---|---|---|---|---|
| A-Housing | 2.675 | 9% | 114.495 | 2% |
| B-Industrial | 2 | 0.01% | 165 | 0.003% |
| C-Commercial | 23 | 0.1% | 2171 | 0.04% |
| D-Agriculture | 24.546 | 86% | 3.560.977 | 73% |
| F-Cultural | 9 | 0.03% | 3.895 | 0.1% |
| G-Recreational | 7 | 0.02% | 14 | 0.0003% |
| H-Health | 3 | 0.01% | 0 | 0.000003% |
| I-Institutional | 121 | 0.4% | 64.377 | 1.31% |
| J- Educational | 84 | 0.3% | 142 | 0.003% |
| K- Religious | 22 | 0.1% | 1.409 | 0.03% |
| L- Agricultural | 104 | 0.4% | 66.652 | 1% |
| M-Livestock | 2 | 0.01% | 718 | 0.01% |
| O-Forestry | 76 | 0.3% | 996.366 | 20% |
| P-Public Use | 45 | 0.2% | 594 | 0.01% |
| Q-Special Services | 84 | 0.3% | 58 | 0.001% |
| R- Undeveloped developable lot | 623 | 2.2% | 1.199 | 0.02% |
| S- Urbanized lot not built or built on | 80 | 0.3% | 12 | 0.0002% |
| T- Undeveloped Lot | 11 | 0.04% | 69.537 | 1.4% |
| (Blank) | 87 | 0.3% | 12.844 | 0.3% |
| **Total** | **28.604** | **100%** | **4.895.625** | **100%** |

Source: UPRA © 2022 based on IGAC 2019 information.

As a result of the characterization of the environmental figures, it was found that these correspond to large properties, which are owned by the State or by private owners/holders, mainly, with a greater distribution of large properties to the State. It was also found that the main economic destination is agriculture and livestock.

In general, the diagnosis is very similar to the one made in chapter 3, with the exception that it does not deal exclusively with private owners or possessors, but in environmental zones the State becomes relevant. Therefore, for the purposes of the implementation of the BioCarbon ERP (PRE Biocarbono in Spanish), agreements with private landowners can be negotiated in the environmental figure areas to implement sustainable projects, but it should also be taken into account that the State has a high importance in terms of area, so joint work with public entities for environmental protection will be required to complement the BioCarbon ERP (PRE Biocarbono in Spanish) and generate synergies with the conservation instruments undertaken by the State.

Finally, it is important to mention that there may be additional local environmental protection areas in addition to those described in this document, such as those of the Land Use Plan (POT in Spanish) and the Regional Autonomous Corporation (CAR in Spanish), such as: threat and risk areas, areas of the public utilities system, areas and properties considered as cultural heritage, areas for agricultural and livestock production and natural resource exploitation, watershed development and management plans.

## 23. Relationship between Environmental Figures

The following is a list of the Environmental Figures present in the Orinoco Region:

### A. National Natural Parks (PNN in Spanish)

A national natural park is defined as "an area that allows for ecological self-regulation and whose ecosystems in general have not been substantially altered by human exploitation or occupation, and where plant and animal species, geomorphological complexes and historical or cultural manifestations have scientific, educational, aesthetic and recreational value and are subject to an appropriate management regime for their perpetuation" (Article 329(a) of Decree 2811 of 1974).

This category includes 8% of the Orinoco region, concentrated mainly in the department of Meta with 62% of the area of the National Natural Parks (PNN in Spanish) present in the region, which in turn represents 14% of the departmental area.

**Table 49. NNP Area – Orinoquia**

| Departament | NNP area in Dept. (ha) | % NNP Area in Dept. (ha)) | Geographic Area Department (ha) | % NNP Depto. |
|---|---|---|---|---|
| Arauca | 173.337 | 9% | 2.383.135 | 7% |
| Casanare | 1.970 | 0,1% | 4.434.139 | 0.04% |
| Meta | 1.213.635 | 62% | 8.555.025 | 14% |

| | | | | |
|---|---|---|---|---|
| Vichada | 560.206 | 29% | 10.008.757 | 6% |
| **Total Regional** | **1.948.741** | **100%** | **25.381.056** | **8%** |

Source: UPRA © 2022 based on PNN 2019 information.

Figure 73**Error! Reference source not found.** shows the geographic location of the National Parks in the Orinoquia region, showing that these types of parks are concentrated in the Macarena sector in Meta, in Saravena and Fortul in the case of Arauca, and on the border between Cumaribo and Puerto Carreño in Vichada.

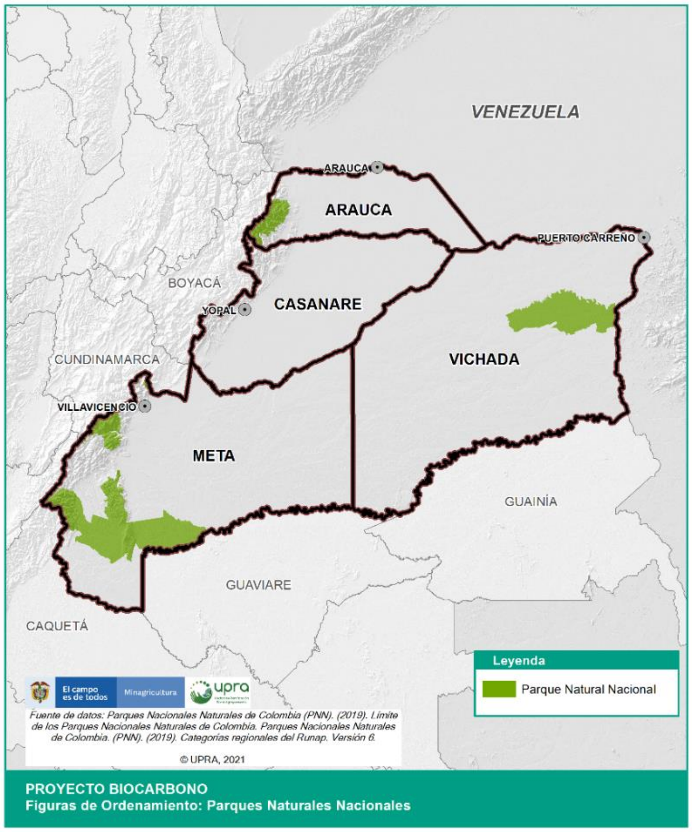



**Figure 73. NNP – Orinoquia**
**Source: UPRA © 2022 based on NNP 2019 information.**

**Table 50. NNP – Orinoquia**

| No. | NNP Name | Total area NNP (ha) | Area NNP Orinoquia (ha) | % Area NNP Orinoquia (ha) |
|---|---|---|---|---|
| 1 | Chingaza | 77.401 | 20.212 | 26% |
| 2 | Cordillera de los Picachos | 287.938 | 205.234 | 71% |
| 3 | El Cocuy | 306.553 | 174.901 | 57% |
| 4 | El Tuparro | 560.206 | 560.206 | 100% |
| 5 | Sierra de la Macarena | 620.583 | 620.328 | 100% |
| 6 | Sumapaz | 221.749 | 153.498 | 69% |

| | | | | |
|---|---|---|---|---|
| 7 | Tinigua | 214.363 | 214.363 | 100% |

Source: UPRA © 2022 based on PNN 2019 information.

Specifically, the Orinoquia registers seven (7) National Natural Parks (PNN in Spanish)[185] , as shown in Source: UPRA © 2022 based on NNP 2019 information.

Table *50*, El Tuparro, Sierra de La Macarena and Tinigua are completely within the region, while Chingaza, Cordillera de los Picachos, El Cocuy and Sumapaz share jurisdiction with other departments, while Chingaza has the smallest share, representing 26% of the park's total area.

Regarding the participation of the National Natural Parks (PNN in Spanish) at the municipal level, the municipalities with the largest municipal area in the National Natural Parks (PNN in Spanish) are located in the department of Meta, with the municipality of Cubarral having the largest municipal area in the Sumapaz National Natural Park (PNN in Spanish) with 68% of its area, followed by Guamal with 61% in the same NNP.

**Table 51. NNP at the municipal level - Orinoquia**

| Dept. | Municipality | NNP Name | NNP Area in Municipality. (ha) | Geographic Area Municipality (ha) | % NNP Municipality. |
|---|---|---|---|---|---|
| **Arauca** | Fortul | El Cocuy | 34.226 | 115.122 | 30% |
| | Saravena | | 108 | 94.371 | 0,1% |
| | Tame | | 139.003 | 538.133 | 26% |
| **Casanare** | La Salina | El Cocuy | 1.535 | 20.308 | 8% |
| | Sácama | | 28 | 31.194 | 0,1% |
| **Meta** | Acacías | Sumapaz | 4.272 | 112.332 | 4% |
| | Cubarral | | 78.347 | 115.637 | 68% |
| | El Castillo | | 11.290 | 57.094 | 20% |
| | Lejanías | | 19.076 | 82.003 | 23% |
| | Guamal | | 36.768 | 59.937 | 61% |
| | Cumaral | Chingaza | 165 | 62.228 | 0,3% |
| | El Calvario | | 1.869 | 27.535 | 7% |
| | La Macarena | Cordillera de los Picachos | 21 | 1.084.152 | 0,002% |
| | | Sierra de la Macarena | 136.220 | | 13% |
| | | Tinigua | 148.679 | | 14% |

[185] **In addition, a cartographic cross-referencing of the official layers shows a minimal participation of the Serranía de Chiribiquete and Pisba PNN with 0,003% and 1%, respectively.**

| | | | | | |
|---|---|---|---|---|---|
| | Mesetas | Sierra de la Macarena | 76.865 | 227.854 | 34% |
| | | Tinigua | 246 | | 0,1% |
| | Puerto Concordia | Sierra de la Macarena | 4.644 | 125.402 | 4% |
| | Puerto Rico | | 137.153 | 337.916 | 41% |
| | Restrepo | Chingaza | 5.305 | 36.794 | 14% |
| | San Juanito | | 12.873 | 23.715 | 54% |
| | San Juan de Arama | Sierra de la Macarena | 12.501 | 117.997 | 11% |
| | Uribe | Cordillera de los Picachos | 205.213 | 643.742 | 32% |
| | | Sierra de la Macarena | 45 | | 0,01% |
| | | Sumapaz | 3.746 | | 1% |
| | | Tinigua | 65.429 | | 10% |
| | Vistahermosa | Sierra de la Macarena | 252.900 | 483.724 | 52% |
| | | Tinigua | 9 | | 0,002% |
| **Vichada** | Cumaribo | El Tuparro | 549.553 | 6.559.535 | 8% |
| | La Primavera | | 7.213 | 1.837.183 | 0,4% |
| | Puerto Carreño | | 3.440 | 1.220.566 | 0,3% |

**Source: UPRA © 2022 based on National Natural Parks (PNN in Spanish) 2019 information.**

## B. Paramos

Paramos are defined as a "High mountain ecosystem, located between the upper limit of the Andean Forest and, if applicable, the lower limit of glaciers, in which plant associations such as pajonales, frailejones, scrublands, meadows and chuscales dominate, in addition there may be low forest formations and shrubs and present wetlands such as rivers, streams, creeks, streams, peatlands, swamps, lakes and lagoons, among others" (Article 3, Law 1930 of 2018).

**Table 52. Paramos Area - Orinoquia**

| Departament | Paramo area in Dept. (ha) | % Paramo Area in Dept. (ha) | Geographic Area Department (ha) | % Paramo vs Depto. |
|---|---|---|---|---|
| Arauca | 68.157 | 31% | 2.383.135 | 3% |
| Casanare | 12.980 | 6% | 4.434.139 | 0.3% |
| Meta | 140.388 | 63% | 8.555.025 | 2% |
| Vichada | 0 | 0% | 10.008.757 | 0% |
| **Total Regional** | **221.525** | **100%** | **25.381.056** | **1%** |

Source: UPRA © 2022 based on information Alexander von Humboldt Institute (IAVH in Spanish) 2012, Ministry of Environment and Sustainable Development (MADS in Spanish) (2014-2017).

In the paramos category, 1% of the Orinoco region is found, concentrated mainly in the department of Meta with 63% of the paramos area present in the region. Furthermore, from the point of view of participation within the departmental

territory, it is found that the largest share of the paramo area is located in the Orinoco region, with about 3% of its territory under this type of environmental figure (Table 52).
As a complement to the previous table, Figure 74, shows the geographic location of the Páramos in the Orinoquia region, whose distribution is concentrated in the San Juanito and El Calvario areas in Meta, as well as in the Tame area in Arauca.

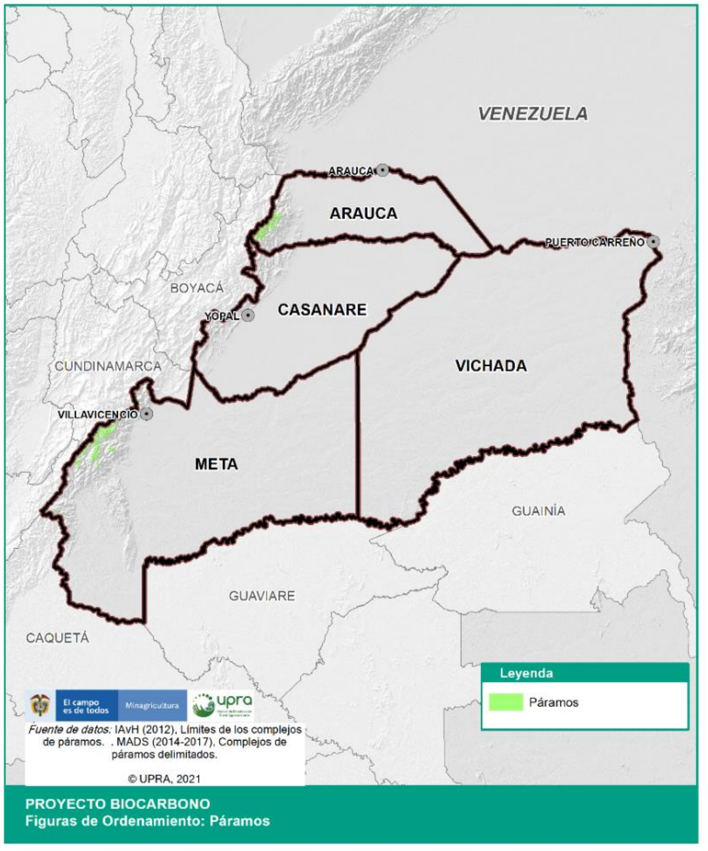



**Figure 74. Paramos – Orinoquia**
**Source: UPRA © 2022 based on information Alexander von Humboldt Institute (IAVH in Spanish) 2012, Ministry of Environment and Sustainable Development (MADS in Spanish) (2014-2017).**

Specifically, the Orinoquia has six (6) Paramos, which are partially located in the region, with the Cruz Verde - Sumapaz Páramo having the highest participation with 38%. The opposite is the case of the Tota Paramo (1%) as shown in Table 53, where the participation of each one is listed.

**Table 53. Paramos – Orinoquia**

| No. | Name Paramo | Total area Paramos (ha) | Paramo Orinoco Area (ha) | % Orinoco Paramos Area (ha) |
|---|---|---|---|---|
| 1 | Páramo Cruz Verde – Sumapaz | 315.065,7 | 121.003 | 38% |

| | | | | |
|---|---|---|---|---|
| 2 | Páramo de Chingaza | 111.671,4 | 12.990 | 12% |
| 3 | Páramo Los Picachos | 23.872,9 | 6.395 | 27% |
| 4 | Pisba | 106.242,9 | 3.416 | 3% |
| 5 | Sierra Nevada del Cocuy | 270.803,9 | 76.686 | 28% |
| 6 | Tota | 151.247,1 | 1.035 | 1% |

**Source: UPRA © 2022 based on information Alexander von Humboldt Institute (IAVH in Spanish) 2012, Ministry of Environment and Sustainable Development (MADS in Spanish) (2014-2017).**

Regarding the participation of paramos at the municipal level, the largest paramo area is La Salina in the department of Casanare with 42% of its territory in this environmental figure in the Paramo de la Sierra Nevada del Cocuy, followed by the municipality of Guamal with 39% in the Paramo Cruz Verde - Sumapaz.

**Table 54. Paramos at the municipal level - Orinoquia**

| Departament | Municipality | Name Paramo | Paramos Area in Municipality (ha) | Geographic Area Municipality (ha) | % Paramos in the municipality |
|---|---|---|---|---|---|
| **Arauca** | Fortul | Sierra Nevada del Cocuy | 12.003 | 115.122 | 10% |
| | Tame | | 56.154 | 538.133 | 10% |
| **Casanare** | Chámeza | Tota | 862 | 29.723 | 3% |
| | La Salina | Pisba | 13 | 20.308 | 0.1% |
| | | Sierra Nevada del Cocuy | 8.529 | | 42% |
| | Recetor | Tota | 173 | 18.210 | 1% |
| | Sácama | Pisba | 1.879 | 31.194 | 6% |
| | Támara | | 1.523 | 109.426 | 1% |
| **Meta** | Acacías | Páramo Cruz Verde – Sumapaz | 5.922 | 112.332 | 5% |
| | Cubarral | | 43.060 | 115.637 | 37% |
| | El Castillo | | 940 | 57.094 | 2% |
| | Guamal | | 23.113 | 59.937 | 39% |
| | Lejanías | | 11.678 | 82.003 | 14% |
| | Mesetas | | 3.982 | 227.854 | 2% |
| | El Calvario | Páramo de Chingaza | 4.295 | 27.535 | 16% |
| | Restrepo | | 942 | 36.794 | 3% |
| | San Juanito | | 7.457 | 23.715 | 31% |
| | Villavicencio | | 296 | 131.127 | 0.2% |
| | Uribe | Páramo Cruz Verde – Sumapaz | 32.308 | 643.742 | 5% |
| | | Páramo Los Picachos | 6.395 | | 1% |

**Source: UPRA © 2022 based on information Alexander von Humboldt Institute (IAVH in Spanish) 2012, Ministry of Environment and Sustainable Development (MADS in Spanish) (2014-2017).**

## C. Wetlands

It is defined as "any land area that is seasonally or permanently saturated or inundated with water. Inland wetlands include aquifers, lakes, rivers, streams, marshes, peatlands, lagoons, floodplains, and swamps. Coastal wetlands include the entire coastline, mangroves, saltwater marshes, estuaries, coastal lagoons or lagoons, seagrass beds, and coral reefs" (Ramsar Convention 1971).
This category includes 3% of the Orinoco region, concentrated mainly in the department of Vichada with 99.997% of the area of wetlands present in the region, which in turn represents 9% of the departmental area.

**Table 55. Wetlands Area - Orinoquia**

| Departament | Wetland Area in Dept. (ha) | Wetland Area in Dept. (ha) | Geographic Area Department (ha) | % Wetland vs. Department. |
|---|---|---|---|---|
| Arauca | 0 | 0% | 2.383.135 | 0% |
| Casanare | 0 | 0% | 4.434.139 | 0% |
| Meta | 25 | 0.003% | 8.555.025 | 0.0003% |
| Vichada | 877.214 | 99.997% | 10.008.757 | 9% |
| **Regional Total** | **877.239** | **100%** | **25.381.056** | **3%** |

Source: UPRA © 2022 based on information Ministry of Environment and Sustainable Development (MADS in Spanish) 2017, RAMSAR Wetlands 2017.

Figure 75 shows the geographical location of wetlands in the Orinoquia region. It can be seen that the wetlands are mainly located in the municipalities of Puerto Carreño and La Primavera, in Vichada. [186]

[186] **In this study, references are made to RAMSAR type wetlands, recognized in the Colombian Orinoco, however, it is specified that according to layers of the Humboldt Institute (http://repository.humboldt.org.co/handle/20.500.11761/31361), and the Ministry of Environment and Sustainable Development, the areas of wetlands existing in the territory are much larger.**


**Figure 75. Wetlands - Orinoquia**
Source: UPRA © 2022 based on information Ministry of Environment and Sustainable Development (MADS in Spanish) 2017, RAMSAR Wetlands 2017.

In summary, the Orinoquia has three (3) wetlands, of which the Bita River Basin Complex is located entirely in the region. On the other hand, the Chingaza Lake System wetland has the lowest participation with 1%, as shown in the following table.

**Table 56. Wetlands - Orinoquia**

| No. | Name Wetland | Total Wetland Area (ha) | Wetland Area Orinoco (ha) | % Wetland Area Orinoco (ha) |
|---|---|---|---|---|
| 1 | Bita River Basin Complex | 824540 | 824540 | 100% |
| 2 | Estrella Fluvial from Inirida | 250159 | 52674 | 21% |
| 3 | Lacustrine system of Chingaza | 4073 | 25 | 1% |

Source: UPRA © 2022 based on information Ministry of Environment and Sustainable Development (MADS in Spanish) 2017, RAMSAR Wetlands 2017.

Regarding the participation of wetlands at the municipal level, the largest area is Puerto Carreño in the department of Vichada with 32% of its area in the Bita River Basin Wetland Complex.

Table 57. Wetlands at municipal level - Orinoquia

| Dept | Municipality | Name Wetland | Wetland municipality area (ha) | Geographic municipality area (ha) | % Wetland Municipality. |
|---|---|---|---|---|---|
| **Meta** | San Juanito | Sistema Lacustre de Chingaza | 25 | 23715 | 0.1% |
| **Vichada** | Cumaribo | Estrella Fluvial del Inírida | 52674 | 6559535 | 1% |
| | La Primavera | Complejo de Humedales de la Cuenca del Río Bita | 436296 | 1837183 | 24% |
| | Puerto Carreño | Complejo de Humedales de la Cuenca del Río Bita | 388244 | 1220566 | 32% |

Source: UPRA © 2022 based on information Ministry of Environment and Sustainable Development (MADS in Spanish) 2017, RAMSAR Wetlands 2017.

## D. Macarena Special Management Area – AMEM in Spanish

This environmental figure is defined as "those zones that are delimited for the administration, management and protection of the environment and renewable natural resources" (Article 308, Decree 2811 of 1974). There are three such areas in Colombia, one of which is located in the Orinoquia Region, specifically in the department of Meta, called the Macarena Special Management Area. It is also pertinent to clarify that within these areas there are other environmental figures such as the PNN, DMI, among others.

This category includes 13% of the Orinoco region, located in the department of Meta, with a significant participation that represents 40% of its departmental area.

Table 58. Area MSMA– Orinoquia

| Dept | MSMA Area in Dept. (ha) | % MSMA Area in Dept. (ha) | Geographic Area Dept. (ha) | % MSMA vs Dept. |
|---|---|---|---|---|
| Arauca | 0 | 0% | 2.383.135 | 0% |
| Casanare | 0 | 0% | 4.434.139 | 0% |
| Meta | 3.415.669 | 100% | 8.555.025 | 40% |
| Vichada | 0 | 0% | 10.008.757 | 0% |
| **Total Regional** | **3.415.669** | **100%** | **25.381.056** | **13%** |

Source: UPRA © 2022 based on information from CORMACARENA 2015.

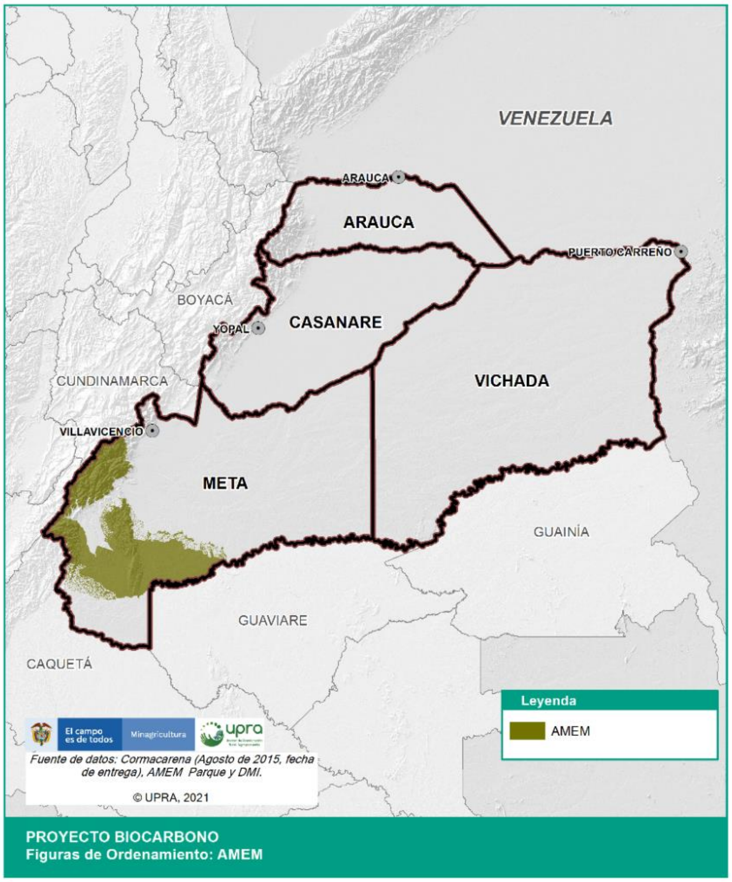



Figure 76. MSMA – Orinoquia
Source: UPRA © 2022 based on information from CORMACARENA 2015.

Figure 76Figure 76. shows the geographic location of the MSMA in the Orinoquia region, showing that it covers the municipalities of La Macarena, Mesetas, Vistahermosa, Puerto Concordia, Puerto Rico and La Uribe, mainly.

Another aspect to mention about the special management area of La Macarena is that it is classified into areas for preservation (which are the most restrictive) and restoration, subzones for sustainable use, restoration for recovery (areas for conditional and compatible uses), which are found in greater proportion in the department of Meta.

Table 59. MSMA – Orinoquia

| No. | Name AMEM | Total AMEM area (ha) | Area AMEM Orinoco (ha) | % Area AMEM Orinoco (ha) |
|---|---|---|---|---|
| 1 | Restoration, Sub-zone for sustainable use, Restoration for Recovery. | 1.665.239 | 1.653.981 | 99.3% |

| | | | | |
|---|---|---|---|---|
| 2 | Preservation | 1.768.356 | 1.761.688 | 99.6% |

Source: UPRA © 2022 based on information from CORMACARENA 2015

Regarding the participation of the Macarena Special Management Area (AMEN in Spanish) at the municipal level, Puerto Concordia has the largest area with 98% in the Macarena Special Management Area (AMEN in Spanish), 88% in areas for conditional and compatible uses and 10% for preservation.

Table 60. AMEN at municipal level - Orinoquia

| Dept | Municipality | AMEN Classification | AMEN municipality area (ha) | Geographic municipality Area (ha) | % AMEN Municipality |
|---|---|---|---|---|---|
| **Meta** | Acacías | Preservation | 4.302 | 112.332 | 4% |
| | Cubarral | Areas for conditional and compatible uses | 2.391 | 115.637 | 2% |
| | | Preservation | 89.671 | | 78% |
| | El Castillo | Areas for conditional and compatible uses | 38.142 | 57.094 | 67% |
| | | Preservation | 18.249 | | 32% |
| | El Dorado | Areas for conditional and compatible uses | 9.648 | 11.803 | 82% |
| | | Preservation | 1.543 | | 13% |
| | Fuente de Oro | Areas for conditional and compatible uses | 30.271 | 57.609 | 53% |
| | Granada | Areas for conditional and compatible uses | 18.062 | 33.673 | 54% |
| | Guamal | Preservation | 36.754 | 59.937 | 61% |
| | La Macarena | Areas for conditional and compatible uses | 683.155 | 1.084.152 | 63% |
| | | Preservation | 390.745 | | 36% |
| | Lejanías | Areas for conditional and compatible uses | 22.217 | 82.003 | 27% |
| | | Preservation | 59.785 | | 73% |
| | Mapiripán | Areas for conditional and compatible uses | 148 | 1.196.320 | 0.01% |
| | Mesetas | Areas for conditional and compatible uses | 79.215 | 227.854 | 35% |
| | | Preservation | 148.638 | | 65% |
| | Puerto Concordia | Areas for conditional and compatible uses | 110.463 | 125.402 | 88% |
| | | Preservation | 12.233 | | 10% |

| Dept | Municipality | AMEN Classification | AMEN municipality area (ha) | Geographic municipality Area (ha) | % AMEN Municipality |
|---|---|---|---|---|---|
| | Puerto Lleras | Areas for conditional and compatible uses | 97.426 | 253.218 | 38% |
| | Puerto Rico | Areas for conditional and compatible uses | 158.301 | 337.916 | 47% |
| | | Preservation | 179.062 | | 53% |
| | San Juan de Arama | Areas for conditional and compatible uses | 96.833 | 117.997 | 82% |
| | | Preservation | 21.164 | | 18% |
| | Uribe | Areas for conditional and compatible uses | 171.595 | 643.742 | 27% |
| | | Preservation | 453.198 | | 70% |
| | Vistahermosa | Areas for conditional and compatible uses | 136.112 | 483.724 | 28% |
| | | Preservation | 346.344 | | 72% |

Source: UPRA © 2022 based on information from CORMACARENA 2015.

## E. Important Bird Conservation Areas (AICAS in Spanish)

It is an international standard that refers to an Important Bird Area. In Colombia and the world, IBAs are identified according to technical criteria that consider the presence of bird species that are a priority for conservation (Alexander von Humboldt Institute (IAVH in Spanish)).

This category includes 7% of the Orinoco region, concentrated mainly in the department of Meta with 57% of the area of the Important Bird Conservation Areas (AICAS in Spanish) present in the region, which in turn represents 12% of the departmental area in this type of environmental figure.

Table 61. AICAS Areas – Orinoquia

| Department | AICAS Area in Dpt. (ha) | % AICAS Area in Dpt. (ha) | Geographic Area Department (ha) | % AICAS vs. Department |
|---|---|---|---|---|
| Arauca | 171.569 | 9% | 2.383.135 | 7% |
| Casanare | 60.580 | 3% | 4.434.139 | 1% |
| Meta | 1.028.286 | 57% | 8.555.025 | 12% |
| Vichada | 557.000 | 31% | 10.008.757 | 6% |
| **Total Regional** | **1.817.435** | **100%** | **25.381.056** | **7%** |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2015 information.

The following figure shows the geographic location of the Important Bird Conservation Areas (AICAS in Spanish) in the Orinoquia region, with a significant presence in the Macarena area in Meta, Cumaribo in Vichada and Tame in Arauca.

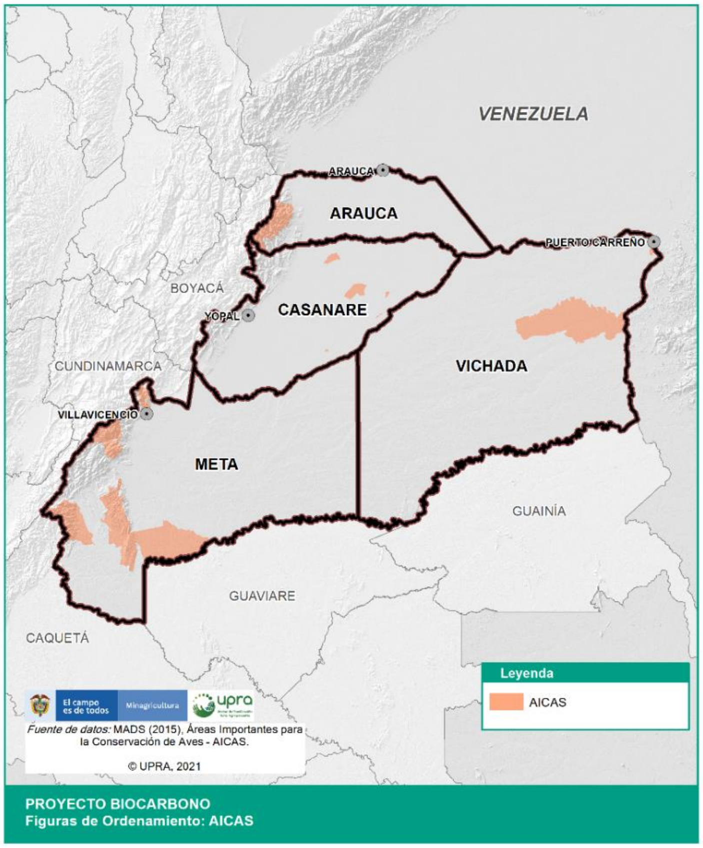



Figure 77. AICAS Areas - Orinoquia
Source: UPRA © 2022 based on information from Ministry of Environment and Sustainable Development (MADS in Spanish) 2015.

The Orinoquia has fifteen (15) Important Bird Areas, of which nine (9) are located entirely in the region, as shown in Table 63.

Table 62. AICAS – Orinoquia

| No. | Name AICAS | Total area AICAS (ha) | AICAS Orinoco Area (ha) | % Area AICAS Orinoco (ha) |
|---|---|---|---|---|
| 1 | Guatiquia River Canyon | 30.010,9 | 30.010,9 | 100% |
| 2 | CHAVIRIPA-EL RUBI | 2.919,9 | 2.919,9 | 100% |
| 3 | LA AURORA | 16.398,5 | 16.398,5 | 100% |

| | | | | |
|---|---|---|---|---|
| 4 | Bojonawi limits | 5.153,4 | 5.153,4 | 100% |
| 5 | Chingaza NNP | 76.163,1 | 19.303,7 | 25% |
| 6 | Los picachos Mountain range NNP | 273.012,7 | 190.663,7 | 70% |
| 7 | El Cocuy NNP | 308.258,8 | 173.245,4 | 56% |
| 8 | El Tuparro NNP | 551.847,1 | 551.847,1 | 100% |
| 9 | Pisba NNP | 49.773,7 | 447,9 | 1% |
| 10 | Sierra de La Macarena NNP | 629.021,2 | 625.386,3 | 99% |
| 11 | Sumapaz NNP | 212.005,7 | 150.128,1 | 71% |
| 12 | ALTAGRACIA RESERVES | 1.350,0 | 1.350,0 | 100% |
| 13 | Western banks of the Duda river | 12.793,3 | 12.793,3 | 100% |
| 14 | TAPARAS | 36.491,9 | 36.491,9 | 100% |
| 15 | WISIRARE | 1.295,1 | 1.295,1 | 100% |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2015 information.

Finally, with regard to the participation of Important Bird Areas at the municipal level, the municipality with the largest municipal area in Important Bird Conservation Areas (AICAS in Spanish) is Cubarral in the department of Meta, with 67% of its area in the Important Bird Conservation Areas (AICAS in Spanish) of Sumapaz NNP.

Table 63. AICAS at the municipal level - Orinoquia

| Departament. | Municipality | Name AICAS | AICAS Area in Municipality (ha) | Geographic Area Municipality (ha) | % AICAS Municipality. |
|---|---|---|---|---|---|
| **Arauca** | Fortul | PNN El Cocuy NNP | 35.696 | 115.122 | 31% |
| | Saravena | PNN El Cocuy NNP | 123 | 94.371 | 0.1% |
| | Tame | PNN El Cocuy NNP | 135.750 | 538.133 | 25% |
| **Casanare** | Hato Corozal | LA AURORA | 15.951 | 549.851 | 3% |
| | La Salina | PNN El Cocuy NNP | 1.673 | 20.308 | 8% |
| | Orocué | WISIRARE | 1.295 | 473.624 | 0.3% |
| | Paz de Ariporo | CHAVIRIPA-EL RUBI | 2.920 | 1.212.900 | 0.2% |
| | | LA AURORA | 448 | | 0.04% |
| | | TAPARAS | 36.492 | | 3% |
| | Sácama | PNN El Cocuy NNP | 3 | 31.194 | 0.01% |
| | Támara | PNN Pisba NNP | 448 | 109.426 | 0.4% |
| | Trinidad | ALTAGRACIA RESERVES | 1.350 | 294.971 | 0.5% |
| **Meta** | Acacías | Sumapaz NNP | 3.973 | 112.332 | 4% |
| | Cubarral | Sumapaz NNP | 76.992 | 115.637 | 67% |
| | Cumaral | Chingaza NNP | 37 | 62.228 | 0.1% |
| | El Calvario | Guatiquia River Canyon | 35.696 | 115.122 | 48% |

| Departament. | Municipality | Name AICAS | AICAS Area in Municipality (ha) | Geographic Area Municipality (ha) | % AICAS Municipality. |
|---|---|---|---|---|---|
| | | Chingaza NNP | 123 | 94.371 | 7% |
| | El Castillo | Sumapaz NNP | 135.750 | 538.133 | 18% |
| | Guamal | Sumapaz NNP | 15.951 | 549.851 | 60% |
| | La Macarena | Cordillera de los Picachos NNP | 1.673 | 20.308 473.624 1.212.900 | 0.01% |
| | | Sierra de La Macarena NNP | 1.295 | | 12% |
| | | Western banks of the Duda river | 2.920 | | 0.1% |
| | Lejanías | Sumapaz NNP | 448 | 82003 | 23% |
| | Mesetas | Sierra de La Macarena NNP | 36.492 | 227854 31.194 | 37% |
| | | Western banks of the Duda river | 3 | | 0.2% |
| | Puerto Concordia | Sierra de La Macarena NNP | 448 | 109.426 | 3% |
| | Puerto Rico | Sierra de La Macarena NNP | 1.350 | 294.971 | 42% |
| | Restrepo | Guatiquia River Canyon | 3.973 | 112.332 | 4% |
| | | Chingaza NNP | 76.992 | 115.637 | 14% |
| | San Juan de Arama | Sierra de La Macarena NNP | 37 | 62.228 | 10% |
| | San Juanito | Guatiquia River Canyon | 35.696 | 115.122 | 27% |
| | | Chingaza NNP | 123 | 94.371 | 52% |
| | Uribe | Cordillera de los Picachos NNP | 135.750 | 538.133 549.851 20.308 473.624 | 30% |
| | | Sierra de La Macarena NNP | 15.951 | | 0.2% |
| | | Sumapaz NNP | 1.673 | | 0.5% |
| | | Western banks of the Duda river | 1.295 | | 2% |
| | Villavicencio | Guatiquia River Canyon | 2.920 | 1.212.900 | 7% |
| | Vistahermosa | Sierra de La Macarena NNP | 448 | 483724 | 53% |
| | | Western banks of the Duda river | 36.492 | | 0.01% |
| **Vichada** | Cumaribo | El Tuparro NNP | 3 | 31.194 | 8% |
| | La Primavera | El Tuparro NNP | 448 | 109.426 | 0.3% |
| | Puerto Carreño | limites bojonawi | 1.350 | 294.971 | 0.4% |
| | | El Tuparro NNP | 3.973 | 112.332 | 0.2% |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2015 information.

## F. Forestry Reserve Zones Law 2 of 1959

Law 2a of 1959 established seven (7) forest reserve areas for the development of the forest economy and the protection of soil, water and wildlife.

The Ministry of Environment and Sustainable Development has developed zoning and management processes within these areas that do not generate changes in land use or modify the very nature of the Forest Reserve, which serve as a planning instrument. This zoning is classified as follows:

**Type A Zone:** Zones that guarantee the continuance of basic ecological processes necessary to ensure the provision of ecosystem services, mainly related to water and climate regulation; assimilation of air and water pollutants; soil formation and protection; protection of unique landscapes and cultural heritage; and support for biological diversity.

**Zone type B:** Zones characterized by having favorable coverage for sustainable forest resource management through an integrated management approach and integrated management of biodiversity and ecosystem services.

**Zone type C:** Zones that, due to their biophysical characteristics, offer conditions for the development of agroforestry, silvopastoral and other productive activities compatible with the objectives of the forest reserve, which must incorporate this component, and that do not imply the reduction of natural forest areas present in their different successional stages.

**Areas with previous management decision:** areas that already have a previous management decision, such as National Parks, Single National Registry of Protected Areas (RUNAP in Spanish) areas, Farmer´s Reserves, Collective and Indigenous Territories, among others, that are within the boundaries of the Reserve, and that maintain this category.187.

According to this zoning, zone type A is the most restrictive in terms of the development of activities. The information on these areas is listed below.

The Type A Zone in the Orinoco region represents 0.1%, concentrated mainly in the department of Arauca with 99% of the Type A zones present in the region,

[187] **Resolution 1275 of 2014**

which in turn represents 1% of the departmental area in this type of environmental figure.

Table 64. Second Law Category A - Orinoquia

| Department | Area Second Law 1959 in department. (ha) | % Area Second Law 1959 in department. (ha) | Geographic Area Department (ha) | % Second Law 1959 vs Department. |
|---|---|---|---|---|
| Arauca | 35.639 | 99% | 2.383.135 | 1% |
| Casanare | 506 | 1% | 4.434.139 | 0.01% |
| Meta | 0 | 0% | 8.555.025 | 0% |
| Vichada | 3 | 0% | 10.008.757 | 0.00003% |
| **Total Regional** | **36.147** | **100%** | **25.381.056** | **0.1%** |

Soruce: UPRA © 2022 based on information from MADS 2018

The following figure shows the geographical location of type A zones in the Orinoquia region, which visually reaffirms the relevance of these zones in Arauca.


Figure 78. Second Category A Law - Orinoquia

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2018 information.

The Orinoquia has two (2) type A zones, of which the Cucuy 2014 zone is located in the region with 19% of its total area, as shown in the following table.

Table 65. Second Law Category A - Orinoquia

| No. | Name Area Second Law 1959 | Total area Second Law 1959 (ha) | Area Second Law 1959 Orinoco (ha) | % Area Second Law 1959 Orinoco (ha) |
|---|---|---|---|---|
| 1 | AMAZONIA 2014 | 1.649.652 | 2.952 | 0.0002% |
| 2 | COCUY 2014 | 189.579 | 36.144 | 19% |

Source: UPRA © 2022 based on the information from MADS 2018

In terms of participation at the municipal level in type A zones, the largest municipal area is Saravena in the department of Arauca, with 10% of its area in the type A zone called El Cocuy 2014.

Table 66. Second Law Category A, municipal level - Orinoquia

| Department | Municipality | Name of area Second Law 1959 | Area Second Law 1959 in Municipality (ha) | Geographic Area Municipality (ha) | % Law Second 1959 Municipality. |
|---|---|---|---|---|---|
| **Arauca** | Fortul | COCUY 2014 | 1.070 | 115.122 | 1% |
| | Saravena | COCUY 2014 | 9.241 | 94.371 | 10% |
| | Tame | COCUY 2014 | 25.328 | 538.133 | 5% |
| **Casanare** | La Salina | COCUY 2014 | 506 | 20.308 | 2% |
| **Vichada** | Cumaribo | AMAZONIA 2014 | 3 | 6.559.535 | 0.00005% |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2018 information.

Type B and C zones and those with a previous management decision in the Orinoco region represent 1%. Like the type A zones, they are mainly concentrated in the department of Arauca, with 99% of the type B and C zones, with previous management decisions in the region, which in turn represents 10% of the departmental area in this type of environmental figure.

Table 67. Second law type B, C zones and zones with previous ordinance decision - Orinoquia

| Department | Area Second Law 1959 in department. (ha) | % Area Second Law 1959 in department. (ha) | Geographic Area Department (ha) | % Second Law 1959 vs department. |
|---|---|---|---|---|
| Arauca | 245.724 | 99% | 2.383.135 | 10% |
| Casanare | 1.330 | 1% | 4.434.139 | 0.03% |
| Meta | 0 | 0% | 8.555.025 | 0% |
| Vichada | 15 | 0% | 10.008.757 | 0.0001% |
| **Total Regional** | **247.069** | **100%** | **25.381.056** | **1%** |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2018 information.

The following figure shows the geographic location of type B and C zones in the Orinoquia region, reiterating that their presence is centered in Arauca.

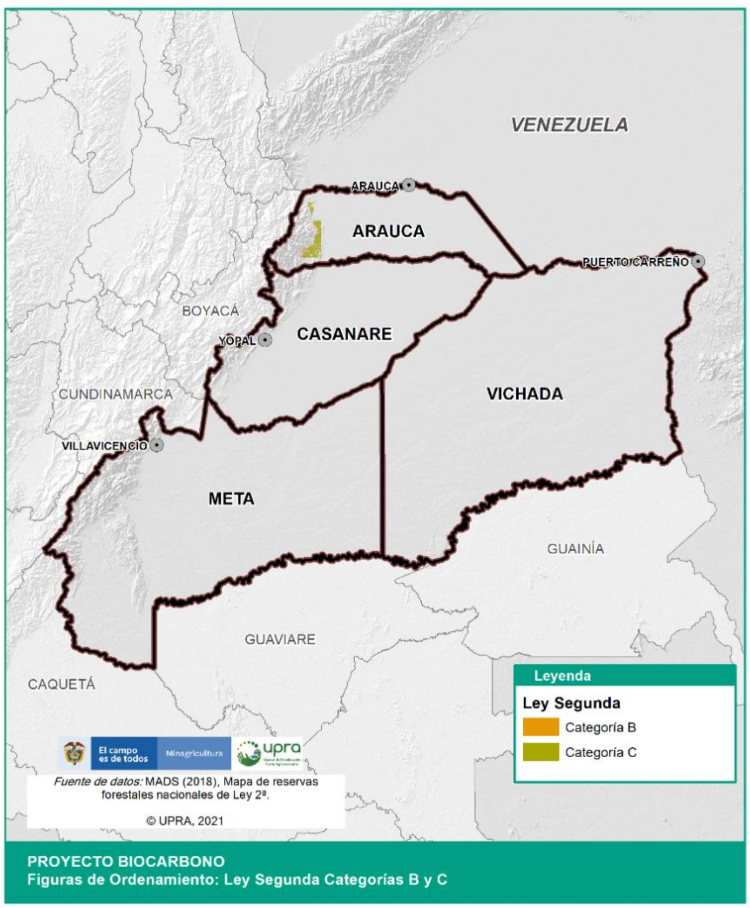



Figure 79. Second Law Categories B and C - Orinoquia

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2018 information.

Of the three types of zones, in the Orinoquia zone type C is the one with the highest participation with 4% of the total number of type C zones, as shown in the following table.

Table 68. Second law for zones type B, C and zones with prior management decision - Orinoquia

| No. | Name Area Second Law 1959 | Total area Second Law 1959 (ha) | Area Second Law 1959 Orinoco (ha) | % Area Second Law 1959 Orinoco (ha) |
|---|---|---|---|---|
| 1 | AREAS WITH PRIOR MANAGEMENT DECISION | 34.253.701 | 189.757 | 1% |
| 2 | B | 2.601.948 | 5.091 | 0.2% |
| 3 | C | 1.202.490 | 52.221 | 4% |

Source: UPRA © 2022 based on information from MADS 2018

In terms of municipal participation in zones B, C and those with a prior management decision, the municipality with the largest municipal area is Fortul in the department of Arauca, with 45% in areas with a prior management decision.

Table 69. Second law, type B, C zones and zones with previous management decision, municipal level - Orinoquia

| Department. | Municipality | Name of area Second Law 1959 | Area Second Law 1959 in Municipality (ha) | Geographic Area Municipality (ha) | % Law Second 1959 Municipality. |
|---|---|---|---|---|---|
| **Arauca** | Fortul | AREAS WITH PREVIOUS MANAGEMENT DECISION | 51.718 | 115.122 | 45% |
| | | C | 780 | | 0.7% |
| | Saravena | AREAS WITH PREVIOUS MANAGEMENT DECISION | 12.178 | 94.371 | 12.9% |
| | | C | 6.232 | | 6.6% |
| | Tame | AREAS WITH PREVIOUS MANAGEMENT DECISION | 124.531 | 538.133 | 23.1% |
| | | B | 5.076 | | 0.9% |
| | | C | 45.209 | | 8.4% |
| **Casanare** | La Salina | AREAS WITH PREVIOUS MANAGEMENT DECISION | 1.330 | 20.308 | 6.5% |

| | | | | | |
|---|---|---|---|---|---|
| **Vichada** | Cumaribo | B | 15 | 6.559.535 | 0.0002% |

Source: UPRA © 2022 based on MADS 2018 information.

## G. Biosphere Reserves

Biosphere Reserves were defined as registered in 1979. In this category, 4% of the Orinoco region is in this category, only in the department of Vichada, representing 11% of its territory under this environmental category.

Table 70. Biosphere Reserves - Orinoquia

| Department. | Biosphere Reserve Area in Departmen. (ha) | % Biosphere Reserve Area in Department (ha) | Geographic Area Department. (ha) | % Biosphere Reserve vs. Department |
|---|---|---|---|---|
| Arauca | 0 | 0% | 2.383.135 | 0% |
| Casanare | 0 | 0% | 4.434.139 | 0% |
| Meta | 0 | 0% | 8.555.025 | 0% |
| Vichada | 1.095.869 | 100% | 10.008.757 | 11% |
| **Regional total** | **1.095.869** | **100%** | **25.381.056** | **4%** |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2015 information.

The following figure shows the geographic location of the biosphere reserves in the Orinoquia region.

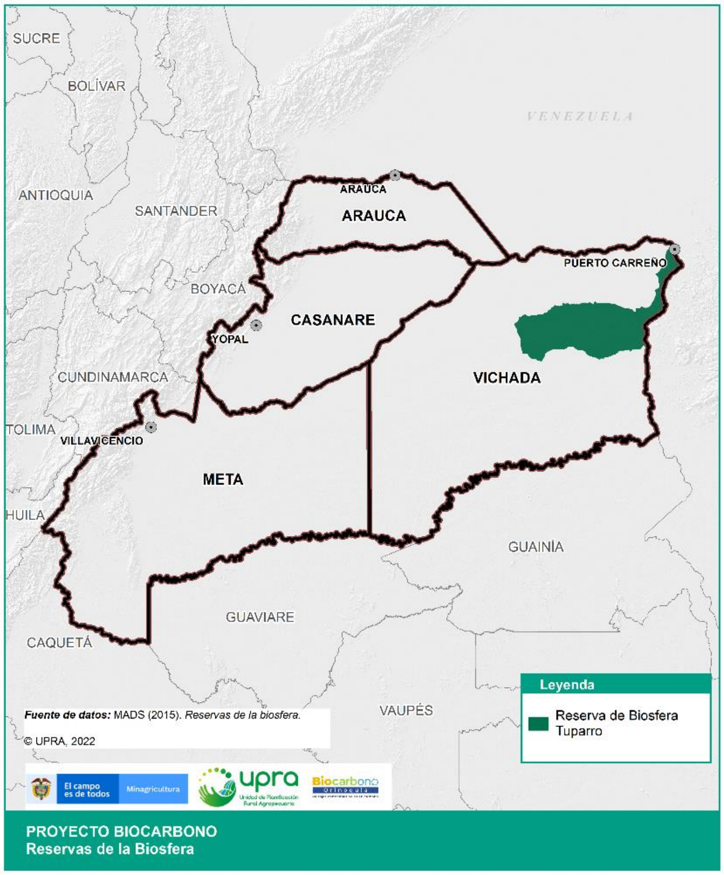



Figure 80. Biosphere Reserves - Orinoquia
Source: UPRA © 2022 based on MADS 2015 information

Table 71. Biosphere Reserves at the municipal level - Orinoquia

| Department | Municipality | Name Biosphere Reserve | Biosphere Reserve Area in Municipality (ha) | Geographic Area Municipality (ha) | % Biosphere Reserve Municipality |
|---|---|---|---|---|---|
| Vichada | Cumaribo | El Tuparro | 718.129 | 6.559.535 | 11% |
| | La Primavera | | 124.224 | 1.837.183 | 7% |
| | Puerto Carreño | | 253.516 | 1.220.566 | 21% |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2015 information.

A detailed review shows that the Orinoquia has a biosphere reserve located entirely in the region, called "El Tuparro". Regarding participation at the municipal level, Table 74 shows that the municipality with the largest municipal reserve area is Puerto Carreño with 21% of its area.

### H. Regional Natural Park– (PNR in Spanish)

Regional Natural Parks are defined as "a geographic space in which landscapes and strategic ecosystems on a regional scale maintain their structure, composition and function, as well as the ecological and evolutionary processes that sustain them, and whose natural and associated cultural values are made available to the human population for their preservation, restoration, knowledge and enjoyment. The reservation, delimitation, boundaries, declaration and administration of the Regional Natural Parks corresponds to the Regional Autonomous Corporations, through their Board of Directors" (Article 13, Decree 2372 of 2010).
This category includes 0.1% of the Orinoco region, present only in the departments of Casanare and Meta, mainly in the latter, with 88% of the area of the PNR present in the region, which in turn represents 0.3% of its territory under this environmental category.

Table 72. PNR – Orinoquia

| Department | PNR Area in Department (ha) | % PNR Area in Department. (ha) | Geographic Area Department (ha) | % PNR vs Departament. |
|---|---|---|---|---|
| Arauca | 0 | 0% | 2.383.135 | 0% |
| Casanare | 3.379 | 12% | 4.434.139 | 0.1% |
| Meta | 24.408 | 88% | 8.555.025 | 0.3% |
| Vichada | 0 | 0% | 10.008.757 | 0% |
| **Total Regional** | **27.786** | **100%** | **25.381.056** | **0.1%** |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2019 information.

The following figure shows the geographic location of the Regional Natural Parks (PNR in Spanish) in the Orinoco region.

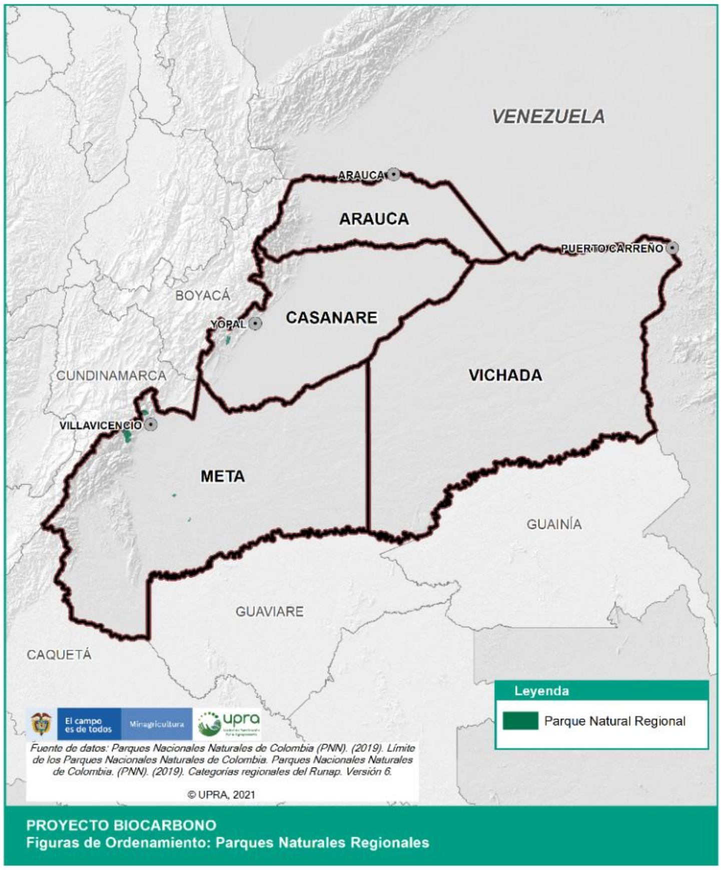



Figure 81. PNR – Orinoquia
Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2019 information.

A detailed review shows that the Orinoquia has six (6) Regional Natural Parks (PNR in Spanish), most of which are located entirely in the region, with the exception of Siberia Ceibas Regional Natural Parks (PNR in Spanish), whose participation is 0,00002%, as shown in the following table, which lists the participation of each one.

Table 73. PNR – Orinoquia

| No. | PNR Name | Total area PNR (ha) | Orinoco PNR Area (ha) | % Orinoco PNR Area |
|---|---|---|---|---|
| 1 | Bosque de Los Guayupes | 18.219 | 18.219 | 100% |
| 2 | Laguna de Lomalinda | 810 | 810 | 100% |
| 3 | Laguna San Vicente | 493 | 493 | 100% |
| 4 | Quebrada Honda | 4.885 | 4.885 | 100% |
| 5 | San Miguel de los Farallones | 3.379 | 3.379 | 100% |
| 6 | Siberia Ceibas | 27.106 | 0,01 | 0.00002% |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2019 information.

Regarding the participation of the Regional Natural Parks (PNR in Spanish) at the municipal level, Table 74 shows that the municipality with the largest municipal area in the Regional Natural Park (PNR in Spanish) is Acacías in the department of Meta with 13% of its area in the Bosque de Los Guayupes Regional Natural Park (PNR in Spanish)

Table 74. PNR at the municipal level - Orinoco

| Department | Municipality | Name PNR | PNR Area in Municipality (ha) | Geographic Area Municipality (ha) | % PNR Municipality |
|---|---|---|---|---|---|
| **Casanare** | Aguazul | San Miguel de los Farallones | 3.242 | 144.501 | 2% |
| | Tauramena | San Miguel de los Farallones | 137 | 238.584 | 0,1% |
| **Meta** | Acacías | Bosque de Los Guayupes | 14.399 | 112.332 | 13% |
| | El Calvario | Quebrada Honda | 2.595 | 27.535 | 9% |
| | Guamal | Bosque de Los Guayupes | 3.820 | 59.937 | 6% |
| | Puerto Lleras | Laguna de Lomalinda | 810 | 253.218 | 0,3% |
| | Puerto Rico | Laguna San Vicente | 493 | 337.916 | 0,1% |
| | Uribe | Siberia Ceibas | 0 | 643.742 | 0,000002% |
| | Villavicencio | Quebrada Honda | 2.290 | 131.127 | 1% |

Source: UPRA © 2022 based on Ministry of Environment and Sustainable Development (MADS in Spanish) 2019 information.

## I. National Protected Forest Reserves (RFPN in Spanish)

They are defined as "Geographic space in which forest ecosystems maintain their function, although their structure and composition has been modified and the associated natural values are made available to the human population for their preservation, sustainable use, restoration, knowledge and enjoyment. This area of public or private property is reserved for the establishment or maintenance and sustainable use of forests and other natural vegetation cover" (Article 12, Decree 2372 of 2010).

This category includes 0.04% of the Orinoco region, present in only three of the departments, with the greatest presence in the department of Arauca with 55% of the area of the PGR present in the region, which in turn is equivalent to 0.2% of its departmental territory.

Table 75. RFPN – Orinoquia

| Department | RFPN Area in Department. (ha) | % RFPN Area in Department. (ha) | Geographic Area Department (ha) | % RFPN vs Departament. |
|---|---|---|---|---|
| Arauca | 5.812 | 55% | 2.383.135 | 0.2% |
| Casanare | 2.680 | 25% | 4.434.139 | 0.1% |
| Meta | 2.029 | 19% | 8.555.025 | 0.02% |
| Vichada | 0 | 0% | 10.008.757 | 0% |
| **Total Regional** | **10.521** | **100%** | **25.381.056** | **0.04%** |

Source: UPRA © 2022 based fon information form the Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021

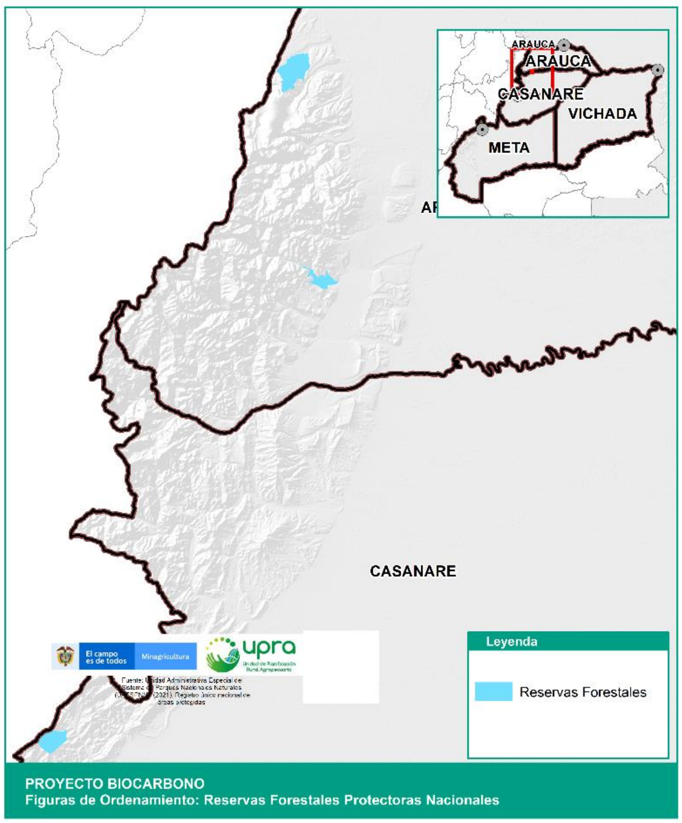



Figure 82. RFPN – Orinoquia
Source: UPRA © 2022 based on Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales (UAESPNN in Spanish) 2021 information.

Graphically, **Error! Reference source not found.** represents the geographic location of the RFPNs in the Orinoco region, for which the department of Arauca must be zoomed in so that it is possible to appreciate the location of this environmental figure. In summary, the Orinoquia has ten (10) RFPN. Of these, the majority are completely in the region, with the exception of four (4) whose participation is less than 3%, corresponding to the Río Sucio, Blanco and Negro Rivers and Serranía La Lindosa, as shown in **Error! Reference source not found.**.

Table 76. RFPN – Orinoquia

| No. | Name RFPN | Total RFPN area (ha) | Orinoquia RFPN area(ha) | Orinoquia RFPN area (ha) |
|---|---|---|---|---|
| 1 | Cerro Vanguardia | 197 | 197 | 100% |
| 2 | Cuenca Alta del Cano Vanguardia | 534 | 534 | 100% |
| 3 | Cuenca Alta del Rio Satoca | 4.163 | 4.163 | 100% |
| 4 | Cuenca del Rio Tame | 1.650 | 1.650 | 100% |
| 5 | Cuenca Hidrografica de la Quebrada la Tablona | 2.682 | 2.680 | 100% |
| 6 | Paramo El Atravesado | 2.933 | 4 | 0.1% |
| 7 | Quebrada Honda y Canos Parrado y Buque | 1.212 | 1.212 | 100% |
| 8 | Rio Rucio | 601 | 20 | 3% |
| 9 | Rios Blanco y Negro | 12.685 | 58 | 0.5% |
| 10 | Serrania La Lindosa - Angosturas II | 28.224 | 4 | 0.01% |

Source: UPRA © 2022 based on UAESPNN 2021 information

Table 77. RFPN at municipal level - Orinoquia

| Department | Municipality | RFPN Name | RFPN Area in Municipality (ha) | Geographic Area Municipality (ha) | % RFPN Municipality |
|---|---|---|---|---|---|
| **Arauca** | Saravena | Satoca River upper Basin | 4.163 | 94.371 | 4% |
| | Tame | Tame River Basin | 1.650 | 538.133 | 0.3% |
| **Casanare** | Yopal | La Tablona Creek Watershed | 2.680 | 248.580 | 1% |
| **Meta** | El Calvario | El Atravesado Paramo | 4 | 27.535 | 0.01% |
| | | Blanco and Negro Rivers | 58 | | 0.2% |
| | Puerto Concordia | La Lindosa - Angosturas II Mountain Range | 4 | 125.402 | 0.003% |
| | Restrepo | Cano Vanguardia upper basin | 1 | 36.794 | 0.004% |
| | San Juanito | Rucio River | 20 | 23.715 | 0.08% |
| | Villavicencio | Vanguardia Hill | 197 | 131.127<br>94.371 | 0.2% |
| | | Cano Vanguardia upper Basin | 532 | | 0.4% |

| | | | | | |
|---|---|---|---|---|---|
| | | Honda Creek and Canos Parrado and Buque | 4.163 | | 0.9% |

Source: UPRA © 2022 based on UAESPNN 2021 information

In the participation of the National Protected Forest Reserves (RFPN in Spanish) at the municipal level, Table 77 shows that the municipality with the largest municipal area in the National Protected Forest Reserves (RFPN in Spanish) is Saravena in the department of Arauca, with 4% of its area in the Cuenca Alta del Rio Satoca National Protected Forest Reserve (RFPN in Spanish).

### J. Regional Integrated Management District (DMI in Spanish)

This environmental category is defined as a "Geographic space in which landscapes and ecosystems maintain their composition and function, although their structure has been modified, and whose natural and associated cultural values are made available to the human population for their sustainable use, preservation, restoration, knowledge and enjoyment"[188].

This category includes 2% of the Orinoco region, mainly present in the department of Arauca with 83% of the Regional Integrated Management District (DMI in Spanish) area in the region, which represents 14% of its departmental territory with this type of environmental figure.

Table 78. DMI – Orinoquia

| Department | DMI Area in Department. (ha) | % DMI Area in Department (ha) | Geographic Area Department (ha) | % DMI vs. Department. |
|---|---|---|---|---|
| Arauca | 333.403 | 83% | 2.383.135 | 14% |
| Casanare | 35.280 | 9% | 4.434.139 | 1% |
| Meta | 15.113 | 4% | 8.555.025 | 0% |
| Vichada | 17.153 | 4% | 10.008.757 | 0% |
| **Regional Total** | **400.949** | **100%** | **25.381.056** | **2%** |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System 2021 information.

The following figure shows the geographic location of the Integrated Management Districts in the Orinoco region.

[188] **Article 14, Decree 2372 of 2010.**

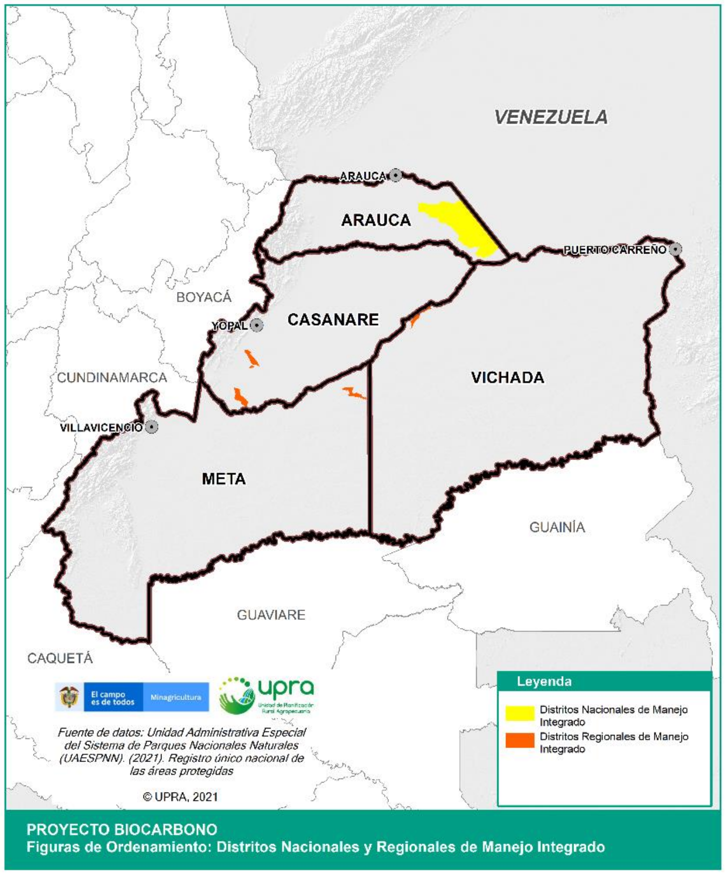



Figure 83. DMI – Orinoquia
Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

As a complement to the graphical result, Table 79 shows that the Orinoquia has six (6) Regional Integrated Management District (DMI in Spanish), of which one is at the national level called "Cinaruco" and all of them are located completely in the region.

Table 79. DMI – Orinoquia

| No. | DMI Name | Total area DMI (ha) | Orinoco DMI Area (ha) | % Orinoco DMI Area (ha) |
|---|---|---|---|---|
| 1 | DRMI-Carimagua | 15.113 | 15.113 | 100% |
| 2 | DNMI-Cinaruco | 333.403 | 333.403 | 100% |
| 3 | DRMI-El Bocachico | 1.378 | 1.378 | 100% |
| 4 | DRMI-El Tinije | 13.769 | 13.769 | 100% |
| 5 | DRMI-Laguna la Primavera | 17.153 | 17.153 | 100% |
| 6 | DRMI-Mata de la Urama | 20.134 | 20.134 | 100% |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

Regarding the participation of the IMD at the municipal level, the municipality with the largest municipal area in the IMD is Cravo Norte in the department of Arauca, with 39% of its area in the Cinaruco National Integrated Management District.

Table 80. DMI at municipal level - Orinoquia

| Department | Municipality | DMI Name | DMI Area in Municipality (ha) | Geographic Area Municipality (ha) | % DMI Municipality |
|---|---|---|---|---|---|
| **Arauca** | Arauca | DNMI-Cinaruco | 129.362 | 578.983 | 22% |
| | Cravo Norte | DNMI-Cinaruco | 204.040 | 519.532 | 39% |
| **Casanare** | Aguazul | DRMI-El Tinije | 8.757 | 144.501 | 6% |
| | Maní | DRMI-El Bocachico | 1.378 | 373.361 | 0,4% |
| | | DRMI-El Tinije | 5.012 | | 1% |
| | Tauramena | DRMI-Mata de la Urama | 20.134 | 238.584 | 8% |
| **Meta** | Puerto Gaitán | DRMI-Carimagua | 15.113 | 1.727.322 | 1% |
| **Vichada** | La Primavera | DRMI-Laguna la Primavera | 16.956 | 1.837.183 | 1% |
| | Santa Rosalía | DRMI-Laguna la Primavera | 197 | 391.473 | 0,01% |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

## K. Soil Conservation District (DCS in Spanish)

They are defined as a "Geographic space whose strategic ecosystems on a regional scale maintain their function, even if their structure and composition have been modified, and essentially contribute to the generation of environmental goods and services, whose natural and associated cultural values are made available to the human population for their restoration, sustainable use, preservation, knowledge and enjoyment" (Article 16, Decree 2372 of 2010).

This category includes 0.001% of the Orinoco region, present only in the department of Meta, which represents 0.003% of the departmental territory with this type of environmental category.

Table 81. DCS – Orinoquia

| Department | DCS Area in Department. (ha) | % DCS Area in | Geographic Area | % DCS vs Department. |
|---|---|---|---|---|

| | | Department. (ha) | Department (ha) | |
|---|---|---|---|---|
| Arauca | 0 | 0% | 2.383.135 | 0% |
| Casanare | 0 | 0% | 4.434.139 | 0% |
| Meta | 294 | 100% | 8.555.025 | 0.003% |
| Vichada | 0 | 0% | 10.008.757 | 0% |
| **Total Regional** | **294** | **100%** | **25.381.056** | **0.001%** |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

The following figure shows the geographic location of the Soil Conservation Districts in the Orinoco region.

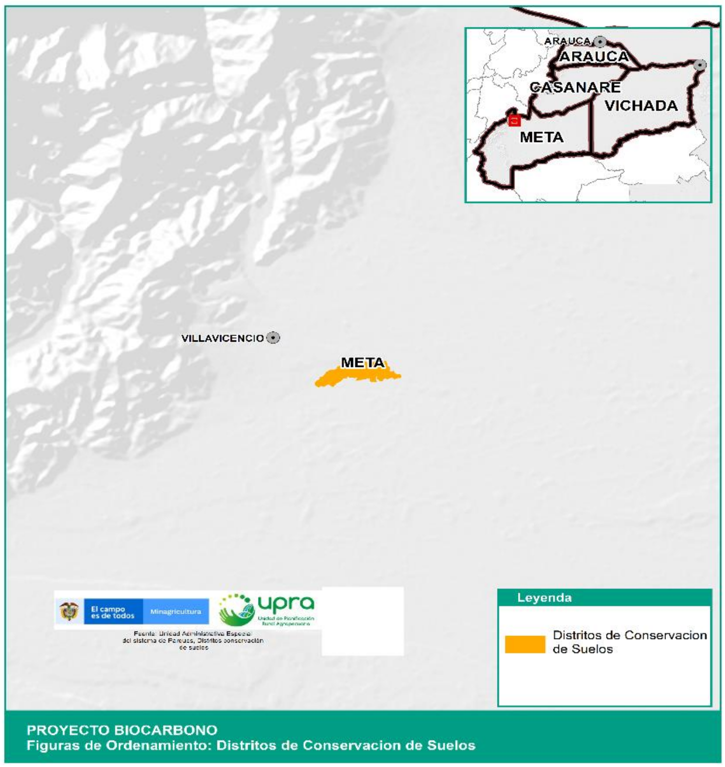



Figure 84. DCS – Orinoquia

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

The data on this environmental category also shows that the Orinoquia has one Soil Conservation District, which is completely located in the region, as shown in the following table where the participation is listed.

Table 82. DCS – Orinoquia

| No. | DCS Name | Total DCS area (ha) | DCS Orinoco Area (ha) | % DCS Orinoco Area (ha) |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| 1 | Kirpas Pinilla la Cuerera | 294.215 | 294.215 | 100% |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

Finally, with respect to participation at the municipal level, the Soil Conservation District (DCS in Spanish) is located in the municipality of Villavicencio in the department of Meta, with 0.2% of its municipal area in the Soil Conservation District (DCS in Spanish) called Cuenca Alta del Rio Sat Kirpas Pinilla la Cuerera.

Table 83. DCS at the municipal level - Orinoquia

| Department | Municipality | DCS Name | DCS Area in Municipality (ha) | Geographic Area Municipality (ha) | % DCS Municipality |
|---|---|---|---|---|---|
| **Meta** | Villavicencio | Kirpas Pinilla la Cuerera | 294 | 131127 | 0.2% |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

## L. Recreation Areas

It is defined as a "Geographic space in which strategic landscapes and ecosystems at the regional scale maintain their function, although their structure and composition have been modified, with a significant potential for recovery and whose natural and associated cultural values are made available to the human population for restoration, sustainable use, knowledge and enjoyment"[189].

This category includes 0.001% of the Orinoco region, present only in the department of Meta, covering 0.003% of its departmental territory with this type of environmental category.

Table 84. Recreational Area - Orinoquia

| Department | Area of Recreation Area in Department. (ha) | % Area of Recreation Area in Department. (ha) | Geographic Area Department (ha) | % Recreation Area vs. Department. |
|---|---|---|---|---|
| Arauca | 0 | 0% | 2.383.135 | 0% |
| Casanare | 0 | 0% | 4.434.139 | 0% |
| Meta | 278 | 100% | 8.555.025 | 0.003% |
| Vichada | 0 | 0% | 10.008.757 | 0% |
| **Total Regional** | **278** | **100%** | **25.381.056** | **0.001%** |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

[189] **Article 15, Decree 2372 of 2010**

The following figure shows the geographic location of the Recreation Areas in the Orinoco region.


Figure 85. Recreation Areas - Orinoquia
Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

The Orinoquia has six (6) Recreation Areas, all located completely in the region, as shown in the following table.

Table 85. Recreation Area - Orinoquia

| No. | Recreation Area Name | Total area Recreation Area (ha) | Recreation Area - Orinoco (ha) | % Orinoco Recreation Area (ha) |
|---|---|---|---|---|
| 1 | Humedal Maiciana Manacal | 128 | 128 | 100% |
| 2 | Parque Ecologico Humedal Calatrava | 7 | 7 | 100% |
| 3 | Parque Ecologico Humedal Caracoli | 33 | 33 | 100% |
| 4 | Parque Ecologico Humedal Charco Oasis | 11 | 11 | 100% |
| 5 | Parque Ecologico Humedal Coroncoro | 30 | 30 | 100% |
| 6 | Parque Ecologico Humedal Zuria | 68 | 68 | 100% |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

Regarding the participation of the Recreation Areas at the municipal level, the municipality with the largest municipal area in Recreation Area is Villavicencio in the department of Meta with 0.05% of its area in the Zuria Ecological Wetland Park Recreation Area.

Table 86. Recreation Area at municipal level - Orinoquia

| Department | Municipality | Name Recreation Area | Recreation Area in Municipality (ha) | Geographic Area Municipality (ha) | % Recreation Area Municipality. |
|---|---|---|---|---|---|
| **Meta** | Puerto Gaitán | Maiciana Manacal Wetland | 128 | 1.727.322 | 0,01% |
| | Villavicencio | Calatrava Wetland Ecological Park | 7 | 131.127 | 0,01% |
| | | Caracoli Wetland Ecological Park | 33 | | 0,03% |
| | | Charco Oasis Wetland Ecological Park | 11 | | 0,01% |
| | | Ecological Park Coroncoro Wetland | 30 | | 0,02% |
| | | Zuria Wetland Ecological Park | 68 | | 0,05% |

Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2021 information.

## M. Civil Society Nature Reserve (RNSC in Spanish)

This figure is defined as "Part or all of the area of a property that preserves a sample of a natural ecosystem and is managed under the principles of sustainability in the use of natural resources and that by the will of its owner is intended for sustainable use, preservation or restoration with long-term vocation" (Article 17, Decree 2372 of 2010).

This category includes 1% of the Orinoco region, concentrated mainly in the department of Casanare with 78% of the area of the CSERs present in the region, which in turn represents 3% of the departmental area in this type of environmental figure, whose graphic distribution can be identified in

.

Table 87. RNSC Area – Orinoquia.

| Department | RNSC Area in | % RNSC Area in | Geographic Area Department (ha) | % RNSC vs Department |
|---|---|---|---|---|

| | Department. (ha) | Department. (ha) | | |
|---|---|---|---|---|
| Arauca | 3.442 | 2% | 2.383.135 | 0% |
| Casanare | 123.732 | 78% | 4.434.139 | 3% |
| Meta | 6.567 | 4% | 8.555.025 | 0% |
| Vichada | 24.053 | 15% | 10.008.757 | 0% |
| **Total Regional** | **157.793** | **100%** | **25.381.056** | **1%** |

Source: UPRA © 2022 based on UAESPNN 2018 informatio


Figure 86. RNSC – Orinoquia
Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2018 information.

In total, the Orinoquia has 150 Special Administrative Units of the National Natural Park System (UAESPNN in Spanish), which are completely within the region due to their scale, as shown in the following table, which lists the participation of each one.

| No. | RNSC Name | Total area RNSC (ha) | % RNSC Orinoquia Area (ha) |
|---|---|---|---|
| 1 | Algarrobo Del Lagunazo | 845,7 | 100% |
| 2 | Altamira | 2.945,3 | 100% |
| 3 | Amanecer en el Palmar 1 | 18,0 | 100% |
| 4 | Amanecer en el Palmar 2 | 114,0 | 100% |
| 5 | Ana Maria | 22,5 | 100% |
| 6 | Anelim | 1.236,4 | 100% |
| 7 | Arizona | 711,6 | 100% |
| 8 | Arreboles | 21,1 | 100% |
| 9 | Batatuaba | 398,1 | 100% |
| 10 | Berlin | 187,2 | 100% |
| 11 | Betania | 25,8 | 100% |
| 12 | Betania Del Lagunazo | 845,8 | 100% |
| 13 | Bombay | 1.074,0 | 100% |
| 14 | Buenaventura | 817,7 | 100% |
| 15 | Campoflorido | 2.758,0 | 100% |
| 16 | Canas Bravas | 309,6 | 100% |
| 17 | Cano Viejo | 3.985,0 | 100% |
| 18 | Casamba | 154,2 | 100% |
| 19 | Chaparral II | 518,2 | 100% |
| 20 | Corocito | 187,9 | 100% |
| 21 | Corocora | 328,9 | 100% |
| 22 | Corozito | 1.214,2 | 100% |
| 23 | Cubarral | 2,1 | 100% |
| 24 | Donana | 1.223,1 | 100% |
| 25 | El Boral | 11.538,5 | 100% |
| 26 | El Cachicamo | 1.249,2 | 100% |
| 27 | El Campin | 420,3 | 100% |
| 28 | El Esparramo | 72,5 | 100% |
| 29 | El Garzon | 48,0 | 100% |
| 30 | El Gavilan | 1.231,9 | 100% |
| 31 | El Guamito | 103,3 | 100% |
| 32 | El Horizonte | 1.056,6 | 100% |
| 33 | El Lagunazo | 845,7 | 100% |
| 34 | El Lagunazo en Santa Clara | 505,8 | 100% |
| 35 | El Leon | 333,4 | 100% |
| 36 | El Limonal y San Pedro | 27,0 | 100% |
| 37 | El Madrono | 920,8 | 100% |
| 38 | El Milagro | 825,8 | 100% |
| 39 | El Ocarro | 508,1 | 100% |
| 40 | El Panuelo | 1.310,9 | 100% |

| No. | RNSC Name | Total area RNSC (ha) | % RNSC Orinoquia Area (ha) |
|---|---|---|---|
| 41 | El Peligro | 843,0 | 100% |
| 42 | El Tautaco | 100,5 | 100% |
| 43 | El Tigrillo | 629,1 | 100% |
| 44 | El Tirriagal | 2.007,7 | 100% |
| 45 | El Triunfo | 16,3 | 100% |
| 46 | El Venado | 843,7 | 100% |
| 47 | Estero Matemarrano | 795,9 | 100% |
| 48 | Fauna Silvestre Capibara | 7,2 | 100% |
| 49 | Finca Matesanto | 801,1 | 100% |
| 50 | Flor Amarillo | 835,6 | 100% |
| 51 | Fundo Palmarito | 447,6 | 100% |
| 52 | Fundo Raudal De Flor Amarillo | 763,4 | 100% |
| 53 | Fundo Vida Tranquila | 498,9 | 100% |
| 54 | Garzas | 845,3 | 100% |
| 55 | Gaviota-Caracoli | 473,6 | 100% |
| 56 | Halcon Colorado Lote 1 | 10,0 | 100% |
| 57 | Hato las Covijas | 845,3 | 100% |
| 58 | Hato Venecia De Guanapalo | 6.510,2 | 100% |
| 59 | Jalisco | 845,6 | 100% |
| 60 | Jardin Botanico de la Macarena I | 52,1 | 100% |
| 61 | Jardin Botanico de la Macarena II | 72,8 | 100% |
| 62 | La Algarabia | 18,0 | 100% |
| 63 | La Aurora | 9.903,7 | 100% |
| 64 | La Bohemia | 4.001,7 | 100% |
| 65 | La Bramadora | 3.999,8 | 100% |
| 66 | La Campana | 1.268,2 | 100% |
| 67 | La Campechana | 333,4 | 100% |
| 68 | La Chivera | 449,4 | 100% |
| 69 | La Chula | 252,0 | 100% |
| 70 | La Cochinito | 32,3 | 100% |
| 71 | La Cosmopolitana | 13,9 | 100% |
| 72 | La Cumbre | 3,0 | 100% |
| 73 | La Esmeralda | 1.908,8 | 100% |
| 74 | La Florida | 2.038,4 | 100% |
| 75 | La Fortuna | 19,5 | 100% |
| 76 | La Gloria | 137,8 | 100% |
| 77 | La Macarena | 374,8 | 100% |

| No. | RNSC Name | Total area RNSC (ha) | % RNSC Orinoquia Area (ha) |
|---|---|---|---|
| 78 | La Palma | 35,3 | 100% |
| 79 | La Palmita | 603,6 | 100% |
| 80 | La Pareja 1 | 255,1 | 100% |
| 81 | La Pareja 2 | 539,1 | 100% |
| 82 | La Pedregoza | 465,7 | 100% |
| 83 | La Perla | 19,2 | 100% |
| 84 | La Provincia | 1.988,3 | 100% |
| 85 | La Reforma | 219,4 | 100% |
| 86 | La Regadera | 290,8 | 100% |
| 87 | La Reina | 1.057,8 | 100% |
| 88 | La Reserva | 16,4 | 100% |
| 89 | La Sonrisa | 115,0 | 100% |
| 90 | La Tamandua | 215,2 | 100% |
| 91 | La Travesada | 4.101,7 | 100% |
| 92 | La Ventana | 1.310,9 | 100% |
| 93 | Las Brisas | 705,5 | 100% |
| 94 | Las Garzas | 7,9 | 100% |
| 95 | Las Malvinas | 504,8 | 100% |
| 96 | Las Pinas | 2.131,9 | 100% |
| 97 | Limonal | 1.631,3 | 100% |
| 98 | Los Clavellinos | 900,7 | 100% |
| 99 | Los Gavanes | 62,1 | 100% |
| 100 | Los Mangos | 43,3 | 100% |
| 101 | Los Maracos | 47,2 | 100% |
| 102 | Los Matapalos del Lagunazo | 845,7 | 100% |
| 103 | Los Musos | 112,3 | 100% |
| 104 | Los Paraguitos | 307,1 | 100% |
| 105 | Los Sauces | 7,2 | 100% |
| 106 | Macarena | 838,8 | 100% |
| 107 | Manguare | 1.269,6 | 100% |
| 108 | Marcella | 164,9 | 100% |
| 109 | Mata de Palma | 2.602,5 | 100% |
| 110 | Matabrava | 4.050,4 | 100% |
| 111 | Matapalito | 1.298,9 | 100% |
| 112 | Maturin | 828,5 | 100% |
| 113 | Medano Los Morrucos | 4.982,5 | 100% |
| 114 | Mesetas de Versalles | 414,9 | 100% |
| 115 | Miralejos | 1.211,6 | 100% |
| 116 | Miralindo | 452,0 | 100% |
| 117 | Miramar | 162,9 | 100% |

| No. | RNSC Name | Total area RNSC (ha) | % RNSC Orinoquia Area (ha) |
|---|---|---|---|
| 118 | Miravalles | 6.452,5 | 100% |
| 119 | Montana | 2.904,2 | 100% |
| 120 | Noel Parra palacio | 271,7 | 100% |
| 121 | Padrote | 206,7 | 100% |
| 122 | Padrote 1 | 146,9 | 100% |
| 123 | Padrote 2 | 110,9 | 100% |
| 124 | Palmarito Casanare | 2.269,7 | 100% |
| 125 | Palmeras | 816,7 | 100% |
| 126 | Palomas | 541,1 | 100% |
| 127 | Pozo Azul | 1.265,3 | 100% |
| 128 | Puerto Chiguiro | 642,9 | 100% |
| 129 | Quinto Patio del Lagunazo | 845,5 | 100% |
| 130 | Rancho Camana | 1,7 | 100% |
| 131 | Rancho Nuevo | 794,5 | 100% |
| 132 | Rancho Paravare II | 501,6 | 100% |
| 133 | Sabanales | 621,9 | 100% |
| 134 | San Andres | 405,8 | 100% |
| 135 | San Cristobal | 414,7 | 100% |
| 136 | San Juan de Tinije | 911,4 | 100% |
| 137 | San Luis | 3.108,9 | 100% |
| 138 | San Pablo | 839,2 | 100% |
| 139 | Santa Trinidad | 2.465,9 | 100% |
| 140 | Santana | 1.233,7 | 100% |
| 141 | Tomo Futuro | 1.208,8 | 100% |
| 142 | Tomo Vida - El Dera | 526,9 | 100% |
| 143 | Tomovida – Shambala | 412,2 | 100% |
| 144 | Tomovida – Trikuti | 756,2 | 100% |
| 145 | Toraiba | 2.593,2 | 100% |
| 146 | Valledupar | 293,2 | 100% |
| 147 | Veracruz | 2.513,7 | 100% |
| 148 | Villa Fatima | 12,5 | 100% |
| 149 | Yurumi | 794,4 | 100% |
| 150 | Yurupari | 149,2 | 100% |

Table 88. RNSC – Orinoquia
Source: UPRA © 2022 based on Special Administrative Unit of the National Natural Park System (UAESPNN in Spanish) 2018 information

Regarding the participation of Civil Society Nature Reserve (RNSC in Spanish) at the municipal level, the municipalities with the largest municipal area in Civil Society Nature Reserve (RNSC in Spanish) are Orocué, San Luis de Palenque and Trinidad in the department of Casanare, each with 2% of their municipal area in the El Boral, Hato Venecia De Guanapalo, Medano Los Morrucos and Miravalles Civil Society Nature Reserves (RNSC in Spanish).

## 24. Environmental territorial claims

In addition to the effective presence of environmental figures in the Orinoco region, it is important to know the intentions of the State to declare new areas of the National System of Protected Areas (SINAP in Spanish), since they would be areas with significant changes in the regulation of use and special characteristics for the development of activities, which could limit or enhance the scope of application of the Biocarbon project.

At the national level, Colombia's National Natural Parks (PNN in Spanish) are making progress in the consolidation of eight (8) processes for the declaration of new areas, of which three (3) are located in the Orinoco region, specifically in the departments of Vichada, Meta and Arauca. The processes can be seen in Table 89, which shows that the area of these processes represents 3% of the region (including the geographic area of Casanare) and that most of the area under process is in the department of Arauca, with a proportion of 46%, which in turn represents 13% of the departmental area.

Table 89. Processes for the declaration of new areas

| Departmental authorities | Department | Name | Observation | Area (ha) | % New protected area (ha) | % Area requested vs. geographical area Department |
|---|---|---|---|---|---|---|
| PNN | Arauca | Sabanas y humedales de Arauca | Temporary Natural Resources Reserve (resolution 0708 2021), preliminary phases to route application | 309.791,3 | 309.791,3 | 309.791,3 |
| | Vichada | Selvas Transicionales de Cumaribo | | 292.210,0 | 292.210,0 | 292.210,0 |
| | Meta | Serranía de Manacacias | Readiness phase, declaration | 68.185,3 | 68.185,3 | 68.185,3 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | route started | | | |
| **Total** | | | | **670.186,6** | **100%** | **3%** |

Source: UPRA © 2022 based on information National Natural Parks (PNN in Spanish) 2021.

Following the route established for the declaration of new areas, through Resolution 1628 of 2015 it was resolved "to declare as protection and development zones of renewable natural resources and the environment giving application to the precautionary principle" of the mentioned processes, as follows: polygon 1– Selvas Transicionales de Cumaribo, polygon 2– Alto Manacacías and polygon 5 – Sabanas y Humedales de Arauca, remaining in force for two (2) years. Subsequently, the following extensions were made to the terms of duration and modifications to the protection zones:

- Resolution 1433 of 2017: extend for a term of one (1) year.
- Resolution 1310 of 2018: extend for the term of one (1) year and the areas of polygon 2 - Alto Manacacías and polygon 5 - Sabanas y Humedales de Arauca are modified.
- Resolution 0960 of 2019: extending for a term of two (2) years and modifying the areas of polygon 5 - Sabanas y Humedales de Arauca.
- Resolution 0708 of 2021: extending for a term of two (2) years and modifying the areas of polygon 5 - Sabanas and Humedales de Arauca.

It is important to mention that these areas, due to their protected status, are conditional areas within the Agricultural Frontier. The following figure shows the geographic location of the new protected areas.


Figure 87. Process of declaring new areas
Source: UPRA © 2022 based on information National Natural Parks (PNN in Spanish) 2021.

The cross-referencing of geographic information with the cadastral database shows that there are 925 properties, of which 77% are concentrated in areas from 20 ha to 1000 ha and 74% of the area of the properties is concentrated in areas greater than 200 ha to 5000 ha.

Table 90. Processes for declaring new areas - Property size

| Predial Size | Number of properties | % Properties | Properties area (ha) | % Properties Area (ha) |
|---|---|---|---|---|
| A1. Up to 0,5 ha | 17 | 2% | 3,6 | 0.001% |
| A2. Greater than 0,5 - Up to 1 ha | 3 | 0.3% | 1,9 | 0.0005% |
| A3. Greater than 1 - Up to 2,5 ha | 14 | 2% | 23,1 | 0.01% |
| A4. Greater than 2,5 - Up to 3 ha | 7 | 1% | 19,5 | 0.01% |
| B1. Greater than 3 - Up to 5 ha | 10 | 1% | 38,9 | 0.01% |
| B2. Greater than 5 - Up to 10 ha | 32 | 3% | 237,1 | 0.1% |
| C1. Greater than 10 - Up to 20 ha | 46 | 5% | 650,6 | 0.2% |
| D1. Greater than 20 - Up to 50 ha | 97 | 10% | 3.453,8 | 1% |
| D2. Greater than 50 - Up to 100 ha | 126 | 14% | 9.499,5 | 2% |
| D3. Greater than 100 - Up to 200 ha | 151 | 16% | 21.553,3 | 6% |
| E1. Greater than 200 - Up to 500 ha | 205 | 22% | 66.436,3 | 17% |
| E2. Greater than 500 - Up to 1000 ha | 137 | 15% | 96.792,8 | 25% |
| E3. Greater than 1000 - Up to 2000 ha | 60 | 6% | 80.529,1 | 21% |
| E4. Greater than 2000 - Up to 5000 ha | 13 | 1% | 42.967,2 | 11% |
| E5. Greater than 5000 - Up to 10000 ha | 5 | 1% | 31.609,1 | 8% |
| E6. Greater than 10000 ha | 2 | 0.2% | 35.365,0 | 9% |
| **Total** | **925** | **100%** | **389.180,8** | **100%** |

Source: UPRA © 2022 based on information National Natural Parks (PNN in Spanish) 2021

Taking the variable by type of owner from the cadastral database, 94% of the properties and 92% of the land area are private.

Table 91. Processes for declaring new areas - Type of Owner

| Type of Owner | No. properties | % Properties | Area (ha) | % Area (ha) |
|---|---|---|---|---|
| 1. STATE | 49 | 5% | 9.483,8 | 2% |
| 2. COLLECTIVES | 3 | 0.3% | 22.488,6 | 6% |
| 3. PRIVATE | 868 | 94% | 356.326,6 | 92% |
| 4. OTHERS | 1 | 0.1% | 52,3 | 0.01% |
| (blank) | 4 | 0.4% | 1.042,7 | 0.3% |

| | | | | |
|---|---|---|---|---|
| **Total** | **925** | **100%** | **389.394,0** | **100%** |

Source: UPRA © 2022 based on information National Natural Parks (PNN in Spanish) 2021.

As mentioned in Table 89, the Serranía de Manacacías is in the process of being declared, therefore, to explain the process in more detail, a description of the information is provided.

In principle, it should be noted that these areas, due to their protected status, are conditioned areas within the Agricultural Frontier, as shown in the following figures of the Manacacías process.

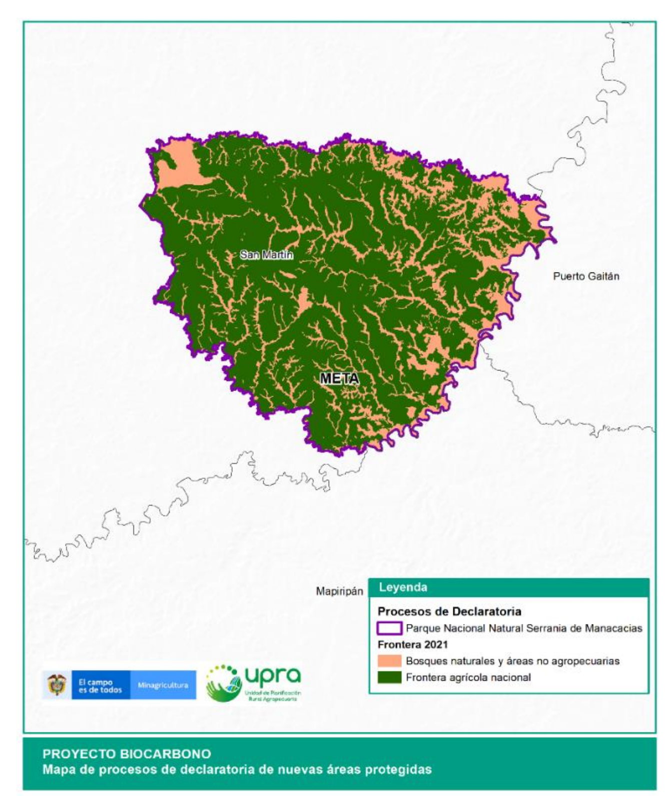



Figure 88. Manacacías - Agricultural Frontier - Declaration Process
Source: UPRA © 2022 based on information National Natural Parks (PNN in Spanish) 2021.

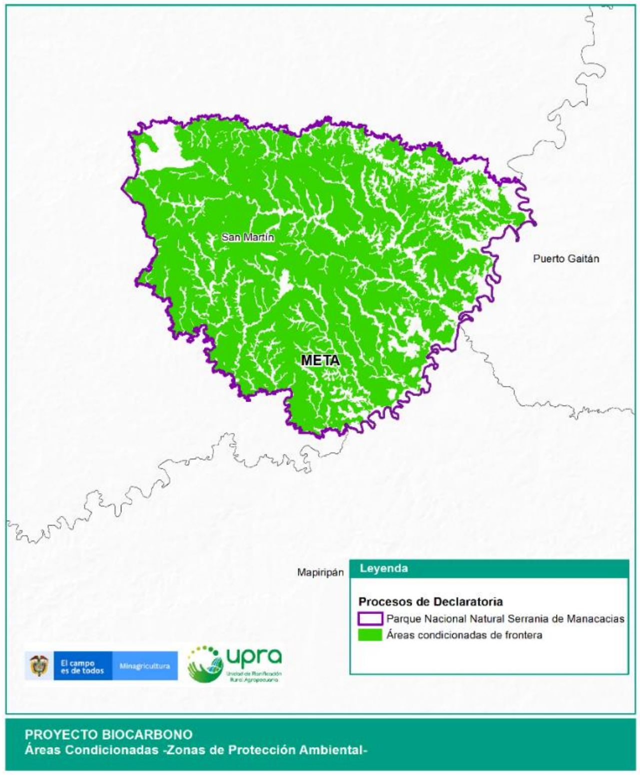



Figure 89. Manacacías - Agricultural frontier (conditioned areas) declaration process.
Source: UPRA © 2022 based on information National Natural Parks (PNN in Spanish) 2021.

The Alto Manacacías process area is located in the department of Meta in the municipalities of San Martín and Mapiripán, covering a total of 31 cadastral properties. Of these properties, one (1) is located in the municipality of Mapiripán and has a "Forestry"[190] economic destination, while the remaining 30 properties, located in the municipality of San Martín, have an "Agricultural" economic destination. Of these, 3 are owned by the State, as can be seen in the following table.

Table 92. Alto Manacacías declaration process

| Municipality | Property size | Economic Destination | Type of Owner | Properties | Geographic Area (ha) | % Geographic Area (ha) |
|---|---|---|---|---|---|---|
| **Mapiripán** | Greater than 200 ha - up to 500 ha | Forestry | STATE | 1 | 213 | 0.3% |

[190] **Properties destined for the exploitation of timber and non-timber species, Article 86 Resolution 70 of 2011.**

| | | | | | | |
|---|---|---|---|---|---|---|
| San Martín | Greater than 20 ha - up to 50 ha | Agriculture and Livestock | PRIVATES | 3 | 117 | 0.2% |
| | Greater than 50 ha - up to 100 ha | Agriculture and Livestock | PRIVATES | 1 | 68 | 0.1% |
| | Greater than 100 ha - up to 200 ha | Agriculture and Livestock | STATE | 2 | 231 | 0.3% |
| | | | PRIVATES | 1 | 326 | 0.5% |
| | Greater than 500 ha - up to 1000 ha | Agriculture and Livestock | STATE | 1 | 581 | 1% |
| | | | PRIVATES | 7 | 6.465 | 9% |
| | Greater than 1000 ha - up to 2000 ha | Agriculture and Livestock | PRIVATES | 8 | 10.433 | 15% |
| | Greater than 2000 ha - up to 5000 ha | Agriculture and Livestock | PRIVATES | 2 | 8.723 | 13% |
| | Greater than 5000 ha - up to 10000 ha | Agriculture and Livestock | PRIVATES | 4 | 26.442 | 39% |
| | Greater than 10000 ha | Agriculture and Livestock | PRIVATES | 1 | 15.018 | 22% |
| **Total** | | | | **31** | **68.618** | **100%** |

Source: UPRA © 2022 based on Agustín Codazzi Geographic Institute (IGAC in Spanish) 2019 information.

Considering the 16 size ranges established by the UPRA's property distribution analysis methodology, the properties in the process area are distributed in 9 of them, from those larger than 20 ha to those larger than 10.000 ha. 88% of the area of the properties are in the ranges greater than 1.000 ha to greater than 10.000 ha, covering a little more than 60.000 ha in 15 properties, which are also of a private nature.

In an additional relationship, the exercise of presumption of informality developed by Rural Agricultural Planning Unit (UPRA in Spanish) is linked, finding that the State properties are considered informal because they present some of the criteria established for informality, as well as 9 private properties located in the municipality of San Martin, which together account for about 42% of the properties in informal conditions, leaving the remaining 58% classified as formal properties, which are also linked to private owners.

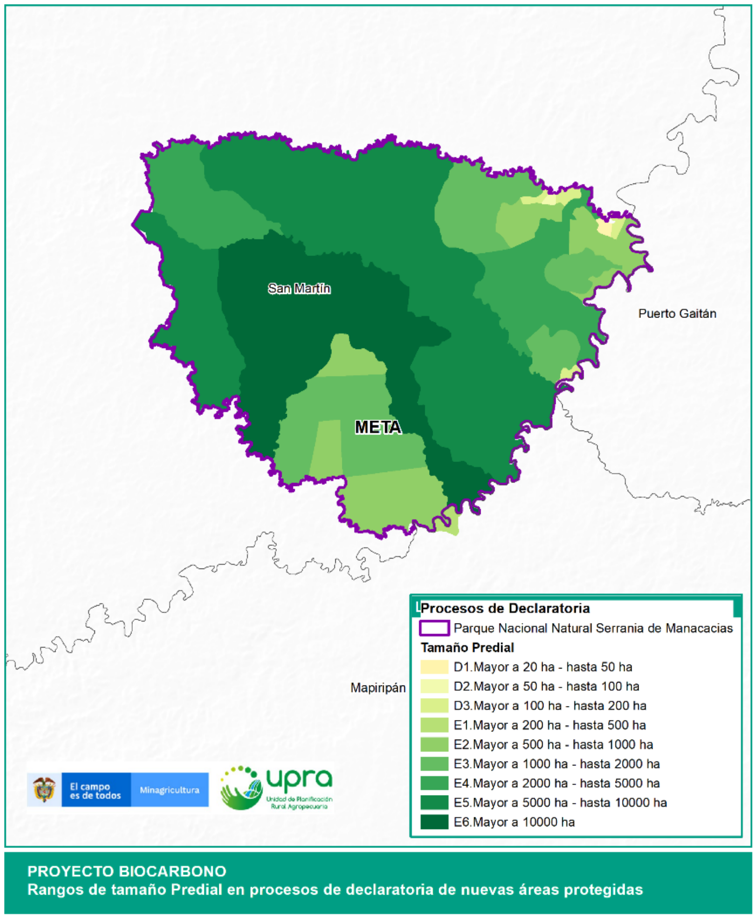



Figure 90. Property size ranges in the process of declaration Alto Manacacías
Source: UPRA © 2022 based on information National Natural Parks (PNN in Spanish) 2021, Agustín Codazzi Geographic Institute (IGAC in Spanish).2019.

Table 93. Alto Manacacías declaration process - Presumption of informality

| Municipality | Type of Owner | Presumption of Informality | Properties | % Properties |
|---|---|---|---|---|
| MAPIRIPÁN | 1. STATE | INFORMAL | 1 | 3% |
| SAN MARTÍN | 1. STATE | INFORMAL | 3 | 10% |
| | 3. PRIVATES | FORMAL | 18 | 58% |
| | | INFORMAL | 9 | 29% |
| **Total** | | | **31** | **100%** |

Source: UPRA © 2022 based on Agustín Codazzi Geographic Institute (IGAC in Spanish) 2019 information.

In general terms, the detailed analysis of the environmental figures, in force and in process, shows a wide diversity of figures present in the Orinoco region, to a greater or lesser extent. Under this diagnosis, from the ERPD of the Biocarbon project, it is required to take into consideration the use limitations implied by each of these figures, which in several of its categories allow only a conditioned forest or agricultural use, which does not necessarily correspond to a restriction, but can mean an opportunity to enhance forest areas to maintain and increase carbon emissions capture, through the formulation of sustainable projects that promote greater forest planting or maintain the area in the municipalities that have a significant inventory of forests. It has also been pointed out that land ownership is distributed between private and state owners, which implies the need to promote agreements with both agents so that environmental protection zones have a significant impact on reducing emissions.

Another aspect to be considered is the regularization of land ownership in environmental zones, since a significant portion of the area has been identified in informal conditions, which ultimately represents a limitation for the holders of these areas to participate in emission reduction agreements based on the activities developed on land without legal security. In this sense, it is necessary to promote land ownership regularization schemes so that there is certainty of ownership and reduction agreements can be generated. The issue of regularization is central to the ERPD, which is why a section of Chapter 6 is devoted to the detailed identification of properties that may have some degree of informality.

In addition to the environmental figures, in the Orinoco region there is an important presence of collective territories that determine land use and delimit landowners in the region. Given their relevance, in the following section there is an explanation of the ethnic management figures that are found in the territory.

## 24.1. Ethnic management figures

Regarding the collective territories legally recognized to indigenous groups and black communities through the figures of Indigenous Reservations and Black Community Lands, respectively, in the Orinoquia region, official information is only available for the indigenous reservations that cover a significant percentage of the territory.

These figures are important in the range of rights, since the State, in recognition of their diversity and culture, has developed legislation to protect them and guarantee their participation, which, although they enjoy the characteristics of private property, are of a special character, titled in a communal manner.

Thus, when it is intended to make decisions or carry out projects in their territories, they have the right to prior consultation[191], to guarantee their participation and protect them in a comprehensive manner, in cultural, social and other aspects.

Additionally, it is important to mention that due to the nature of these territories titled to indigenous communities, there may be some environmental figures that overlap with indigenous reserves. The information related to the ethnic collective territories present in the four (4) departments that make up the Orinoco Region is detailed below.

## Indigenous Reserves

As mentioned above, the indigenous reserves are the only legal figure of ethnic collective territories present in the Orinoco region and cover a high percentage of the territory's area, accounting for 18% of the Orinoco region, as can be seen in the following table:

Table 94. Indigenous reserves Orinoco Region

| Department | Reserves Area (ha) | % Reserves Area | Geographic area of the department (ha) | % Reserves in Department |
|---|---|---|---|---|
| Arauca | 133.170 | 3% | 2.383.135 | 6% |
| Casanare | 148.035 | 3% | 4.434.139 | 3% |
| Meta | 481.029 | 10% | 8.555.025 | 6% |
| Vichada | 3.821.579 | 83% | 10.008.757 | 38% |
| **Total** | **4.583.813** | **100%** | **25.381.056** | **18%** |

Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2018 information.

Another relevant aspect of the indigenous reserves is that they are concentrated especially in the department of Vichada, which accounts for 83% of the total area of legally constituted reserves in the region, which in turn represents 38% of the departmental territory. In contrast, the participation of this ownership typology in Casanare is barely 3% of its territory. Graphically, Figure 91 shows the high

[191] **Prior Consultation is a fundamental right of indigenous peoples, recognized by the UN through OIT Convention 169 of 1989.**

participation of indigenous reserves in the territory of Vichada, together with the lower proportion in the other departments.

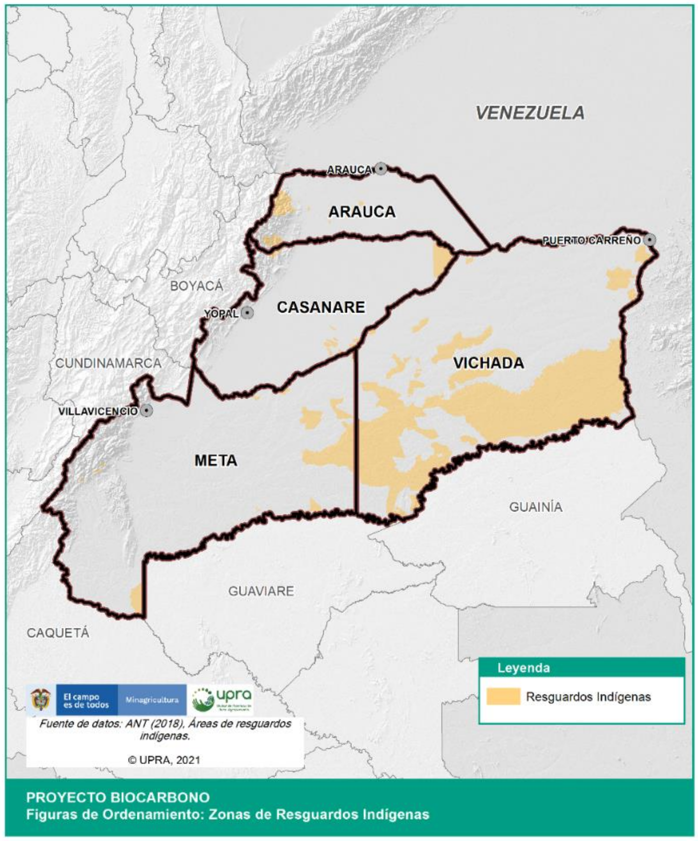



Figure 91. Indigenous Reservations Orinoquia Region
Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2018 information.

Table 95 shows the details of the indigenous reserves in the Orinoquia region, highlighting that there are 100 in total, of which 13 are partially located in the region of the Biocarbon project. Of the latter, "Minitas-Miralindo" has the smallest participation with 0.5% of the region's total; it is also worth noting that the largest reservation in terms of area is "Selva de Matavén" with 1'874,197 ha, representing 37% of the total area of the region's reservations, followed by "Alto Unuma" with 13%.

Table 95. Indigenous reserves - Orinoco

| No. | Indigenous reserve | Total Area RI (ha) | % Area RI | Orinoquia RI Area (ha) | % Orinoquia RI Area |
|---|---|---|---|---|---|
| 1 | alto unuma | 676.229 | 13% | 676.229 | 100% |
| 2 | Angosturas | 3.275 | 0.1% | 3.275 | 100% |
| 3 | awia tuparro sikuani (marimba) | 148.400 | 3% | 148.400 | 100% |

| No. | Indigenous reserve | Total Area RI (ha) | % Area RI | Orinoquia RI Area (ha) | % Orinoquia RI Area |
|---|---|---|---|---|---|
| 4 | Bayoneros | 123 | 0.002% | 123 | 100% |
| 5 | Cajaros | 227 | 0.004% | 227 | 100% |
| 6 | cali-barranquilla | 56.677 | 1% | 56.677 | 100% |
| 7 | campo alegre y ripialito | 6.947 | 0.1% | 6.947 | 100% |
| 8 | Cananama | 1.924 | 0.0% | 1.924 | 100% |
| 9 | caño bachaco | 6.383 | 0.1% | 6.383 | 100% |
| 10 | caño claro | 1.637 | 0.03% | 1.637 | 100% |
| 11 | caño guaripa | 8.244 | 0.2% | 8.244 | 100% |
| 12 | caño jabón | 5.698 | 0.1% | 5.698 | 100% |
| 13 | caño la hormiga | 4.188 | 0.1% | 4.188 | 100% |
| 14 | caño mesetas-dagua y murciélago | 83.662 | 2% | 83.662 | 100% |
| 15 | caño mochuelo | 93.864 | 2% | 93.864 | 100% |
| 16 | caño ovejas (betania corocito) | 1.729 | 0.03% | 1.729 | 100% |
| 17 | chaparral y barronegro | 16.522 | 0.3% | 16.522 | 100% |
| 18 | charco caiman | 1.929 | 0.04% | 1.929 | 100% |
| 19 | Chocon | 35.290 | 1% | 35.290 | 100% |
| 20 | chololobo matatu | 6.392 | 0.1% | 6.392 | 100% |
| 21 | comunidad indigena kanalitojo puerto colombia | 1.316 | 0.03% | 1.316 | 100% |
| 22 | corocito, yopalito y gualabo | 9.865 | 0.2% | 9.865 | 100% |
| 23 | corozal tapaojo | 8.182 | 0.2% | 8.182 | 100% |
| 24 | cuiloto ii | 81 | 0.002% | 81 | 100% |
| 25 | Cusay | 1.035 | 0.02% | 1.035 | 100% |
| 26 | egua-guariacana | 15.525 | 0.3% | 15.525 | 100% |
| 27 | el consejo | 4.190 | 0.1% | 4.190 | 100% |
| 28 | el medano | 1.968 | 0.04% | 1.968 | 100% |
| 29 | el saladillo | 1.535 | 0.03% | 1.535 | 100% |
| 30 | el suspiro el rincón del socorro | 1.987 | 0.04% | 1.987 | 100% |
| 31 | el tigre | 50.549 | 1% | 50.549 | 100% |
| 32 | el turpial la victoria (umapo) | 4.117 | 0.1% | 4.117 | 100% |
| 33 | el vigia | 483 | 0.01% | 483 | 100% |
| 34 | el zamuro | 195 | 0.004% | 195 | 100% |
| 35 | flores sombrero | 20.347 | 0.4% | 20.347 | 100% |
| 36 | guacamayas maipore | 16.899 | 0.3% | 16.899 | 100% |
| 37 | guacamayas mamiyare | 18.808 | 0.4% | 18.808 | 100% |
| 38 | guahibo de los rios tomo y los caños urimica y samarro | 24.741 | 0.5% | 24.741 | 100% |
| 39 | julieros y velasqueros | 223 | 0.004% | 223 | 100% |

| No. | Indigenous reserve | Total Area RI (ha) | % Area RI | Orinoquia RI Area (ha) | % Orinoquia RI Area |
|---|---|---|---|---|---|
| 40 | Kawáneruba | 8.691 | 0.2% | 8.691 | 100% |
| 41 | la Esmeralda | 2.788 | 0.1% | 2.788 | 100% |
| 42 | la esperanza - la fortaleza y el totumo | 120 | 0.002% | 120 | 100% |
| 43 | la isla | 129 | 0.003% | 129 | 100% |
| 44 | la Julia | 206 | 0.004% | 206 | 100% |
| 45 | la llanura | 66.542 | 1% | 66.542 | 100% |
| 46 | la Pascua | 18.919 | 0.4% | 18.919 | 100% |
| 47 | la sal | 3.328 | 0.1% | 3.328 | 100% |
| 48 | la voragine-la illusion | 843 | 0.02% | 843 | 100% |
| 49 | laguna tranquila | 15.733 | 0.3% | 15.733 | 100% |
| 50 | los iguanitos | 564 | 0.01% | 564 | 100% |
| 51 | los planes | 2.088 | 0.04% | 2.088 | 100% |
| 52 | Macarieros | 18 | 0.0003% | 18 | 100% |
| 53 | Macuare | 21.250 | 0.4% | 21.250 | 100% |
| 54 | Macucuana | 6.678 | 0.1% | 6.678 | 100% |
| 55 | Maguari | 44 | 0.001% | 44 | 100% |
| 56 | Matecandela | 16 | 0.0003% | 16 | 100% |
| 57 | merey, la veraita | 3.122 | 0.1% | 3.122 | 100% |
| 58 | muco mayoragua | 10.904 | 0.2% | 10.904 | 100% |
| 59 | nacuañedorro tuparro | 95.908 | 2% | 95.908 | 100% |
| 60 | naexal lajt del pueblo jiw | 1.733 | 0.03% | 1.733 | 100% |
| 61 | naexil put | 385 | 0.01% | 385 | 100% |
| 62 | nueva esperanza del tomo | 9.935 | 0.2% | 9.935 | 100% |
| 63 | ondas del cafre | 3.753 | 0.1% | 3.753 | 100% |
| 64 | Parreros | 206 | 0.004% | 206 | 100% |
| 65 | piaroa de cachicamo | 16.700 | 0.3% | 16.700 | 100% |
| 66 | playas de bojabá | 1.293 | 0.03% | 1.293 | 100% |
| 67 | punta bandera | 3.072 | 0.1% | 3.072 | 100% |
| 68 | Puyeros | 33 | 0.001% | 33 | 100% |
| 69 | río siare | 46.783 | 1% | 46.783 | 100% |
| 70 | ríos muco y guarrojo | 85.632 | 2% | 85.632 | 100% |
| 71 | ríos tomo y weberi | 61.485 | 1% | 61.485 | 100% |
| 72 | Roqueros | 103 | 0.002% | 103 | 100% |
| 73 | sabanas de curipao | 32.777 | 1% | 32.777 | 100% |
| 74 | san josé de lipa o caño colorado | 3.943 | 0.1% | 3.943 | 100% |
| 75 | san juanito, el duya y paravare | 21.314 | 0.4% | 21.314 | 100% |
| 76 | santa rosalia | 5.257 | 0.1% | 5.257 | 100% |

| No. | Indigenous reserve | Total Area RI (ha) | % Area RI | Orinoquia RI Area (ha) | % Orinoquia RI Area |
|---|---|---|---|---|---|
| 77 | santa teresita del tuparro | 206.603 | 4% | 206.603 | 100% |
| 78 | saracure-cadá | 185.107 | 4% | 185.107 | 100% |
| 79 | sikuani de awáliba | 20.786 | 0.4% | 20.786 | 100% |
| 80 | sikuani de domo planas | 37.812 | 1% | 37.812 | 100% |
| 81 | sikuani de iwiwi | 2.977 | 0.1% | 2.977 | 100% |
| 82 | Valdivia | 3.914 | 0.1% | 3.914 | 100% |
| 83 | vencedor-piriri-guamito y matanegra | 39.268 | 1% | 39.268 | 100% |
| 84 | villa lucia | 2.663 | 0.1% | 2.663 | 100% |
| 85 | Waliani | 4.639 | 0.1% | 4.639 | 100% |
| 86 | valles del sol | 26.820 | 1% | 26.820 | 100% |
| 87 | Cibariza | 35.538 | 1% | 35.538 | 100% |
| 88 | selva de matavén | 1.874.197 | 37% | 1.863.460 | 99% |
| 89 | Concordia | 90.734 | 2% | 85.175 | 94% |
| 90 | guaco bajo y guaco alto | 49.764 | 1% | 39.110 | 79% |
| 91 | carpintero palomas | 42.950 | 1% | 27.796 | 65% |
| 92 | Corocoro | 36.604 | 1% | 14.695 | 40% |
| 93 | llanos del yarí - yaguará ii | 198.992 | 4% | 67.598 | 34% |
| 94 | pueblo nuevo-laguna colorada | 46.281 | 1% | 14.263 | 31% |
| 95 | murciélago Altamira | 7.292 | 0.1% | 1.208 | 17% |
| 96 | laguna araguato y barranco ceiba | 26.936 | 1% | 3.688 | 14% |
| 97 | barranco Colorado | 9.493 | 0.2% | 1.037 | 11% |
| 98 | la Esperanza | 1.046 | 0.02% | 67 | 6% |
| 99 | unido uwa | 223.740 | 4% | 5.741 | 3% |
| 100 | minitas-miralindo | 35.607 | 1% | 170 | 0.5% |
| **Total** | | **5.103.440** | **100%** | **4.583.813** | **90%** |

Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2018 information.

Considered by department, Vichada has participation in 43 indigenous reserves, including the largest mentioned above, "Selva de Matavén", whose area is equivalent to 41% of the area of the reserves in the region. Likewise, the "Alto Unuma" reserve is found in greater proportion in Vichada with 11% and another part in Meta with 4%, as shown in Table 96.

Table 96. Indigenous reserves by department - Orinoquia

| Department | Indigenous reserve | RI Area (ha) | % RI Area (ha) |
|---|---|---|---|
| Arauca 28 | Angosturas | 3.275 | 0.1% |
| | Bayoneros | 123 | 0.003% |

| Department | Indigenous reserve | RI Area (ha) | % RI Area (ha) |
|---|---|---|---|
| | Cajaros | 227 | 0.005% |
| | Cananama | 1.924 | 0.04% |
| | Caño claro | 1.637 | 0.04% |
| | Caño mochuelo | 22 | 0.0005 % |
| | Cibariza | 35.538 | 1% |
| | Cuiloto ii | 81 | 0.002% |
| | Cusay | 1.035 | 0.02% |
| | El vigia | 483 | 0.01% |
| | El zamuro | 195 | 0.004% |
| | Julieros y velasqueros | 223 | 0.005% |
| | La Esperanza | 67 | 0.001% |
| | La esperanza - la fortaleza y el totumo | 120 | 0.003% |
| | La isla | 129 | 0.003% |
| | La voragine-la illusion | 843 | 0.02% |
| | Laguna tranquila | 15.733 | 0.3% |
| | Los iguanitos | 564 | 0.01% |
| | Macarieros | 18 | 0.0004 % |
| | Matecandela | 16 | 0.0003 % |
| | Parreros | 206 | 0.005% |
| | Playas de bojabá | 1.293 | 0.03% |
| | Puyeros | 33 | 0.001% |
| | Roqueros | 103 | 0.002% |
| | Sabanas de curipao | 32.777 | 1% |
| | San josé de lipa o caño colorado | 3.943 | 0.1% |
| | Unido uwa | 5.741 | 0.1% |
| | Valles del sol | 26.820 | 1% |
| Casanare 8 | Caño mochuelo | 93.842 | 2% |
| | Chaparral y barronegro | 16.522 | 0.4% |
| | El consejo | 4.190 | 0.1% |
| | El medano | 1.968 | 0.04% |
| | El saladillo | 1.535 | 0.03% |
| | El suspiro el rincón del socorro | 1.987 | 0.04% |
| | Macucuana | 6.678 | 0.1% |
| | San juanito, el duya y paravare | 21.314 | 0.5% |

| Departmen t | Indigenous reserve | RI Area (ha) | % RI Area (ha) |
|---|---|---|---|
| Meta 25 | Alto unuma | 187.859 | 4% |
| | Barranco Colorado | 1.037 | 0.02% |
| | Caño jabón | 5.698 | 0.1% |
| | Caño ovejas (betania corocito) | 1.729 | 0.04% |
| | Charco caiman | 1.929 | 0.04% |
| | Corocito, yopalito y gualabo | 9.865 | 0.2% |
| | Corozal tapaojo | 8.160 | 0.2% |
| | El tigre | 50.549 | 1% |
| | El turpial la victoria (umapo) | 4.117 | 0.1% |
| | La Julia | 206 | 0.004% |
| | La sal | 3.328 | 0.1% |
| | Laguna araguato y barranco ceiba | 3.688 | 0.1% |
| | Llanos del yarí - yaguará ii | 67.598 | 1% |
| | Los planes | 2.088 | 0.05% |
| | Macuare | 21.250 | 0.5% |
| | Maguare | 44 | 0.001% |
| | Naexal lajt del pueblo jiw | 1.733 | 0.04% |
| | Naexil put | 385 | 0.01% |
| | Ondas del cafre | 3.753 | 0.1% |
| | Sikuani de awáliba | 20.786 | 0.5% |
| | Sikuani de domo planas | 37.812 | 1% |
| | Sikuani de iwiwi | 846 | 0.02% |
| | Vencedor-piriri-guamito y matanegra | 39.268 | 1% |
| | Villa lucia | 2.663 | 0.1% |
| | Waliani | 4.639 | 0.1% |
| Vichada 43 | Alto unuma | 488.370 | 11% |
| | Awia tuparro sikuani (marimba) | 148.400 | 3% |
| | Cali-barranquilla | 56.677 | 1% |
| | Campo alegre y ripialito | 6.947 | 0.2% |
| | Caño bachaco | 6.383 | 0.1% |
| | Caño guaripa | 8.244 | 0.2% |
| | Caño la hormiga | 4.188 | 0.1% |
| | Caño mesetas-dagua y murciélago | 83.662 | 2% |
| | Carpintero palomas | 27.796 | 1% |
| | Chocon | 35.290 | 1% |
| | Chololobo matatu | 6.392 | 0.1% |

| Department | Indigenous reserve | RI Area (ha) | % RI Area (ha) |
|---|---|---|---|
| | Comunidad indigena kanalitojo puerto colombia | 1.316 | 0.03% |
| | Concordia | 85.175 | 2% |
| | Corocoro | 14.695 | 0.3% |
| | Corozal tapaojo | 23 | 0.0005 % |
| | Egua-guariacana | 15.525 | 0.3% |
| | Flores sombrero | 20.347 | 0.4% |
| | Guacamayas maipore | 16.899 | 0.4% |
| | Guacamayas mamiyare | 18.808 | 0.4% |
| | Guaco bajo y guaco alto | 39.110 | 1% |
| | Guahibo de los rios tomo y los caños urimica y samarro | 24.741 | 1% |
| | Kawáneruba | 8.691 | 0.2% |
| | La Esmeralda | 2.788 | 0.1% |
| | La llanura | 66.542 | 1% |
| | La Pascua | 18.919 | 0.4% |
| | Merey, la veraita | 3.122 | 0.1% |
| | Minitas-miralindo | 170 | 0.004% |
| | Muco mayoragua | 10.904 | 0.2% |
| | Murciélago Altamira | 1.208 | 0.03% |
| | Nacuañedorro tuparro | 95.908 | 2% |
| | Nueva esperanza del tomo | 9.935 | 0.2% |
| | Piaroa de cachicamo | 16.700 | 0.4% |
| | Pueblo nuevo-laguna colorada | 14.263 | 0.3% |
| | Punta bandera | 3.072 | 0.1% |
| | Río siare | 46.783 | 1% |
| | Ríos muco y guarrojo | 85.632 | 2% |
| | Ríos tomo y weberi | 61.485 | 1% |
| | Santa rosalia | 5.257 | 0.1% |
| | Santa teresita del tuparro | 206.603 | 5% |
| | Saracure-cadá | 185.107 | 4% |
| | Selva de matavén | 1.863.460 | 41% |
| | Sikuani de iwiwi | 2.131 | 0.05% |
| | Valdivia | 3.914 | 0.1% |
| **Total** | | **4.583.813** | **100%** |

Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2018 information.

Considering the participation of indigenous reserves in the region by size, 39 of them have areas larger than 10,000 ha and cover 96% of the total area of participation in the region, as shown in the following table and figure.

Table 97. Size of indigenous reserves - Orinoco

| Size Range | Indigenous reserves | % Indigenous reserves | Orinoquia RI Area (ha) | % Orinoquia RI Area |
|---|---|---|---|---|
| C1.Greater than 10 ha - up to 20 ha | 2 | 2% | 33 | 0.001% |
| D1.Greater than 20 ha - up to 50 ha | 2 | 2% | 77 | 0.002% |
| D2.Greater than 50 ha - up to 100 ha | 2 | 2% | 149 | 0.003% |
| D3.Greater than 100 ha - up to 200 ha | 6 | 6% | 841 | 0.02% |
| E1.Greater than 200 ha - up to 500 ha | 6 | 6% | 1729 | 0.04% |
| E2.Larger than 500 ha - up to 1000 ha | 2 | 2% | 1408 | 0.03% |
| E3.Greater than 1000 ha - up to 2000 ha | 13 | 13% | 20.329 | 0.4% |
| E4.Greater than 2000 ha - up to 5000 ha | 16 | 16% | 55.745 | 1% |
| E5.Greater than 5000 ha - up to 10000 ha | 12 | 12% | 88.013 | 2% |
| E6. Greater than 10000 ha | 39 | 39% | 4.415.489 | 96% |
| **Total** | **100** | **100%** | **4.583.813** | **100%** |

Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2018 information.

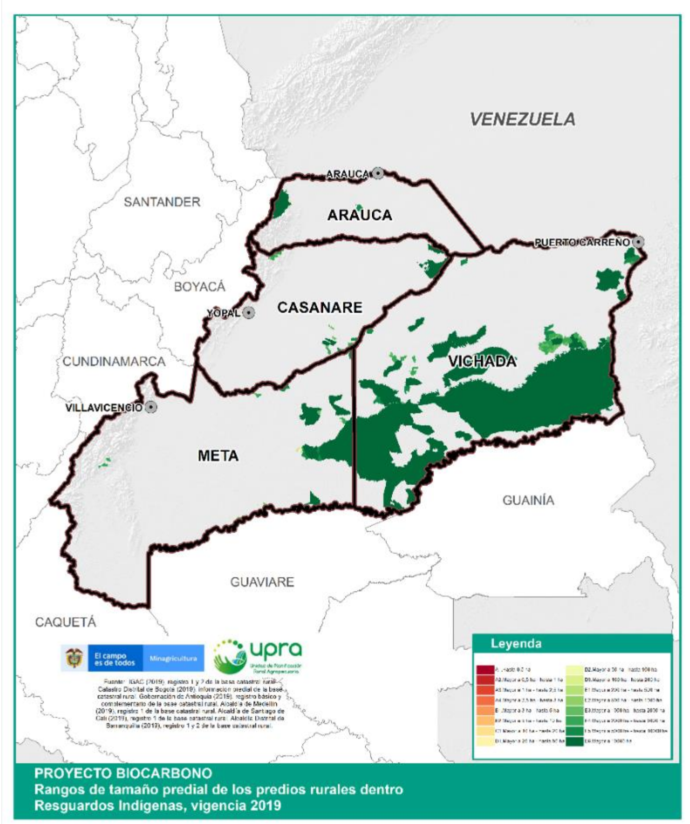



Figure 92. Size Ranges in Indigenous Reserves
Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2018 information, Agustín Codazzi Geographic Institute (IGAC in Spanish)

It is worth mentioning that it is not uncommon that the presence of ethnic communities or indigenous territories covers more than what is legally constituted and that there are territories with requests from these communities.

## 24.2. Requests from indigenous reserves

In the context of potential changes in land ownership conditions, it is important to know the ethnic expectations in the territory, which refer to areas over which the indigenous communities have made requests (incorporation, expansion, restructuring/sanitation or clarification) where they may be present and are not legally the owners; these requests are subjected to the legal and technical processes with the corresponding entity.

The following image shows the geographic location of the requests for legalization of indigenous reserves classified by type of request, showing large extensions, particularly for the expansion of reserves.

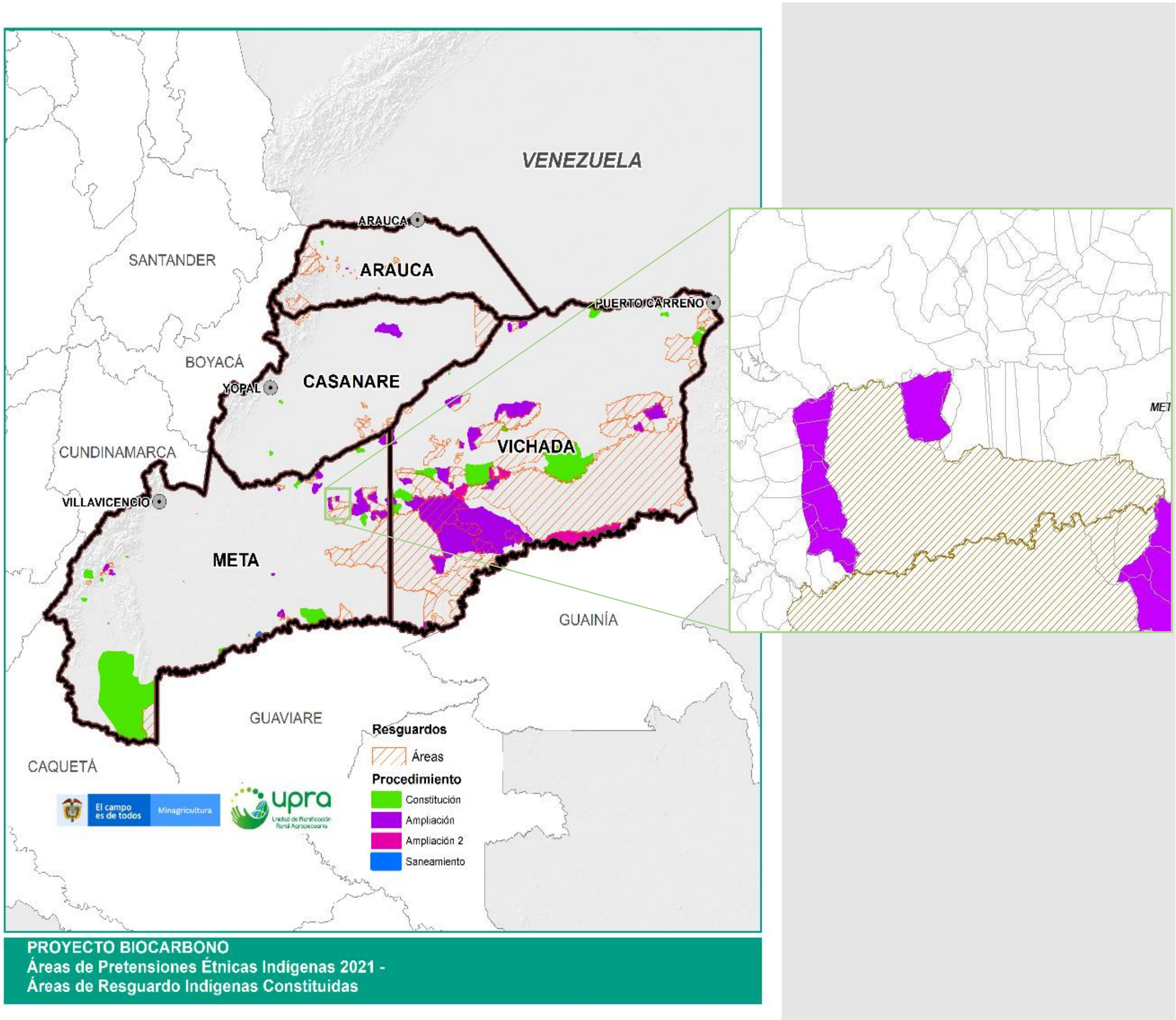



Figure 93. Requests for Legalization of Indigenous Reserves
Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2021 information.

Requests for legalization of Indigenous Reserves represent 8% of the area of the Orinoquia Region and are mainly concentrated in the department of Vichada, where they represent 67% of the requested area, which in turn represents 14% of the area of the department, followed by the department of Meta with 32%, Casanare and Arauca in smaller proportions with less than 1%, as shown in the table.

Table 98. Indigenous Reservation Legalization Requests Area

| Department | Geographic area (ha) Department | Area (ha) requested | % request | % request for Department |
|---|---|---|---|---|
| Arauca | 2.383.135 | 1.385,6 | 0.1% | 0.1% |
| Casanare | 4.434.139 | 27.875,4 | 1% | 0.6% |
| Meta | 8.555.025 | 680.455,0 | 32% | 8.0% |
| Vichada | 10.008.757 | 1.425.650,6 | 67% | 14.2% |
| **Total** | **25.381.056** | **2.135.366,6** | **100%** | **8%** |

Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2021 information.

In addition, Table 99 shows the information on requests for legalization of indigenous reserves in the region, specifying the number of properties and the area they cover. The segment of requests for constitution comprises 521 properties with 373,000 hectares. Then comes the request for extension with 403 plots totaling 942,510 hectares. In third place, in terms of plots, is the Sanitation request, which has 13 plots and 5145 hectares, located in the municipality of Puerto Concordia in the department of Meta.

At the departmental level, Table 99 shows that Arauca has requests for the constitution of reserves in 10 properties located in the municipality of Saravena with 356 hectares. The department of Casanare has 182 properties with requests, of which 168 correspond to an expansion of 24,000 hectares located in the municipality of Paz de Ariporo. In the department of Meta, there are 288 properties with legalization requests, most of which correspond to incorporation requests with 174 properties totaling 54,000 hectares, most of which are located in the municipality of Mapiripán. Finally, the department of Vichada has 482 properties with legalization requests, of which 333 correspond to requests for the constitution of 317 thousand hectares, located in the municipality of Cumaribo[192].

Table 99. Requests for Legalization of Indigenous Reserves

| Application | | Constitution | | Sanitation | | Extension | | Extension 2 | |
|---|---|---|---|---|---|---|---|---|---|
| **Dpt.** | **Municipality** | **Number of properties** | **Area (ha)** | **Number of properties** | **Area (ha)** | **Number of properties** | **Area (ha)** | **Number of properties** | **Area (ha)** |
| **Arauca** | Saravena | 10 | 355,54 | | | | | | |
| **Subtotal** | | **10** | **355,54** | **0** | **0** | **0** | **0** | | |
| **Casanare** | La Salina | 2 | 207,04 | | | | | | |
| | Maní | 1 | 713,28 | | | | | | |
| | Paz de Ariporo | | | | | 168 | 24.205,90 | | |

[192] **In the database there is a field called "Expansion 2" only for the municipality of Cumaribo, and there are 7 properties in more than 1 request in this same municipality.**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Yopal | 1 | 420,73 | | | | | | |
| **Subtotal** | | **24** | **2.052,12** | **0** | **0** | **168** | **24.205.90** | | |
| **Meta** | Lejanías | 3 | 68,37 | | | | | | |
| | Mapiripán | 153 | 40.789,74 | | | 3 | 4.579,20 | | |
| | Mesetas | 9 | 539,30 | | | 34 | 684,47 | | |
| | Puerto Concordia | | | 13 | 5.144,93 | | | | |
| | Puerto Gaitán | 8 | 12.956,85 | | | 63 | 78.113,16 | | |
| | Puerto López | 1 | 1,90 | | | 1 | 204,70 | | |
| **Subtotal** | | **174** | **54.356,16** | **13** | **5.144,93** | **101** | **83.581,53** | | |
| **Vichada** | Cumaribo | 254 | 285.961,38 | | | 74 | 747.276,42 | 22 | 191.594,06 |
| | La Primavera | 8 | 4.379,02 | | | 52 | 78.912,57 | | |
| | Puerto Carreño | 71 | 27.097,14 | | | | | | |
| | Santa Rosalía | | | | | 8 | 8.533,86 | | |
| **Subtotal** | | **333** | **317.437,54** | **0** | **0.00** | **134** | **834.722,85** | | |
| **Total** | | **521** | **373.490,28** | **13** | **5.144,93** | **403** | **942.510,28** | **22** | **191.594,06** |

Fuente: UPRA © 2022 based on information National Land Agency (ANT in Spanish) 2021

On the other hand, regarding the size of the properties being applied for, again based on the ranges defined in the UPRA methodology, 59% are in ranges greater than 100 ha to 2000 ha, but the greatest amount of area (55%) is concentrated in 9 properties in the range of more than 10,000 ha. (See Table 100).

Table 100. Requests for legalization of indigenous reserves - Property Size

| Predial Size | No. of properties | % properties | Property area (ha) | % Area (ha) |
|---|---|---|---|---|
| A1. Up to 0,5 ha | 37 | 4% | 8,50 | 0.001% |
| A2. Greater than 0,5 - Up to 1 ha | 19 | 2% | 14,18 | 0.001% |
| A3. Greater than 1 - Up to 2,5 ha | 33 | 3% | 56,37 | 0.004% |
| A4. Greater than 2,5 - Up to 3 ha | 4 | 0,4% | 11,04 | 0.001% |
| B1. Greater than 3 - Up to 5 ha | 20 | 2% | 77,67 | 0.01% |
| B2. Greater than 5 - Up to 10 ha | 37 | 4% | 274,78 | 0.02% |
| C1. Greater than 10 - Up to 20 ha | 37 | 4% | 559,90 | 0.04% |
| D1. Greater than 20 - Up to 50 ha | 69 | 7% | 2.358,20 | 0.2% |
| D2. Greater than 50 - Up to 100 ha | 52 | 5% | 3.886,60 | 0.3% |

| | | | | |
|---|---|---|---|---|
| D3. Greater than 100 - Up to 200 ha | 112 | 12% | 16.452,87 | 1% |
| E1. Greater than 200 - Up to 500 ha | 153 | 16% | 50.248,91 | 3% |
| E2. Greater than 500 - Up to 1000 ha | 123 | 13% | 91.753,55 | 6% |
| E3. Greater than 1000 - Up to 2000 ha | 174 | 18% | 246.509,66 | 17% |
| E4. Greater than 2000 - Up to 5000 ha | 60 | 6% | 169.898,53 | 11% |
| E5. Greater than 5000 - Up to 10000 ha | 13 | 1% | 82.044,40 | 6% |
| E6. Greater than 10000 ha | 9 | 1% | 820.545,35 | 55% |
| **Total** | **952** | **100%** | **1.484.700,51** | **100%** |

Source: UPRA © 2022 based on Agustín Codazzi Geographic Institute (IGAC in Spanish). information, National Land Agency (ANT in Spanish) 2021

In conclusion, it can be said that the size ranges of the properties subject to legalization requests are concentrated in large properties, which would imply that the future negotiation of carbon sequestration projects would be with indigenous landowners, subject to the legalization process being carried out by the National Land Agency (ANT in Spanish).

Finally, from the variable of type of owner, 55% of the lands requested as indigenous reserves are in the name of private owners, but 68% of the area is concentrated in 43% of the lands and belongs to the State, as shown in Table 101.

Table 101. Requests for legalization of indigenous reserves - Type of owner

| Owner type | Number of properties | % properties | Area (ha) | % Area (ha) |
|---|---|---|---|---|
| 1.STATE | 411 | 43% | 1.002.254,06 | 68% |
| 2. COLLECTIVES | 8 | 1% | 96.320,57 | 6% |
| 3. PRIVATES | 526 | 55% | 382.960,21 | 26% |
| No information | 7 | 1% | 3.165,66 | 0% |
| **Total** | **952** | **100%** | **1.484.700,51** | **100%** |

Source: UPRA © 2022 based on information Agustín Codazzi Geographic Institute (IGAC in Spanish). 2019, National Land Agency (ANT in Spanish) 2021.

The diagnosis of indigenous reserves confirms the analysis of chapter 3, in the sense that they are a very important actor in the structuring of emission reduction agreements, particularly in Vichada, where they own a large portion of land. Under this scenario, the ERPD implementation should have a focus on collective territories, especially in Vichada, so that the indigenous reserves can participate in the benefits of the project, promote sustainable development schemes and as a consequence achieve a greater impact of the PRE Biocarbon. This will require a broad process of socialization with these communities so that the PRE Biocarbon is understood by the communities and land uses are promoted in accordance with their tradition and soil conditions.

**Community territories of black communities**

The Orinoco region does not currently have any territories titled to black, Afro-Colombian, Raizal and Palenquero communities, but there are some areas requested for these communities, as described in the following section.

## 24.3. Solicitudes de comunidades negras

The Orinoco region does not currently have any territories titled to black, Afro-Colombian, Raizal and Palenquero communities, but there are some areas requested by these communities, as described in the following section.

Table 102. Requests for land titling to black communities by department

| Dept | Geobraphic Area (ha) Dept | Area (ha) requested | % request ed | % requested according to Dpt |
|---|---|---|---|---|
| Arauca | 2.383.135 | 1.361,98 | 11% | 0,1% |
| Casanar e | 4.434.139 | 8.643,01 | 68% | 0,2% |
| Vichada | 10.008.757 | 2.644,37 | 21% | 0,03% |
| **Total** | **16.826.031** | **12.649,37** | **100%** | **0,05%** |

Source: UPRA © 2022 based on ANT 2021 information

When considering the information by municipality, it is found that, Yopal, in the department of Casanare, has the largest amount of area requested, followed by Cumaribo in the department of Vichada and the municipality of Cravo Norte in the department of Arauca.

Table 103. Requests for land titling to black communities by municipality

| Dept. | Mubicipalit y | Name | Area (ha) |
|---|---|---|---|
| Arauca | Arauca | Consejo Comunitario Los Gabanes 1 Y 2 | 10,45 |
| | Arauquita | Consejo Comunitario El Oasis | 3,56 |
| | | Consejo Comunitario El Triunfo | 64,28 |
| | | Consejo Comunitario Los Chorros La Gran Esperanza | 65,68 |
| | | Consejo Comunitario Panama De Arauca | 62,61 |
| | | Consejo Comunitario Vereda La Paz | 36,36 |

| | | | |
|---|---|---|---|
| | Cravo Norte | Federación de Consejos Comunitarios de las Comunidades Negras y otras organizaciones de Arauca "FECODA" | 1.098,44 |
| | Tame | Consejo Comunitario Meleocipo Amu Arrechea | 20,60 |
| **Total Arauca** | | | **1.361,98** |
| Casanare | Yopal | Consejo Comunitario Casafrodescendientes Del Casanares Conmudecas | 8.641,20 |
| | Hato Corozal | Federación de Consejos Comunitarios de las Comunidades Negras y otras organizaciones de Arauca "FECODA" | 1,81 |
| **Total Casanare** | | | **8.643,01** |
| Vichada | Cumaribo | Consejo Comunitario La Vereda Mata Grande | 2.644,37 |
| **Total Vichada** | | | **2.644,37** |
| **TOTAL** | | | **12.649,37** |

Source: UPRA © 2022 based on ANT 2021 information.


Figure 94. Requests for legalization of black communities
Source: UPRA © 2022 based on information Agustín Codazzi Geographic Institute (IGAC in Spanish) 2019, National Land Agency (ANT in Spanish) 2021.

Figure 94 shows the geographic location of the properties requested for titling of Community Territories of Black communities.
The cross-referencing with the cadastral geographic information shows that the areas requested for the titling of community territories of black communities are contained in 41 cadastral properties.
Then, analyzing the property size ranges, it is observed that 73% of the requested properties have an area between 20 ha and 1.000 ha, but 87% of the area comprising the properties subject to title applications corresponds to properties larger than 200 ha up to 5.000 ha, as can be seen in the following table:

Table 104. Requests for land titling to black communities - Property size.

| Size of property | No. of properties | % properties | Area (ha) properties | % Area (ha) properties |
|---|---|---|---|---|
| A2. Greater than 0,5 ha - up to 1 ha | 1 | 2% | 0,70 | 0,01% |
| A3. Greater than 1 ha - up to 2,5 ha | 2 | 5% | 2,95 | 0,02% |
| A4. Greater than 2,5 ha - up to 3 ha | 1 | 2% | 2,93 | 0,02% |
| B1. Greater than 3 ha - up to 5 ha | 1 | 2% | 3,56 | 0,03% |
| B2. Greater than 5 ha - up to 10 ha | 1 | 2% | 9,21 | 0,1% |
| C1. Greater than 10 ha - up to 20 ha | 1 | 2% | 11,94 | 0,1% |
| D1. Greater than 20 ha - up to 50 ha | 5 | 12% | 168,13 | 1% |
| D2. Greater than 50 ha - up to 100 ha | 10 | 24% | 679,18 | 5% |
| D3. Greater than 100 ha - up to 200 ha | 6 | 15% | 870,14 | 6% |
| E1. Greater than 200 ha - up to 500 ha | 4 | 10% | 1.574,73 | 12% |
| E2. Greater than 500 ha - up to 1000 ha E3. | 5 | 12% | 4.271,39 | 32% |
| E3. Greater than 1000 ha - up to 2000 ha E4. | 3 | 7% | 3.760,61 | 28% |
| E4. Greater than 2000 ha - up to 5000 ha | 1 | 2% | 2.118,75 | 16% |
| **Total** | **41** | **100%** | **13.474,21** | **100%** |

Source: UPRA © 2022 based on information IGAC 2019, ANT 2021.

Taking the variable of type of owner, it is found that 88% of the properties for which titling is requested by black communities are of a private nature. Likewise, in terms of area, the largest representation corresponds to the same type of owners, with 76%.

Table 105. Requests for titling to black communities - Type of landowner

| Type of Owner | No. of properties | % properties | Area (ha) | % Area (ha) |
|---|---|---|---|---|
| 1. STATE | 3 | 7% | 2.224,85 | 17% |
| 3. PRIVATES | 36 | 88% | 10.292,05 | 76% |
| 4. OTHERS | 1 | 2% | 930,47 | 7% |
| (Blank) | 1 | 2% | 26,85 | 0% |
| **Total** | **41** | **100%** | **13.474,21** | **100%** |

Source: UPRA © 2022 based on information Agustín Codazzi Geographic Institute (IGAC in Spanish). 2019, National Land Agency (ANT in Spanish) 2021.

## 24.4. Other forms of social property organization

In addition to the management figures described so far, there are other management typologies in the Orinoco region that could have an impact on rural property ownership conditions and carbon emission reduction agreements. Therefore, it is important to review the behavior of farmer reserve zones, zones of interest for rural, economic and social development, and business development zones.

# 25. Farmer Reserve Zones (ZRC in Spanish)

The farmer reserve zones (ZRC) were created through Chapter XIII of Law 160 of 1994 and regulated in Decree 1777 of 1996, subsequently compiled by Decree 1071 of 2015. Specifically, Article 2.14.13.1 of the aforementioned Decree states that the ZRCs "... aim to promote and stabilize the farmer economy, overcome the causes of social conflicts that affect them and, in general, create the conditions for the achievement of peace and social justice in the respective areas...".
As the CRZs are an instrument to promote the rural economy, it is relevant to consider the presence of this figure in the Orinoco region, particularly because the land market operates differently there and there may be areas greater than the UAF. In this sense, when the geographic cross-referencing of the farmer reserve

zones - ZRC legally constituted in the region is carried out, there are 2 properties in the municipality of Puerto Concordia - Meta belonging to the ZRC called "Guaviare". As shown in Figure 95.

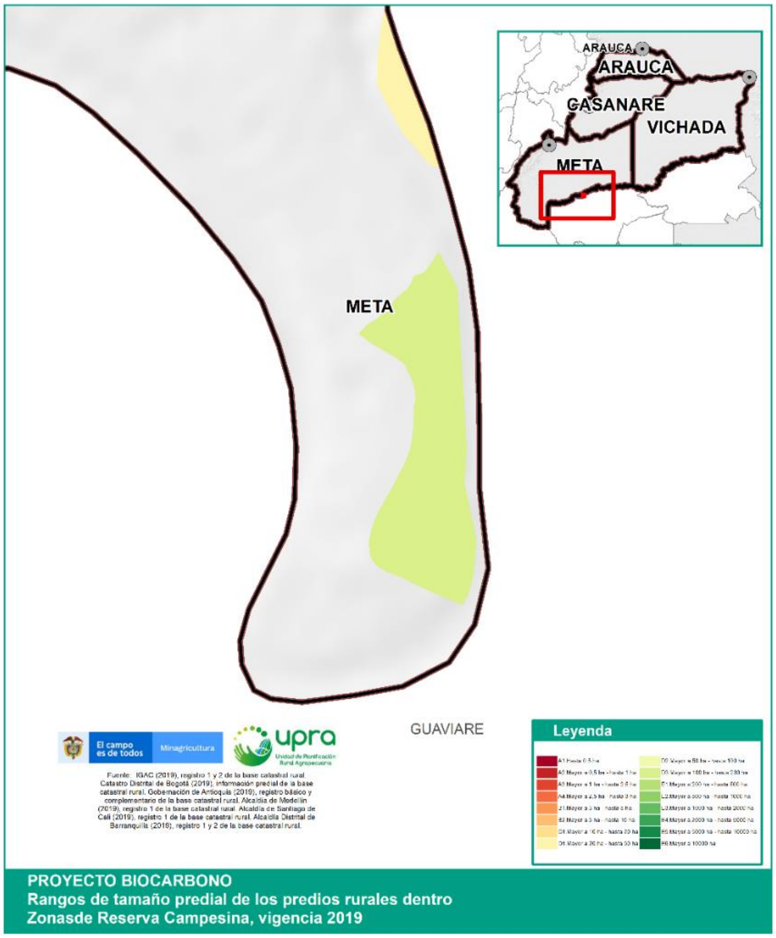



Figure 95. Campesino Reserve Zones (ZRC in Spanish) - Orinoquia
Source: UPRA © 2022 based on information Agustín Codazzi Geographic Institute (IGAC in Spanish). 2019, National Land Agency (ANT in Spanish) 2020.

A complementary analysis, using the cadastral information, shows that the land is owned by the State, with an accumulated area of 163,42 ha and an economic use of the land as agricultural land. [193]

Table 106. Properties in ZRC in the Orinoco Region

| Property area (ha) | Economic destination | Type Owner | Property Size |
|---|---|---|---|

[193] **Land for agricultural and livestock purposes, Article 86 Resolution 70 of 2011**

| | | | |
|---|---|---|---|
| 139,76 | agriculture and livestock | 1. STATE | D3. Greater than 100 ha - up to 200 ha |
| 23,66 | agriculture and livestock | 1. STATE | D1. Greater than 20 ha - up to 50 ha |

Source: UPRA © 2022 based on Agustín Codazzi Geographic Institute (IGAC in Spanish) 2019 information.

In addition to the lands in CRZs constituted, it is worth mentioning that in the region there is an expectation or claim of two (2) areas for the constitution of CRZs by the communities, called Guejar - Cafre (Puerto Rico - Meta) and Losada-Guayabero (La Macarena and Uribe - Meta). Both processes have a Resolution of initiation of processing, which for the first one is 2059 of August 11, 2011 and for the second one is 431 of March 23, 2012. However, to date, the National Land Agency - ANT, through Agreements 187 and 189, dated October 2021 has determined not to constitute them due to non-compliance with the requirements or aspects defined in Article 9 of Agreement 024 of 1996. The information of these two requested areas is described below.

The area requested for the creation of CRZs represents 2.3% of the area of the department of Meta, concentrated mainly in the area known as Losada-Guayabero in the municipalities of La Macarena and Uribe with 2%, which in turn represents 83% of the requested area.

Table 107. ZRC Requested - Orinoco

| Department | Geographic area (ha) Department | Name ZRC in process of constitution | Area (ha) requested process of constitution | % request | % request in relation to Department |
|---|---|---|---|---|---|
| Meta | 8555025 | Losada-Guayabero | 164.105,40 | 83% | 2% |
| | | Guejar – Cafre | 33.603,75 | 17% | 0.4% |
| **Total** | | | **197.709,15** | **100%** | **2.3%** |

Source: UPRA © 2022

The following figure shows the two areas requested for the establishment of the ZRC in the Orinoco region.


**Figure 96. ZRC requested - Orinoco**

Source: UPRA © 2022 based on National Land Agency (ANT in Spanish) 2020 information.

When verifying the property size ranges, 72% of the requested properties are between 5 ha and 100 ha, and 55% of the area comprising the requested properties are between 20 ha and 100 ha, as shown in the following table:

**Table 108. ZRC Requested - Property size**

| Predial Size | No. Properties | % Properties | Area (ha) land | % Area (ha) land |
|---|---|---|---|---|
| A1. Up to 0,5 ha | 59 | 8% | 3,83 | 0,01% |
| A2. Greater than 0,5 ha - up to 1 ha | 11 | 1% | 8,06 | 0,02% |
| A3. More than 1 ha - up to 2,5 ha | 39 | 5% | 67,27 | 0,2% |
| A4. Greater than 2,5 ha - up to 3 ha | 18 | 2% | 48,78 | 0,1% |
| B1.Greater than 3 ha - up to 5 ha | 53 | 7% | 212,63 | 1% |
| B2. Greater than 5 ha - up to 10 ha | 82 | 11% | 603,69 | 2% |
| C1.Greater than 10 ha - up to 20 ha | 105 | 14% | 1.530,02 | 4% |

| | | | | |
|---|---|---|---|---|
| D1.Greater than 20 ha - up to 50 ha | 175 | 23% | 5.826,66 | 17% |
| D2. Greater than 50 ha - up to 100 ha | 183 | 24% | 13.215,74 | 38% |
| D3.Greater than 100 ha - up to 200 ha | 24 | 3% | 2.915,16 | 8% |
| E1.Greater than 200 ha - up to 500 ha | 7 | 1% | 2.117,30 | 6% |
| E2. Greater than 500 ha - up to 1000 ha | 1 | 0,1% | 529,05 | 2% |
| E4. Greater than 2000 ha - up to 5000 ha | 2 | 0,3% | 7.461,27 | 22% |
| **Total** | **759** | **100%** | **34.539,45** | **100%** |

Source: UPRA © 2022 based on Agustín Codazzi Geographic Institute (IGAC in Spanish) 2019 information.

Considering the properties size in terms of UAF (in Spanish) per relatively homogeneous zone, the largest number of properties (48%) are within the established range of UAF, as shown in the following table.

**Table 109. ZRC – UAF**

| Classification UAF | No. Properties | % properties | Area (ha) | % Area (ha) |
|---|---|---|---|---|
| Within UAF | 174 | 23% | 16.535,78 | 48% |
| Greater than UAF | 2 | 0,3% | 7.461,27 | 22% |
| Less than UAF | 583 | 77% | 10.542,41 | 31% |
| **Total** | **759** | **100%** | **34.539,45** | **100%** |

**Source: UPRA © 2022 based on Agustín Codazzi Geographic Institute (IGAC in Spanish). 2019 information**

Finally, considering the type of owner variable, it can be seen from the cadastral information that 63% of the properties are private and the rest are State properties, as shown in the following table.

**Table 110. ZRC – Owner type**

| Owner Type | No. Properties | % properties | Area (ha) | % Area (ha) |
|---|---|---|---|---|
| 1. State properties | 161 | 21% | 12.669,96 | 37% |
| 3. Private properties | 598 | 79% | 21.869,49 | 63% |
| **Total** | **759** | **100%** | **34.539,45** | **100%** |

**Source: UPRA © 2022 based on IGAC 2019 information**

## 26. Zones of interest for rural, economic and social development (ZIDRES in Spanish)

Zones of interest for rural, economic and social development (ZIDRES in Spanish) were created by Law 1776 of 2016, these zones are defined as territories with agricultural, livestock, forestry and fish farming aptitude, where productive dynamics are promoted for their inclusion in the regional, national and international economy under conditions of competitiveness, equity, social development and environmental sustainability, which will be established from comprehensive rural development plans (PDRI in Spanish) in a framework of formal economy and land use planning, they must comply with the following requirements[194]:

- The zone is isolated from the most significant urban centers.
- Demand high costs of productive adaptation due to their agrological and climatic characteristics.
- Have low population density.
- Have high poverty rates or lack minimum infrastructure for transportation and product commercialization.

It also establishes restrictions on the ZIDRES creation[195]:

- Territories declared indigenous reserves
- Duly established farmer reserve zones.
- Collective territories titled or in the process of being titled by black communities.
- Territories that include areas declared and delimited as strategic ecosystems, natural parks, paramos and wetlands.

This Law was regulated by Decree 1273 of 2016 and has the exequibility concept through the Constitutional Court's ruling C-077 of 2017, which indicated that the constitution process must be preceded by a process of information, consultation and coordination with the municipal councils of the territorial entities in accordance with the plans, basic plans and land management schemes, it also establishes, under a systemic interpretation and in accordance with the protection of ethnic communities, that the prohibition of Article 29 of Law 1776 of 2016 is equally applicable to constituted territories and territories in the constitution process, both of Afro-descendant communities and indigenous peoples.
According to the Law, UPRA is in charge of identifying the zones, for which it made the indicative estimate of reference areas at the National level technically taking into account the criteria and restrictions of Law[196], these reference areas are the

[194] **Article 1 Law 1776 of 2016**
[195] **Articles 29 and 30 Law 1776 of 2016, Article 2.18.2.3. Decree 1273 of 2016.**
[196] **Additional considerations related to agricultural, livestock, forestry and fish farming suitability were taken into account in the methodological development.**

input to start the ZIDRES identification phase and are found in CONPES 3917 of 2018. The legal framework establishes the process for identifying, delimiting, and approving the ZIDRES, as shown in the following figure:

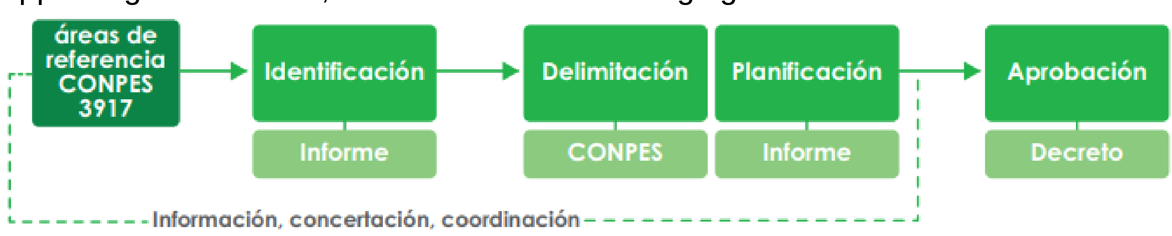



**Figure 97. Zidres constitution process – Orinoquia**
**Source: UPRA © 2018 Technical Report Identification of potential areas ZIDRES Puerto Lopez**

As a result, the ZIDRES reference areas are obtained, which according to their characteristics are mostly concentrated in the Orinoco Region with 76,3% of the reference areas at the national level, as shown in the following table.

**Table 111. Reference areas ZIDRES - Orinoquia**

| National Position | Department | Area (ha) | % Area (ha) according to National |
|---|---|---|---|
| 1 | Vichada | 2.483.806 | 34,1% |
| 2 | Meta | 2.391.192 | 32,9% |
| 5 | Casanare | 404.475 | 5,6% |
| 6 | Arauca | 268.545 | 3,7% |
| **Total** | | **5.548.018** | **76,3%** |

**Fuente: UPRA © 2018, CONPES 3917 of 2018.**

Figure 98 shows the geographic distribution of the reference areas in the Orinoquia region.

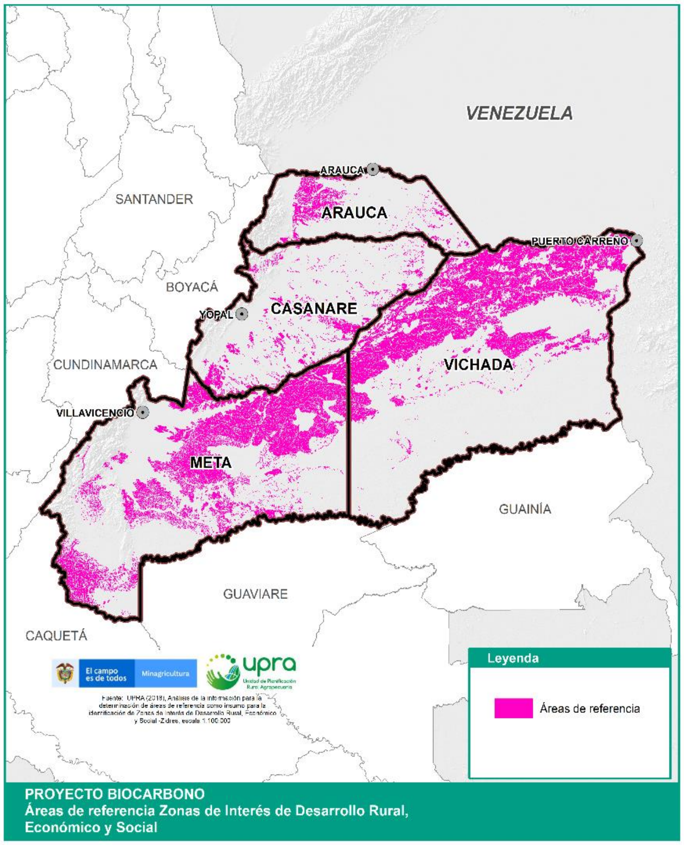



**Figure 98. Reference areas ZIDRES – Orinoquia**
**Source: UPRA © 2022**

The geographic cross-referencing with property information shows that the Meta department has 54% of the properties in ZIDRES reference areas with 11.200 properties, which cover 42% of the area, while the Vichada department has the largest area, with 51%, distributed in 3.184 properties representing 15% of the total. The department with the lowest participation in reference areas is Arauca with 2% of the area, which corresponds to 16% of the properties with 3.248 (Table 112).

**Table 112. ZIDRES property distribution - Reference areas in the Orinoco region.**

| Department | Properties | % Properties | Area Properties (ha) | % Area (ha) |
|---|---|---|---|---|
| Arauca | 3.248 | 16% | 126.711,51 | 2% |
| Casanare | 3.008 | 15% | 259.019,10 | 5% |
| Meta | 11.280 | 54% | 2.285.815,89 | 42% |
| Vichada | 3.184 | 15% | 2.817.088,65 | 51% |
| **Total** | **20.720** | **100%** | **5.488.635,14** | **100%** |

**Source: UPRA © 2022**

At the departmental level, the Arauca department has ZIDRES areas in all municipalities[197], where 69% of the department's reference area is concentrated in the municipality of Arauquita, which accounts for 76% of the properties. In the department of Casanare, the reference areas are distributed in 17 of the 19 municipalities, with San Luis de Palenque being the municipality with the largest area, representing 24% of the department's reference area, distributed in 14% of the properties.

For Meta department, the ZIDRES reference areas are distributed in 20 of the 29 municipalities[198], with Puerto Lopez being the municipality with the largest area, with a 20% share of the department's reference area, which is found in 10% of the properties.

In the department of Vichada, the reference areas are distributed in all municipalities, with La Primavera being the one with the largest area, equivalent to 51% of the department's reference area, distributed among 42% of the properties. This information is detailed in the following table:

**Table 113. Properties distribution at the departmental level - Reference areas in the Orinoco region**

| Department | Municipality | Properties | % Properties | Area Properties (ha) | % Area (ha) |
|---|---|---|---|---|---|
| **Arauca** | Arauca | 32 | 1% | 993,7 | 1% |
| | Arauquita | 2467 | 76% | 87.229,9 | 69% |
| | Cravo norte | 31 | 1% | 13.933,9 | 11% |
| | Fortul | 691 | 21% | 24.307,5 | 19% |
| | Puerto Rondón | 22 | 1% | 95,6 | 0,1% |
| | Saravena | 5 | 0,2% | 151,0 | 0,1% |
| **Subtotal Arauca** | | **3.248** | **100%** | **126711,51** | **100%** |
| **Casanare** | Aguazul | 97 | 3% | 5.571,2 | 2% |
| | Hato Corozal | 179 | 6% | 14.697,0 | 6% |
| | La Salina | 53 | 2% | 1.019,9 | 0,4% |
| | Maní | 227 | 8% | 12.802,3 | 5% |
| | Monterrey | 128 | 4% | 5.690,2 | 2% |
| | Nunchía | 34 | 1% | 8.011,5 | 3% |
| | Orocué | 130 | 4% | 23.565,4 | 9% |
| | Paz de Ariporo | 144 | 5% | 13.260,3 | 5% |
| | Pore | 9 | 0,3% | 369,9 | 0,1% |
| | Sácama | 35 | 1% | 370,9 | 0,1% |
| | Sabanalarga | 4 | 0% | 281,8 | 0,1% |

[197] There is no geographic information available for the Tame municipality.
[198] There is no geographic information available for the Macarena and Uribe municipalities.

| Department | Municipality | Properties | % Properties | Area Properties (ha) | % Area (ha) |
|---|---|---|---|---|---|
| | San luis de Palenque | 434 | 14% | 62.973,5 | 24% |
| | Támara | 305 | 10% | 7.179,6 | 3% |
| | Tauramena | 410 | 14% | 47.262,1 | 18% |
| | Trinidad | 288 | 10% | 17.160,5 | 7% |
| | Villanueva | 419 | 14% | 30.758,6 | 12% |
| | Yopal | 112 | 4% | 8.044,5 | 3% |
| **Subtotal Casanare** | | **3.008** | **100%** | **259.019,10** | **100%** |
| **Meta** | Acacías | 36 | 0,3% | 2.157,9 | 0.1% |
| | Barranca de Upía | 84 | 1% | 15.693,4 | 1% |
| | Cabuyaro | 783 | 7% | 72.036,4 | 3% |
| | Cumaral | 258 | 2% | 18.830,1 | 1% |
| | El Castillo | 548 | 5% | 12.861,4 | 1% |
| | El Dorado | 1 | 0,01% | 30,4 | 0,001 % |
| | Fuente de Oro | 75 | 1% | 3.476,0 | 0,2% |
| | Lejanías | 305 | 3% | 4.333,7 | 0,2% |
| | Mapiripán | 349 | 3% | 112.130,9 | 5% |
| | Mesetas | 765 | 7% | 22.098,8 | 1% |
| | Puerto Concordia | 393 | 3% | 29.477,8 | 1% |
| | Puerto Gaitán | 1528 | 14% | 938.130,0 | 41% |
| | Puerto López | 1089 | 10% | 458.022,9 | 20% |
| | Puerto Lleras | 1104 | 10% | 97.168,2 | 4% |
| | Puerto Rico | 1049 | 9% | 55.892,2 | 2% |
| | Restrepo | 22 | 0,2% | 1.566,5 | 0,1% |
| | San Carlos de Guaroa | 319 | 3% | 33.113,3 | 1% |
| | San Juan de Arama | 281 | 2% | 27.827,6 | 1% |
| | San Martin | 320 | 3% | 294.059,9 | 13% |
| | Vistahermosa | 1971 | 17% | 86.908,5 | 4% |
| **Subtotal Meta** | | **11.280** | **100%** | **2.285.815,89** | **100%** |
| **Vichada** | Cumaribo | 436 | 14% | 580.817,2 | 21% |
| | La Primavera | 1330 | 42% | 1.427.568,3 | 51% |
| | Puerto Carreño | 1216 | 38% | 718.730,3 | 26% |
| | Santa Rosalía | 202 | 6% | 89.972,9 | 3% |
| **Subtotal Vichada** | | **3.184** | **100%** | **2.817.088,65** | **100%** |

**Source: UPRA © 2022**

Considering the ZIDRES constitution process, up to now, this has only taken place for the municipality of Puerto López, not only at the departmental or regional level, but also at the national level, since this process was prioritized by the National Government to constitute the first ZIDRES in the country.

On the other hand, taking as a reference the basic input for the process of identifying potential areas, based on the Reference Areas of CONPES 3917 of 2018, the following variables are identified:

- Areas within the agricultural frontier
- Identification of the determinants of the territorial management plan (POT in Spanish) or local restrictions.
- Properties requested for expansion of indigenous reservation.
- Properties registered in other municipalities.
- High flood threat areas (risk management study).
- Presence Certification of ethnic communities.
- Other information that supports the identification process.

Once the exercise of excluding the areas corresponding to the above variables is completed, the potential areas for declaring ZIDRES are obtained, on which the partially or totally contained properties are identified by means of geographic cross-referencing with the cadastral base, as shown in the figure:

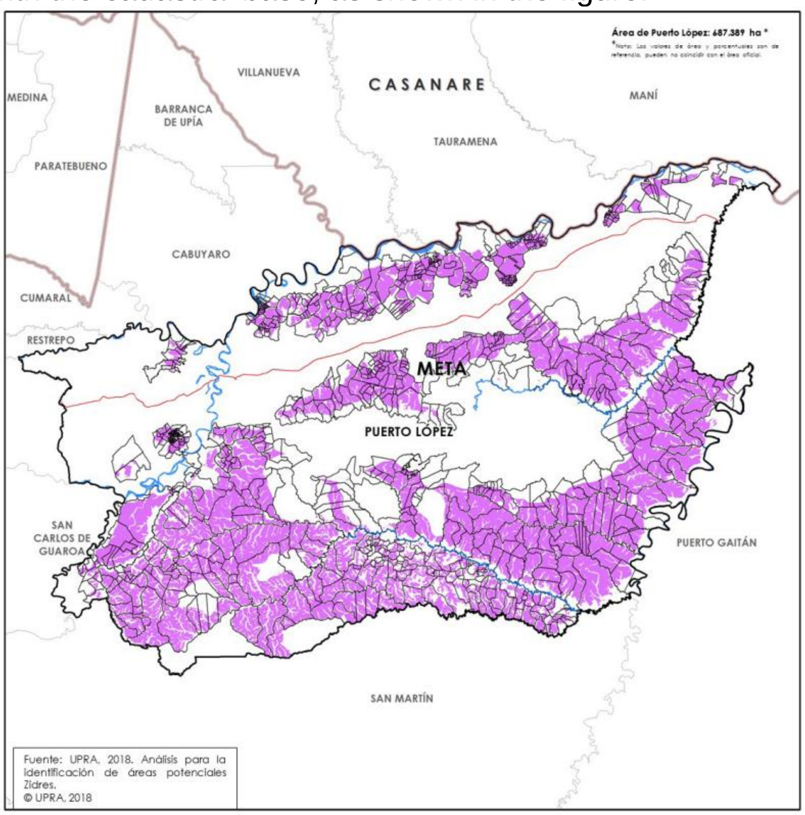



Figure 99. Potential areas to declare ZIDRES - Puerto López
**Source: UPRA © 2022**

Based on this property inventory, a one-by-one review of the properties in their cadastral and legal status is carried out to determine whether they present imperfect situations in their ownership, so a group of 860 properties was obtained that are classified as "Sanitized", which are subject to public annotation in the registry of public instruments. This process is included in the CONPES 3940 of 2018 and is an integral part of the Comprehensive Rural Development Plan (PDRI in Spanish) and the Productive and Social Planning Plan for Rural Property (OSPPR in Spanish).

## 27. Enterprise Development Zones (ZDE in Spanish)

Enterprise Development Zones (ZDE) were created in Law 160 of 1994. Subsequently, Agreement 028 of 1995 defines them as *"areas where there are established, or may be established, properties in optimal conditions and efficient economic exploitation, adequate use of natural resources and environmental sustainability, which generate employment in the municipality and whose fragmentation implies deterioration in the current or potential production volumes, employment units and income generation, will be adopted as business development zones, in order to protect and promote private capital investment, in accordance with the provisions of Articles 82 and 83 of Law 160 of 1994*."[199]
UPRA developed a technical exercise in which it presented the guidelines and components of the macro and micro delimitation of the ZDEs, such as legal restrictions, property characterization, physical, productive, and environmental characterization.
Thus, in the Macro delimitation, an indicative calculation of the reference areas was developed as an input for the delimitation activities of the ZDE, based on the analysis and consideration of variables and criteria to define the excluded and conditioned areas for the ZDEs constitution. Among the legal restrictions and conditions are the following:

- Ethnic community territories declared and reserved.
- Farmer Reserve Zones (ZRC in Spanish).
- Areas of declared and delimited environmental categories.
- Mining and energy activities.
- Infrastructure areas.
- Non-mitigable threat or high risk areas.
- Territories with protection measures.
- Areas of cultural importance.
- Agricultural frontier.

As a result of the exercise, the reference areas classified as Suitable, Conditioned and Restricted for ZDEs were obtained. Based on this classification, the

[199] **Title 18, Agreement 028 of 1995**

departments of the Orinoco region have a significant proportion of their area with potential for the implementation of ZDEs.
According to the results in Figure 100, the department with the highest proportion of area suitable for ZDE is Casanare with 53,5% of its registered area; on the other hand, the department with the lowest proportional area is Vichada, with 24,6%, although it is a value close to that of Meta, whose suitable area represents 26,1%. In the conditioned classification, Casanare again has the highest proportion of available area, with 13,1% of its total area, while in Vichada and Arauca this proportion is only 1,3% and 2,2%, respectively. For the restricted segment, Vichada has an available area of 74,1% and Meta 67,8%. On the other hand, Casanare has 33,3% of its available area for restricted ZDE use. Finally, in the combination of suitable and conditioned area for ZDE delimitation, Casanare has the largest share with 66,7% of its territory, followed by the department of Arauca with 41,3%, Meta, with 32,2%, and Vichada, with 25,9%.

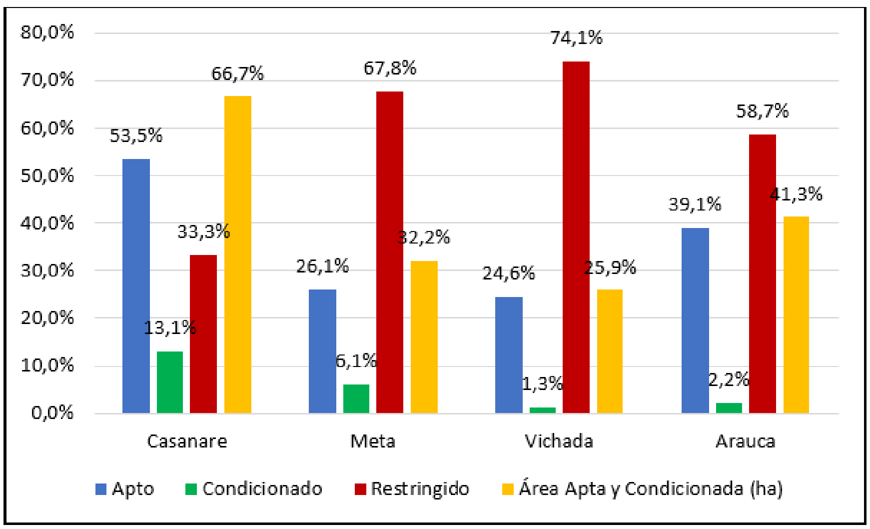



**Figure 100. ZDE reference areas as a proportion of the departmental area - Orinoquia**
**Source: UPRA © 2022**

A graphic representation of the geographic distribution is shown in the following figure:

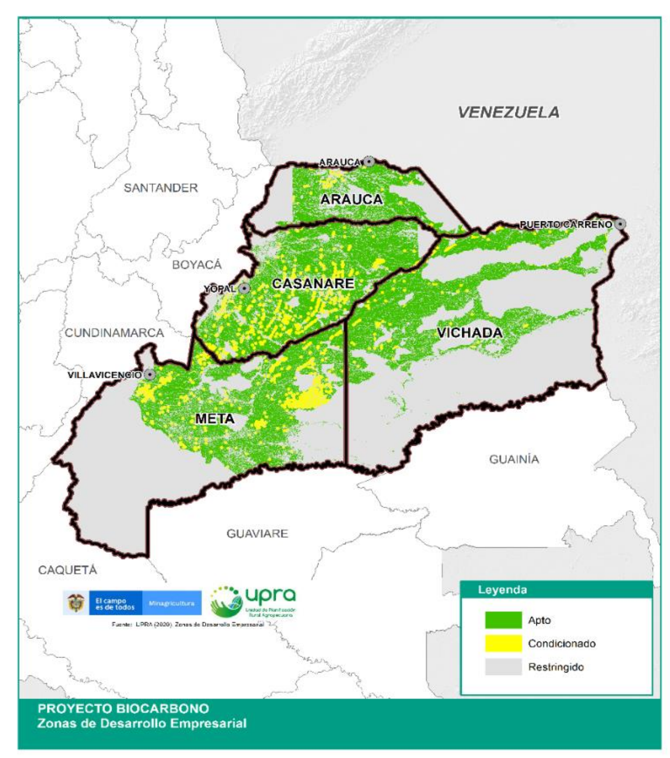



**Figure 101. ZDE – Orinoquia**
**Source: UPRA © 2022**

At the municipal level, among the 20 municipalities with the highest incidence in the geographic areas of reference for the ZDE delimitation at the national level, 19 are located in the Orinoquia region, with the municipality of Puerto Gaitán - Meta in first place and the municipality of Tauramena - Casanare in 20th place.
The cross-referencing with the geographic property layer yields 75.970 properties in the suitable and conditioned reference areas, in which Meta has the largest number of properties in reference areas with 51% of the total number of properties, although the Casanare department has the largest amount of property area, equivalent to 32% of the total, as shown in the table:

**Table 114. ZDE reference areas at property level - Orinoquia**

| ZDE | Suitable | | | | Conditioned | | | | Suitable and conditioned area (ha) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Departments** | **Properties** | **%** | **Area (ha)** | **%** | **Properties** | **%** | **Area (ha)** | **%** | **Properties** | **%** | **Area (ha)** | **%** |
| Arauca | 5.819 | 9% | 827.428 | 9% | 882 | 6% | 38.420 | 3% | 6.701 | 9% | 865.848 | 8% |
| Casanare | 22.481 | 36% | 2.713.686 | 30% | 5.080 | 37% | 574.580 | 45% | 27.561 | 36% | 3.288.266 | 32% |
| Meta | 30.920 | 50% | 2.709.374 | 30% | 7.496 | 55% | 548.547 | 43% | 38.416 | 51% | 3.257.921 | 31% |
| Vichada | 3.144 | 5% | 2.869.903 | 31% | 148 | 1% | 116.400 | 9% | 3.292 | 4% | 2.986.304 | 29% |
| **Total** | **62.364** | **100%** | **9.120.391** | **100%** | **13.606** | **100%** | **1.277.947** | **100%** | **75.970** | **100%** | **10.398.339** | **100%** |

**Source: UPRA © 2022**

Considering the size ranges established in the UPRA methodology, in the suitable and conditioned areas, the largest amount of area is concentrated in the range greater than 1000 ha to 2000 ha, where the main contributor is the Vichada department, followed by Meta. In addition, in terms of the number of properties, the largest amount is found in the range up to 0.5 ha, where the department of Meta is the main contributor, followed by Casanare. In the Arauca and Casanare departments, the ZDE reference areas are concentrated in properties larger than 500 ha and up to 1000 ha.

**Table 115. Size ranges reference areas ZDE - Orinoquia**

| Tamaño Predial | ARAUCA | | CASANARE | | META | | VICHADA | | Total Apto y Condicionado | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Predios | Área (ha) | Predios | Área (ha) | Predios | Área (ha) | Predios | Área (ha) | Predios | Área (ha) |
| A1.Hasta 0,5 ha | 95 | 21 | 8832 | 570 | 18768 | 2072 | 326 | 23 | 28021 | 2686 |
| A2.Mayor a 0,5 ha - hasta 1 ha | 62 | 48 | 702 | 523 | 1823 | 1349 | 18 | 13 | 2605 | 1933 |
| A3.Mayor a 1 ha - hasta 2,5 ha | 159 | 274 | 1396 | 2358 | 2828 | 4633 | 36 | 62 | 4419 | 7327 |
| A4.Mayor a 2,5 ha - hasta 3 ha | 38 | 105 | 334 | 917 | 557 | 1531 | 5 | 14 | 934 | 2566 |
| B1.Mayor a 3 ha - hasta 5 ha | 206 | 845 | 1201 | 4753 | 1829 | 7199 | 25 | 98 | 3261 | 12895 |
| B2.Mayor a 5 ha - hasta 10 ha | 570 | 4314 | 2056 | 14929 | 2194 | 15692 | 45 | 311 | 4865 | 35247 |
| C1.Mayor a 10 ha - hasta 20 ha | 1032 | 15380 | 2454 | 35726 | 2129 | 30335 | 43 | 620 | 5658 | 82062 |
| D1.Mayor a 20 ha - hasta 50 ha | 2191 | 72399 | 3474 | 113953 | 2581 | 84927 | 80 | 2551 | 8326 | 273829 |
| D2.Mayor a 50 ha - hasta 100 ha | 1022 | 70610 | 2317 | 163225 | 1600 | 114346 | 86 | 6396 | 5025 | 354577 |
| D3.Mayor a 100 ha - hasta 200 ha | 436 | 59807 | 1591 | 225648 | 1186 | 167457 | 200 | 29791 | 3413 | 482704 |
| E1.Mayor a 200 ha - hasta 500 ha | 422 | 135693 | 1577 | 509314 | 1143 | 361701 | 622 | 205046 | 3764 | 1211755 |
| E2.Mayor a 500 ha - hasta 1000 ha | 315 | 224086 | 1111 | 815429 | 904 | 672713 | 579 | 442196 | 2909 | 2154424 |
| E3.Mayor a 1000 ha - hasta 2000 ha | 127 | 160537 | 353 | 468233 | 646 | 877704 | 906 | 1209102 | 2032 | 2715576 |
| E4.Mayor a 2000 ha - hasta 5000 ha | 20 | 60265 | 115 | 349239 | 180 | 527645 | 284 | 804534 | 599 | 1741683 |
| E5.Mayor a 5000 ha - hasta 10000 ha | 5 | 31318 | 34 | 227456 | 40 | 258570 | 28 | 177466 | 107 | 694810 |
| E6.Mayor a 10000 ha | 1 | 30146 | 14 | 355992 | 8 | 130046 | 9 | 108080 | 32 | 624264 |
| **Total** | **6701** | **865848** | **27561** | **3288266** | **38416** | **3257921** | **3292** | **2986304** | **75970** | **10398339** |

Source: UPRA © 2022

According to the potential ZDEs by type of owner listed in the cadastral database, it can be seen that private properties predominate, being 91% of the properties, which account for 82% of the total property area. In this data, the department that contributes the most private properties is Meta, with 47% of the properties, corresponding to 30% of the property area (Table 116).

Table 116. Type of owner reference areas ZDE - Orinoquia

| Department | Owner Type | Properties | % Properties | Area (ha) | % Area (ha) |
|---|---|---|---|---|---|
| **Arauca** | 1. Public | 327 | 0% | 30.033 | 0% |
| | 3. Private | 6.297 | 8% | 824.702 | 8% |
| | 4. Others | 3 | 0% | 54 | 0% |
| | No information | 74 | 0% | 11.060 | 0% |
| **Casanare** | 1. Public | 1.634 | 2% | 324.452 | 3% |

| | | | | | |
|---|---|---|---|---|---|
| | 2. Collectives | 2 | 0% | 216 | 0% |
| | 3. Private | 25.579 | 34% | 2.914.869 | 28% |
| | 4. Others | 18 | 0% | 2.216 | 0% |
| | No Information | 328 | 0% | 46.513 | 0% |
| **Meta** | 1. Public | 2.755 | 4% | 94.541 | 1% |
| | 2. Collectives | 1 | 0% | 452 | 0% |
| | 3. Private | 35.413 | 47% | 3.156.543 | 30% |
| | 4. Others | 20 | 0% | 824 | 0% |
| | No Information | 227 | 0% | 5.562 | 0% |
| **Vichada** | 1. Public | 1.502 | 2% | 1.282.891 | 12% |
| | 2. Collectives | 4 | 0% | 20.484 | 0% |
| | 3. Private | 1.776 | 2% | 1.675.064 | 16% |
| | 4. Others | 1 | 0% | 2 | 0% |
| | No Information | 9 | 0% | 7.863 | 0% |
| **Total** | | **75.970** | **100%** | **10.398.339** | **100%** |

Source: UPRA © 2022

Taking into account the normative provisions, where it is indicated that the ZDEs must be constituted on vacant properties, and based on the exercise of the reference geographic areas the geographic crossing with the exercise of presumed vacant properties carried out by UPRA, described above, the areas that can potentially be used for the delimitation and constitution of the ZDEs are identified, with the provison that this is indicative data, since the full identification is accomplished in the stages of the process by the National Land Agency. As a result of the above, 11.747 presumably vacant properties were obtained in the suitable and conditioned areas, where the department with the largest area of presumed vacant properties is Vichada with 43% of the accumulated area of the 4 departments, while in terms of the number of properties, the largest proportion is in the department of Casanare with 57% of the properties, as shown in **Error! Not a valid bookmark self-reference.**.

Table 117. Departments with the greatest participation in area (vacant properties) in the macro delimitation - Orinoquia

| National Position | Department | Suitable | | Conditioned | | Restricted | | Suitable and Conditioned Area (ha) | |
|---|---|---|---|---|---|---|---|---|---|
| | | Presumed vacant properties | Area (ha) | Presumed vacant properties | Area (ha) | Presumed vacant properties | Area (ha) | Presumed vacant properties | Área (ha) |
| 1 | Vichada | 1.526 | 1.354.356 | 62 | 43.681 | 1.421 | 2.718.526 | 1.588 | 1.398.037 |
| 2 | Casanare | 5.195 | 1.118.051 | 1.449 | 165.248 | 7.815 | 378.169 | 6.644 | 1.283.299 |
| 3 | Meta | 1.837 | 387.360 | 563 | 71.521 | 14.513 | 1.869.510 | 2.400 | 458.881 |
| 9 | Arauca | 943 | 133.415 | 172 | 4.634 | 1.098 | 226.159 | 1.115 | 138.049 |
| **Total** | | **9.501** | **2.993.182** | **2.246** | **285.084** | **24.847** | **5.192.364** | **11.747** | **3.278.266** |

Source: UPRA © 2022

In the development of this chapter, the different land use planning figures that are present in the Orinoco region have been addressed, finding that it is a diverse territory with a wide variety of these figures, which involve interaction with different actors. Under this scenario, for the implementation of the ERPD it is necessary to link the agents and lands covered by these figures, taking into account the limitations and potential to promote forestry production systems or sustainable agriculture, the latter in the uses that allow it.

However, to ensure the applicability of the BioCarbon ERP, the need for regularization must be considered, evidenced by the degree of informality that characterizes the region, in addition to limiting the signing of agreements, generating conflicts associated with land use between agents, such as overlapping land between owners, collective territories or even with the State. Precisely to fully understand the influence that informality may have in the Orinoco region, the following chapter deals with this topic, together with other important rural land tenure issues.

# 28. IMPORTANT ASPECTS OF RURAL LAND TENURE

## 28.1. Presumption of rural land informality

In the analysis of land tenure, informality is a common problem that affects the legal security of the property, this represents a condition in which there is no valid title that supports the full rights over it and, consequently, the disposition of the property is limited to those who inhabit it.

The Rural Agricultural Planning Unit (UPRA in Spanish), within the framework of its mission, developed an information analysis exercise that allows an approximation of the estimation, identification and location of properties with possible existence of informality in land tenure. The Rural Agricultural Planning Unit - UPRA, within the framework of its mission, developed an information analysis exercise that allows an approximation of the estimation, identification and location of properties with possible existence of informality in land tenure. Due to its development at the property level, this is an exercise that allows obtaining aggregated or disaggregated information, i.e., it is possible to obtain the informality index value at the national, regional, departmental, municipal and property level.

First of all, it is important to remember that the calculation is based mainly on cadastral information, whose main restriction is that it is outdated. Despite this limitation, the informality indicator is a strong estimator if the criteria established for its calculation are taken into account, among which, in addition to the cadastral information, is the use of information from the Registry of Public Instruments -Land

Restitution Unit and the National Land Agency. The latter, in relation to the progress of the property regularization process, providing greater reliability to the data.

According to the UPRA methodology, the criteria to establish informality in a property are as follows:

- Properties not interrelated in the Cadastre-Registry Interrelation Project (ICARE in Spanish). This is a fixed and constant criterion considering that the project has not been updated since 2014. Although it is not updated, it is a criterion that is maintained because, since there is no correspondence in the databases of the entities responsible for the property information management (Property - Folio), it has a high possibility of being informal, due to the fact that the information of real estate registration number, property number, address, owner name and identification document is compared.
- Properties with no real estate registration in the cadastral database. When the cadastral census was carried out by any of the cadastral processes, no information was found or provided on the legal component of the property and, therefore, it is presumed that it has no registry record.
- Properties identified with improvements on another's property within the cadastral base. The cadastral improvement refers to a construction on someone else's property, clearly typifying a condition of informality.
- Properties with false tradition registered in the real estate registration folio (FMI in Spanish). Although there is a real estate registration, the false tradition indicates that there is no full right over the property. The acts that refer to false tradition are identified by legal code 0600. To date they are from 0601 to 0622 [200].
- Properties with annotations in the real estate registration folio (FMI in Spanish) that presume a situation of informality. 20 acts were identified that are presumed to be informal, including tradition, precautionary actions and others.
- Properties that are part of the inventory of vacant properties.

Subsequently, the group of properties identified with at least one of the criteria is checked to see if they are included in the progress inventories of the Regularization processes by the State through the different existing land access processes, such as:

- Adjudication of vacant properties.
- Conformation and adjudication of Black Communities Collective Territories (TCCN in Spanish) and Indigenous Reservations (RI in Spanish).

[200] **Resolution 6264 of 2016 and SNR Resolution 11885 of 2016.**

- Formalization of private property.
- Formalization of general ANT processes other than private.
- Adjudication of properties of the Land Fund (Integration with properties of the former National Agrarian Fund).
- Restituted properties - Land restitution sentences.

If a property is identified with at least one of the informality criteria, but at the same time is in one of the Regularization processes, it is considered a formal property and is excluded from the presumption of informality marking.
Following the scheme formulated by the (UPRA, 2019) in the document " Informalidad de la tenencia de la tierra en Colombia 2019 in Spanish"[201],. , an exercise for the Orinoco region shows an informality index of 45,9%, i.e., about 46% of the properties are in a condition of presumed informality, which indicates that they have at least one of the criteria established for their identification. At the departmental level, Vichada is the one with the highest presumption of informality, being in the range of 50% to 75%, while the remaining three (3) departments are in the range of 25% to 50%, as can be seen in the following figure:

[201] **https://www.upra.gov.co/documents/10184/159215/001_informalidad_tenencias_tierras**

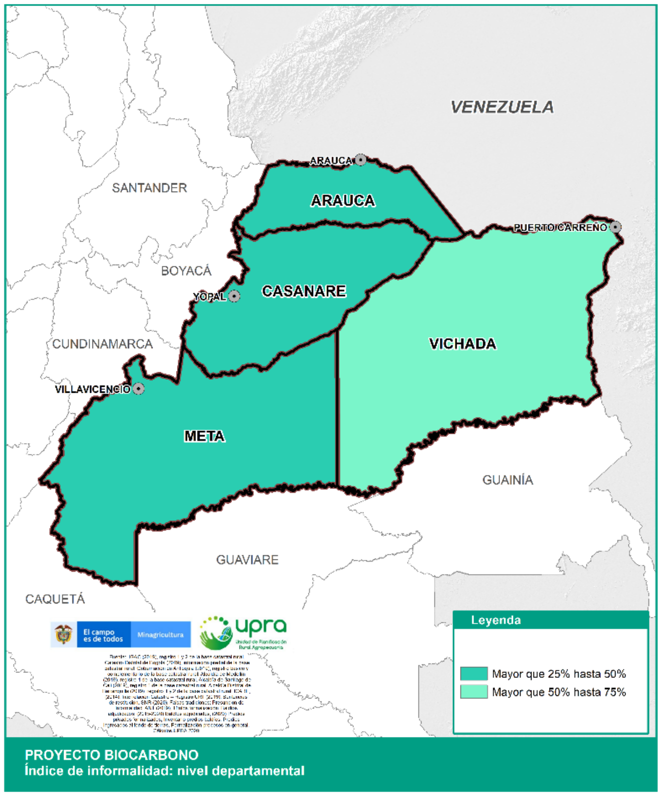



Figure 102. Informality index - Orinoquia Departmental level
Source: UPRA © 2019

As indicated above, Vichada is the one with the highest informality index with 66,84% of the properties in this condition, which occupy about 3 million hectares, followed by the departments of Casanare, Meta and Arauca with 46,03%, 45,10% and 43,27% of informality, respectively.

Considering the number of presumably informal properties in the region (110.518 properties), the department of Meta contributes 56% of them, totaling an area of 3.020.449 ha, while Vichada is the department with the smallest number of properties, with 5% of the total, but which corresponds to large extensions, since area total is 3.006.974 ha, as shown in the following table:

Table 118. Informality characterization in the departments of the Orinoco region.

| Department | Total properties | Properties area (ha) | Informal Properties | Informal Properties area (ha) | informality index | Participation in the Region |
|---|---|---|---|---|---|---|
| Arauca | 25.277 | 2.479.777 | 10.938 | 1.094.830 | **43,27%** | 10% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Casanare | 71.160 | 4.310.652 | 32.758 | 2.326.185 | **46,03%** | 30% |
| Meta | 136.407 | 6.536.487 | 61.522 | 3.020.449 | **45,10%** | 56% |
| Vichada | 7.929 | 8.538.906 | 5.300 | 3.006.974 | **66,84%** | 5% |
| **Total** | **240.773** | **21.865.822** | **110.518** | **9.448.437** | **45,90%** | **100%** |

Source: UPRA © 2019 based on information IGAC 2019

The calculation of the informality index allows us to know this data at the municipal level, where it is found that the 59 municipalities of the region can be classified in 4 informality ranges, as follows:

- Between 0% to 25%: It is considered the most presumably Formal, in this range are two (2) municipalities of the department of Meta (Cumaral and San Carlos de Guaroa).
- Greater than 25% to 50%: In this range there are a total of 23 municipalities, 5 in the department of Arauca, including the municipality of Tame, 5 in the department of Casanare and 13 municipalities in the department of Meta.
- Greater than 50% to 75%: In this range there are a total of 24 municipalities, 2 in the department of Arauca, 12 in the department of Casanare and 8 in the department of Meta, including the municipality of La Macarena, according to the property information available for it, and 2 municipalities in the department of Vichada.
- Greater than 75% to 100%: A total of 10 municipalities are in this range, 2 in the department of Casanare, 6 in the department of Meta and 2 municipalities in the department of Vichada.

Figure 103 shows the municipalities' geographic distribution according to the rank corresponding to the informality index calculated for each one:

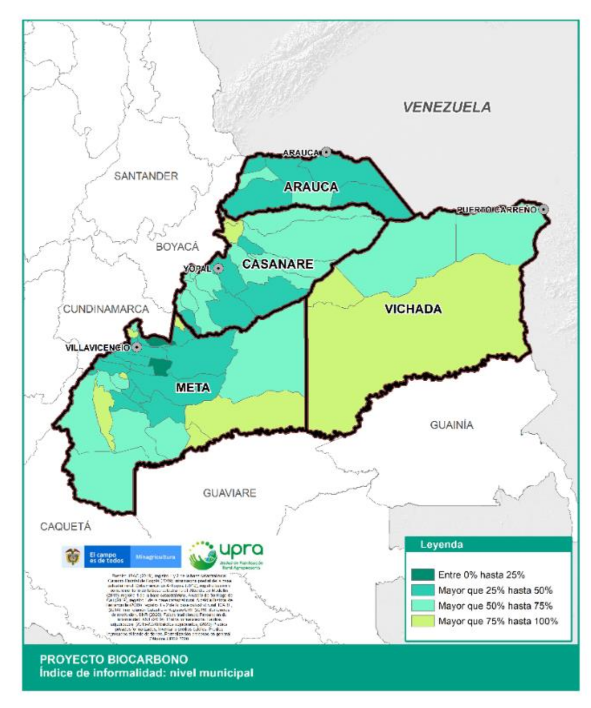



Figure 103. Informality index - Orinoquia municipal level
Source: UPRA © 2019

Likewise, as mentioned above, the exercise is at the property level, achieving the location or geographic localization of the properties that are presumed to be informal, as shown in the following figure:

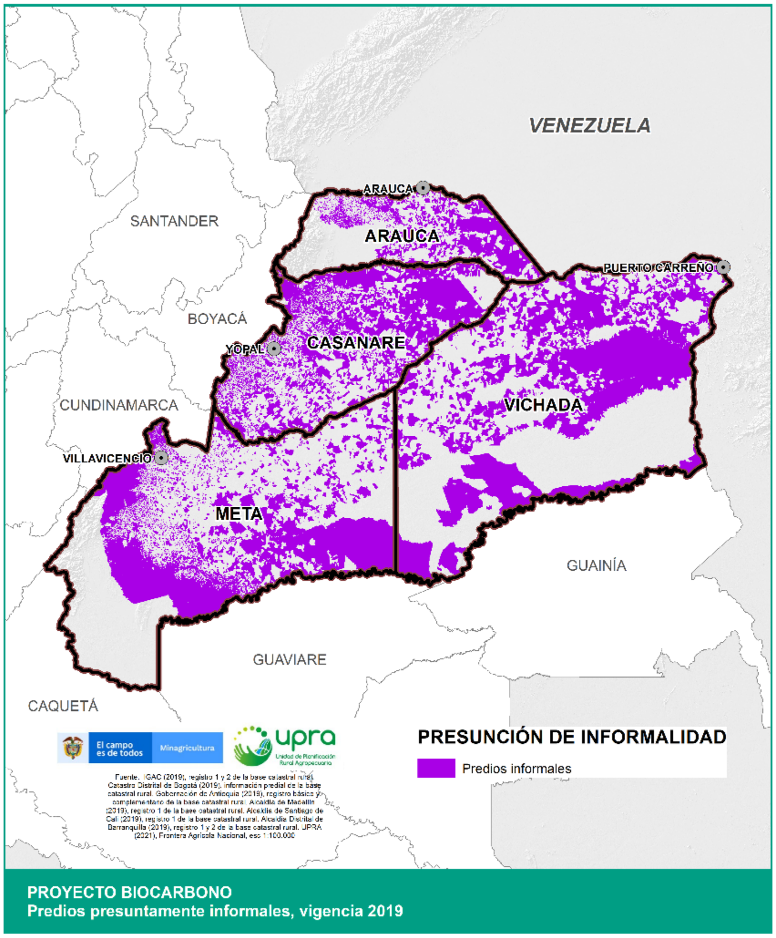



Figure 104 Presumed informal properties - Orinoquia
Source: UPRA © 2019

The following section describes the behavior of the informality index by department.

## 29. Arauca

The municipalities in the Arauca department have informality indexes above 30%, as shown in Table 119, with the municipality of Fortul being the one with the highest number of presumed informal properties, with 60,66%. Contrary to this, the municipality of Tame is the one with the highest presumption of formality, with 37,92% of informal properties.

According to the total number of presumably informal properties in the department (10.938 properties), the Tame municipality is the largest contributor with 28% of the properties, which together total 213.114 ha, while the Cravo Norte municipality is the smallest contributor with 3% of the properties, but corresponds to the largest area under informal conditions, with a total of 306.018 ha.

Table 119. Informality at municipal level - Arauca

| Municipality | Total properties | Properties area (ha) | Informal Properties | Informal Properties area (ha) | informality index | % Department participation |
|---|---|---|---|---|---|---|
| Fortul | 2.204 | 98.385 | 1.337 | 40.517 | **60,66%** | 12% |
| Puerto Rondon | 750 | 205.066 | 386 | 89.176 | **51,47%** | 4% |
| Cravo Norte | 698 | 539.412 | 336 | 306.018 | **48,14%** | 3% |
| Saravena | 4.691 | 89.587 | 2.121 | 19.711 | **45,21%** | 19% |
| Arauca | 3.049 | 563.975 | 1.318 | 291.967 | **43,23%** | 12% |
| Arauquita | 5.815 | 264.095 | 2.380 | 134.328 | **40,93%** | 22% |
| Tame | 8.070 | 719.255 | 3.060 | 213.114 | **37,92%** | 28% |
| **Total** | **25.277** | **2.479.777** | **10.938** | **1.094.830** | **43,27%** | **100%** |

Source: UPRA © 2019

## 30. Casanare

The municipalities of the department of Casanare have informality indexes above 20% as shown in Table 120, with the Támara municipality having the most presumably informal properties, with 86,96%, which corresponds to the highest index in the entire region. The opposite occurs with the Yopal municipality, which is the one with the highest presumption of formality with 27,51% of the properties. Considering the total number of presumably informal properties in the department (32.758 properties), Yopal is the largest contributor with 24% of the properties, which together total 100.940 ha, followed by the Paz de Ariporo municipality with 14% of the properties, which contribute 696.411 ha. The municipalities with the least number of properties are Sácama, Chámeza, Recetor and Orocué, with about 1% each and a combined area equivalent to 219.433 ha.

Table 120. Informality at municipal level – Casanare

| Municipality | Total properties | Properties area (ha) | Informal Properties | Informal Properties area (ha) | informality index | % Department participation |
|---|---|---|---|---|---|---|
| Tamara | 3.674 | 86.601 | 3.195 | 71.992 | **86,96%** | 10% |
| Sacama | 325 | 23.945 | 257 | 15.526 | **79,08%** | 1% |
| La salina | 657 | 21.047 | 492 | 18.605 | **74,89%** | 2% |
| Hato Corozal | 2.419 | 572.165 | 1.718 | 389.768 | **71,02%** | 5% |
| Chameza | 774 | 29.232 | 489 | 20.644 | **63,18%** | 1% |
| Tauramena | 3.713 | 237.853 | 2.271 | 108.799 | **61,16%** | 7% |
| Aguazul | 4.926 | 139.560 | 2.979 | 66.691 | **60,48%** | 9% |
| Paz de Ariporo | 7.425 | 1.138.484 | 4.482 | 696.411 | **60,36%** | 14% |
| Recetor | 715 | 17.986 | 388 | 9.380 | **54,27%** | 1% |
| San Luis de Palenque | 1.872 | 300.654 | 977 | 149.579 | **52,19%** | 3% |
| Nunchia | 2.585 | 113.843 | 1.345 | 61.061 | **52,03%** | 4% |
| Trinidad | 1.988 | 289.217 | 1.025 | 168.268 | **51,56%** | 3% |
| Sabanalarga | 1.067 | 38.404 | 550 | 20.949 | **51,55%** | 2% |
| Monterrey | 1.900 | 77.270 | 960 | 32.178 | **50,53%** | 3% |
| Mani | 2.602 | 358.111 | 1.197 | 126.759 | **46,00%** | 4% |
| Villanueva | 2.276 | 80.709 | 1.031 | 51.843 | **45,30%** | 3% |
| Pore | 2.184 | 73.255 | 969 | 42.910 | **44,37%** | 3% |
| Orocue | 1.054 | 471.062 | 454 | 173.883 | **43,07%** | 1% |
| Yopal | 29.004 | 241.253 | 7.979 | 100.940 | **27,51%** | 24% |
| **Total** | **71.160** | **4.310.652** | **32.758** | **2.326.185** | **46,03%** | **100%** |

Source: UPRA © 2019

## 31. Meta

The municipalities of the Meta department have informality indexes above 4% as shown in Table 121, with the municipality of Barranca de Upía having the highest number of presumed informal properties with 86,39%. On the other hand, the

Cumaral municipality has the highest presumption of formality with 4,64% of informal properties, being also the municipality with the lowest informality in the region.

Table 121. Informality at municipal level – Meta

| Municipality | Total properties | Properties area (ha) | Informal Properties | Informal Properties area (ha) | informality index | % Department participation |
|---|---|---|---|---|---|---|
| Barranca de Upia | 404 | 41.703 | 349 | 31.873 | **86,39%** | 1% |
| Puerto Concordia | 1.760 | 117.098 | 1.492 | 75.849 | **84,77%** | 2% |
| Mapiripan | 2.023 | 1.123.176 | 1.692 | 881.095 | **83,64%** | 3% |
| El Calvario | 1.430 | 25.547 | 1.142 | 22.398 | **79,86%** | 2% |
| Mesetas | 4.478 | 224.433 | 3.569 | 190.933 | **79,70%** | 6% |
| El dorado | 904 | 10.772 | 710 | 8.129 | **78,54%** | 1% |
| Puerto Rico | 3.780 | 341.721 | 2.827 | 270.137 | **74,79%** | 5% |
| San Juanito | 824 | 24.665 | 600 | 21.740 | **72,82%** | 1% |
| Vistahermosa | 5.587 | 216.093 | 4.062 | 162.670 | **72,70%** | 7% |
| Uribe | 999 | 75.204 | 679 | 56.792 | **67,97%** | 1% |
| El Castillo | 2.324 | 59.697 | 1.346 | 39.220 | **57,92%** | 2% |
| Puerto Gaitan | 3.544 | 1.716.569 | 2.043 | 376.658 | **57,65%** | 3% |
| Lejanias | 2.321 | 27.598 | 1.233 | 15.290 | **53,12%** | 2% |
| La Macarena | 881 | 130.942 | 468 | 95.951 | **53,12%** | 1% |
| San Juan de Arama | 2.168 | 106.458 | 1.068 | 41.367 | **49,26%** | 2% |
| Puerto Lleras | 2.392 | 236.869 | 1.174 | 76.268 | **49,08%** | 2% |
| Castilla la Nueva | 1.451 | 47.933 | 662 | 10.371 | **45,62%** | 1% |
| Guamal | 3.025 | 44.712 | 1.330 | 35.347 | **43,97%** | 2% |
| Granada | 5.033 | 31.179 | 2.099 | 9.544 | **41,70%** | 3% |
| Villavicencio | 51.584 | 122.387 | 21.337 | 35.052 | **41,36%** | 35% |
| Puerto Lopez | 8.024 | 665.900 | 3.293 | 115.629 | **41,04%** | 5% |
| Cabuyaro | 996 | 88.857 | 383 | 26.139 | **38,45%** | 1% |
| Fuente de Oro | 2.170 | 53.024 | 791 | 11.905 | **36,45%** | 1% |
| Cubarral | 2.687 | 127.670 | 931 | 111.868 | **34,65%** | 2% |
| Restrepo | 6.665 | 33.867 | 2.233 | 17.348 | **33,50%** | 4% |
| San Martin | 2.050 | 589.380 | 656 | 202.292 | **32,00%** | 1% |

| Municipality | Total properties | Properties area (ha) | Informal Properties | Informal Properties area (ha) | informality index | % Department participation |
|---|---|---|---|---|---|---|
| Acacias | 8.741 | 115.622 | 2.750 | 64.757 | **31,46%** | 4% |
| San Carlos de Guaroa | 1.546 | 77.830 | 296 | 10.890 | **19,15%** | 0% |
| Cumaral | 6.616 | 59.583 | 307 | 2.937 | **4,64%** | 0% |
| **Total** | **136.407** | **6.536.487** | **61.522** | **3.020.449** | **45,10%** | **100%** |

Source: UPRA © 2019

Taking into account the total number of presumably informal properties in the department (61.522 properties), the capital of the department, the municipality of Villavicencio, is the largest contributor with 35% of the properties, which total 35.052 ha, while the San Carlos de Guaroa and Cumaral municipalities are the smallest contributors with less than 1%, representing 13.826 ha. Another municipality to consider is Mapiripán, because it has a participation of 3% of the properties and contributes about 881.095 ha, i.e., with few properties it contributes the largest amount of area in informal conditions in the department.

## 32. Vichada

The municipalities of the department of Vichada have informality indexes above 50% as shown in Tabla 122, with the Cumaribo municipality having the highest number of presumed informal properties, with 77,91%. At the other extreme is the municipality of La Primavera, where 57,80% of the properties are presumed to be informal.
Based on the total number of presumably informal properties in the department (5.300 properties), the municipality of Cumaribo is the largest contributor with 35% of the properties, with an area of 1.359.710 ha. On the other hand, Santa Rosalía is the municipality that contributes the least amount of properties with 9%, with an area equivalent to 193.262 ha.

Tabla 122. Informality at municipal level – Vichada

| Municipality | Total properties | Properties area (ha) | Informal Properties | Informal Properties area (ha) | informality index | % Department participation |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Cumaribo | 2.358 | 5.207.515 | 1.837 | 1.359.710 | **77,91%** | 35% |
| Santa Rosalia | 584 | 294.731 | 451 | 193.262 | **77,23%** | 9% |
| Puerto Carreno | 2.321 | 1.105.264 | 1.471 | 527.155 | **63,38%** | 28% |
| La Primavera | 2.666 | 1.931.395 | 1.541 | 926.847 | **57,80%** | 29% |
| **Total** | **7.929** | **8.538.906** | **5.300** | **3.006.974** | **66,84%** | **100%** |

Source: UPRA © 2019

In general terms, behind the 46% informality indicator in the Orinoco region, there is a dispersed behavior among departments and municipalities, in which Vichada represents the highest degree of informality, with about 66%, while Arauca has the lowest informality degree with about 43%. In addition, variable behavior between municipalities was identified, ranging from a minimum of 4% in Cumaral - Meta, to a maximum of 87% in Tamara - Casanare.
In any case, the results of informality are a clear indication of the need for the region to start land ownership regularization processes to contribute to the formalization of land tenure. The relevance of the regularization process in the BioCarbon ERP (PRE Biocarbono in Spanish), focuses on the fact that the inexistence of legal security on informal properties reduces the scope of the project, which prevents the promotion of agreements on properties that do not have a clear title of ownership. Therefore, in order to expand implementation, it is necessary that the project be complemented with a property regularization process.

## 33. Presumed vacant properties

The identification of vacant properties is an important aspect in the forms of tenure as they are included among the fiscal assets. Therefore, UPRA, in the development of its mission function, carried out an indicative exercise to provide support for compliance with Ruling T-488 of 2014, the plan for clarification and recovery of unduly occupied vacant properties.
It is important to mention that, as a basic indicative exercise, a review of the identified properties is required to determine their legal nature as vacant properties, as well as to establish their destination, because the marking may include State-owned properties for public use or fiscal properties for patrimonial purposes.
In the development of the exercise, variables were established to determine the condition of presumed vacant properties based on information from the cadastral and SNR databases, complemented with inventories of information from ANT management, which makes it possible to determine the non vacant property condition.

The variables for determining the presumption of vacant properties are:

- Properties that do not have a real estate registration number in the cadastral base.
- Properties identified by owner's name as vacant.
- Properties identified as owner to INCODER/INCORA.
- Properties identified as owned by departments, municipalities, governors' offices, townships and the nation, including schools, hospitals, community action boards, public utilities, cemeteries and religious institutions. Indigenous reserves, communities, National Concessions Institute (INCO in Spanish), INURBE, National Roads Institute (INVIAS in Spanish) and Regional Autonomous Corporation (CAR in Spanish) properties are excluded.
- Properties with false SNR tradition: The properties reported by the SNR with an annotation of false tradition are identified within the alphanumeric cadastral base. For this purpose, all annotations reported by the SNR of false tradition that include registry codes from 600 to 620 were taken.
- Properties identified by SNR in reports (1 to 7) given to the Constitutional Court in compliance with the Seventh Order of Ruling T-488 of 2014 as presumed vacant properties: Properties reported by SNR as presumed vacant properties are identified within the alphanumeric cadastral base.

On the other hand, the variables to determine the NON vacant properties presumption are:

- Properties adjudicated by INCODER (history of adjudications): The alphanumeric cadastral base identifies the adjudicated properties from the purged base because of the massive registration committee of vacant properties, in cooperation with USAID; the properties that were found registered and those not registered during the exercise were taken.
- National Agrarian Fund properties: The properties identified in the inventory of the National Agrarian Fund (FNA in Spanish) of INCODER are identified within the alphanumeric cadastral base.

As a result of the identification of presumed vacant properties in the Orinoco region, 26% of the properties are presumed to be vacant, and the department with the highest number of presumed vacant properties is Meta, with 57% of the total. Likewise, the Vichada department has 66% of its properties as presumed vacant.

Table 123. Presumed vacant properties -Orinoquia

| Department | Presumed vacant properties | % Presumed vacant properties | No Presumed vacant properties | Total properties | % Presumed vacant properties in the department |
|---|---|---|---|---|---|
| Arauca | 3.939 | 6% | 21.338 | 25.277 | 16% |

| | | | | | |
|---|---|---|---|---|---|
| Casanare | 18.224 | 29% | 52.936 | 71.160 | 26% |
| Meta | 36.407 | 57% | 100.000 | 136.407 | 27% |
| Vichada | 5.200 | 8% | 2.729 | 7.929 | 66% |
| **Total** | **63.770** | **100%** | **177.003** | **240.773** | **26%** |

Source: UPRA © 2019 based on information IGAC 2019, SNR 2020, ANT 2020

The following figure shows the spatial distribution of the presumed vacant properties identified.

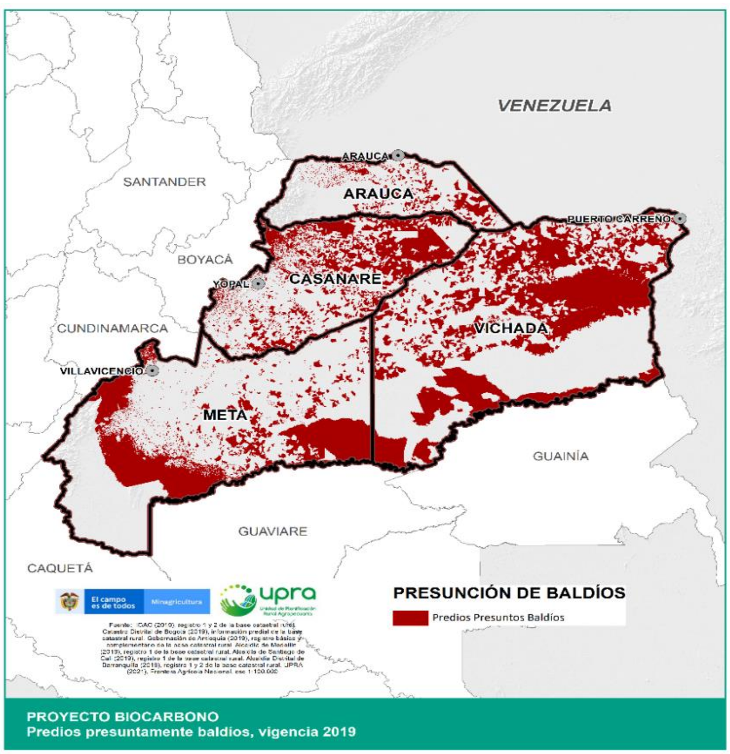



Figure 105. Presumed vacant properties – Orinoquia
Source: UPRA © 2019 based on information IGAC 2019

51% of the presumed vacant properties in the Orinoco region are properties with areas of less than 0,5 ha, being the smallest range of the classification, concentrated mainly in the Meta and Casanare departments. In smaller proportions, there are presumed vacant properties in the other size ranges.

Table 124. Property sizes Presumed vacant properties –Orinoquia

| Property Size | Presumed vacant properties | % Presumed vacant properties |
|---|---|---|

| | | |
|---|---|---|
| A1. Up to 0,5 ha | 32.288 | 51% |
| A2. Greater than 0,5 – up to 1 ha | 1.870 | 3% |
| A3. Greater than 1 - up to 2,5 ha | 2.925 | 5% |
| A4. Greater than 2,5 - up to 3 ha | 666 | 1% |
| B1. Greater than 3 - up to 5 ha | 2.333 | 4% |
| B2. Greater than 5 - up to 10 ha | 3.694 | 6% |
| C1. Greater than 10 - up to 20 ha | 4.251 | 7% |
| D1. Greater than 20 - up to 50 ha | 5.693 | 9% |
| D2. Greater than 50 - up to 100 ha | 3.332 | 5% |
| D3. Greater than 100 - up to 200 ha | 2.206 | 3% |
| E1. Greater than 200 - up to 500 ha | 1.845 | 3% |
| E2. Greater than 500 - up to 1000 ha | 1.226 | 2% |
| E3. Greater than 1000 - up to 2000 ha | 945 | 1% |
| E4. Greater than 2000 - up to 5000 ha | 356 | 1% |
| E5. Greater than 5000 - up to 10000 ha | 80 | 0% |
| E6. Greater than 10000 ha | 60 | 0% |
| **Total** | **63.770** | **100%** |

Source: UPRA © 2019 based on information IGAC 2019

The occupation of vacant properties is an important aspect when addressing land tenure, therefore, from the institutional bases an identification of the possible occupation in the presumed vacant properties is carried out, such as the marking of properties with improvement in the cadastral base and false traditions in the registration base of public instruments.

Table 125 shows this identification at the departmental level, showing that, based on the exercise of presumption of vacant properties in the region, there is a 10% of occupation, located mainly in the Vichada department with 33% of the total of presumed vacant properties identified (5.200 properties). On the other hand, taking as a reference the number of properties with presumed occupation, the department of Meta has the largest number of properties with this condition, with a participation equivalent to 67% of the total identified.

Table 125. Presumed occupation – Orinoquia

| Department | Presumed vacant properties | Improved / false tradition properties | % Improved / false tradition properties | % occupancy with respect to presumed vacant properties |
|---|---|---|---|---|
| Arauca | 3.939 | 82 | 1% | 2% |
| Casanare | 18.224 | 348 | 5% | 2% |
| Meta | 36.407 | 4.455 | 67% | 12% |
| Vichada | 5.200 | 1.720 | 26% | 33% |
| **Total** | **63.770** | **6.605** | **100%** | **10%** |

Source: UPRA © 2022 based on IGAC 2019, SNR 2019 information

## 33.1. Colonists Considerations

In the first part of this chapter it has been exposed that informality is a land relationship that characterizes a large part of the territory in the Orinoco, which can lead to land use conflicts. However, these are not the only actors that can cause conflicts or that are determinant for the application and scope of the BioCarbon ERP (PRE Biocarbono in Spanish).

Therefore, the colonists represent another actor to which attention should be paid due to their interference and the possibility of generating conflicts. For the purposes and scope of this document, it would be relevant to carry out a detailed analysis of the presence of colonists in the Orinoco departments, but this is an impossible task because of the lack of formal information on this population.

In view of this limitation, it was decided to provide a historical context of the colonization process in the Orinoco region, in order to set the precedent that it is an aspect to be considered during the field work.

Colonization in the departments of the region has been formed from migratory processes coming from other regions, at different times and with different dynamics since the late XIX century and with greater momentum since the second half of the XX century (Gomez, 1988), which continues to exist in the XXI century.

In order to provide some historical context, it can be stated that the colonization boom is associated at the beginning with social violence in other areas of the country that, according to (Gomez, 1988), caused the expulsion of a significant number of families to the border areas, particularly to the eastern plains, where the author records the occupation and titling of 431.495 ha in the Meta, Casanare and Arauca departments in the period 1961 to 1972.

In addition to the impact of violence, as the Orinoco region has traditionally been considered one of the last agricultural frontiers to be exploited, due to the scarcity of land in other regions and the inhospitable nature of some of its locations, it has been the object of colonization by families looking for new horizons, as well as policies of recognition of vacant properties by the Colombian State. The latter was promoted during the XX century, in different agrarian reforms, such as the one subscribed within the framework of López Pumarejo's "revolution in progress" or Law 135 of 1961 "On agrarian social reform", which sought to promote the adjudication of the nation's vacant properties to colonists and sharecroppers, focused on small and medium producers, in an attempt to eliminate and prevent the inequitable concentration of land ownership, as well as to promote access to land as an instrument to improve people's socioeconomic wellbeing (FAO, 2017).

A third component that has determined colonization in the Orinoquia has been the agricultural, livestock and agroindustrial bonanzas, both of legal and illegal products, including illicit crops that began in the 1970s, rubber that began around the same time, extensive cattle ranching due to the abundance of land and, recently, the agro-industrial boom, mainly focused on biofuels that have resulted in large extensions cultivated with palm oil (Farjado Montaña, 1998). All these processes have attracted different types of colonists and have expanded land use in all departments of the region.

As a result of the persistent colonization process in the Orinoco region, a scenario of agricultural land expansion has been consolidated, leading to a panorama of large extensions of land destined for extensive cattle ranching, agroindustry and transitory crops. In addition, a series of social conflicts have arisen between agents in the territory.

The initial conflict arose between colonists and indigenous people because the latter were displaced by the occupation of ancestral lands by the former. In the context of this conflict, the colonists appropriated large extensions of land that were traditionally used by nomadic indigenous people, who in retaliation began to steal cattle and goods from the colonists, which triggered the persecution phenomenon by the colonists against the indigenous people (Gomez, 1988).

A second representative moment of conflict between agents occurred with the promotion of agro-industrial crops and extensive cattle ranching by large companies and landowners, which displaced the colonists and pushed them to the edges of the agricultural frontier, in protected areas such as the Macarena reserve zone (Sanchez Silva, 2007).

In addition to the conflicts that may be generated by the presence of colonists in the Orinoco region, which may limit the scope of the ERPD, the management of these actors is of special relevance because their actions, when they are not involved in colonization processes on national vacant properties, are directly related to the increase of carbon emissions, due to the fact that their traditional practices are to deforest reserve areas to implement agricultural production, mainly extensive cattle ranching. Regarding this assertion, the (IDEAM, 2011) compiles information to indicate that colonization and border expansion, illicit crops, forest fires and timber production are the main causes of deforestation at the national level.

In general terms, although there is no information available on the magnitude of the colonist phenomenon in the Orinoco region, its presence has several implications that should be taken into account at the time of implementing the BioCarbon ERP (PRE Biocarbono in Spanish), which can be summarized as follows:

- The presence of colonists in the Orinoco region can be a drawback for the signing of REC contracts due to conflicts of use with other actors in the territory or because they may be linked to deforestation processes in environmental areas.
- The delimitation of indigenous reservation areas may be affected by the invasion of colonists, thus affecting the area that would be eligible for the BioCarbon ERP.
- The conflict between colonists and agribusiness or cattle ranching generates pressures on reserve areas because it drives the former towards protected frontier zones, causing deforestation and loss of carbon sequestration capacity in the Orinoco region. In this sense, it is necessary to promote policies that prevent deforestation in reserve areas and, on the contrary, promote alliances to reforest these areas. In this regard, the ERPD could be an incentive for colonists to contribute to the reforestation of affected reserve areas.

Based on the arguments presented, the issue of colonists is not minor for the BioCarbon ERP, so in its structuring it is necessary to involve this type of population in order to reduce the harmful effects of the agricultural frontier expansion in reserve areas and to link them to the program, in such a way that a greater impact is achieved.

## 33.2. Mere tenancy

According to the Colombian Civil Code, mere tenancy is "that which is exercised over a thing, not as owner, but in place of or on behalf of the owner. The pledgee, the sequestrator, the usufructuary, the user, the one who has the right of habitation, are mere holders of the thing pledged, sequestered or whose usufruct, use or habitation belongs to them"[202], unlike possession, in mere tenancy the owner is recognized.

To obtain information on mere tenancy, there are two sources such as the Public Instruments Registry and the information from the National Agricultural Census (CNA in Spanish). Regarding the registry, as mentioned at the beginning, there are

[202] **Article 775 Colombian Civil Code**

legal acts registered between 2015 to 2019 in which the consultation of "Titles of Tenancy" corresponding to the legal nature codes of 0500, In addition, it is considered convenient to complement with the information from the CNA, specifically in one of the topics addressed "Land tenure regime of the agricultural production unit" declared by the producers, which, although it is of a declarative nature[203], shows the mere tenure since this type of acts are not customary to register.

From the information available in the public registry instruments, a total of 305 acts of tenancy titles were found for the Orinoco region in rural folios, which 91% corresponded to temporary destination and deposit[204] related to assets affected with precautionary measures and with extinction of domain, in proportion of 4% is the gratuitous bailment, followed by leasing in 3%.

Table 126. Tenancy titles – Orinoquia

| Legal Nature | Acts of tenancy titles | % Acts of tenancy titles |
|---|---|---|
| Lease | 8 | 3% |
| Gratuitous bailment | 11 | 4% |
| Constitution of real estate leasing | 3 | 1% |
| Destination / provisional deposit | 278 | 91% |
| Assets received by the victim reparations fund | 1 | 0.3% |
| Exchange of rights and shares | 4 | 1% |
| **Total** | **305** | **100%** |

Source: UPRA © 2022 based on information SNR 2021

At the departmental level, they are distributed in greater proportion in the Meta department with 74% of the acts of tenancy, since it is the department with the largest number of properties, as opposed to Vichada, which has 0,3% of the acts, corresponding to one act of commodatum.

Table 127. Total tenancy titles by department – Orinoquia

| Departments | Acts Titles of Tenancy | % Acts Titles of Tenancy |
|---|---|---|
| Arauca | 34 | 11% |
| Casanare | 45 | 15% |

**[203] In the CNA, question 39 is of a declarative nature, i.e., based on a person's assessment and without the verification of documents that support the tenure relationship.**

**[204] ARTICLE 2.5.5.5.5.1. Provisional assignment. This is the management mechanism by virtue of which the Administrator of FRISCO transfers an asset under its management to the service of a state entity or a non-profit legal person under private law. ARTICLE 2.5.5.5.6.1. Provisional deposit. This is a mechanism for the administration of FRISCO's Assets, by virtue of which a person is appointed who meets the necessary conditions of suitability to administer, care for, maintain, guard and ensure that they continue to be productive and generate employment.**

| | | |
|---|---|---|
| Meta | 225 | 74% |
| Vichada | 1 | 0.3% |
| **Total** | **305** | **100%** |

Source: UPRA © 2022 based on SNR information 2021

The acts of destination and provisional deposit are distributed in great proportion in each of the departments except for Vichada, which does not have this type of act, in Casanare it is followed by the commodatum acts with 13% of the acts of the department, in the Meta it is followed by leasing with 3% of the acts of the department.

Table 128. Tenancy titles by department – Orinoquia

| Departments | Specification Legal Nature | Acts Titles of Tenancy | % Acts Titles of Tenancy |
|---|---|---|---|
| Arauca | Constitution of real estate leasing | 1 | 3% |
| | Destination / interim deposit | 33 | 97% |
| **Total Arauca** | | **34** | **100%** |
| Casanare | Lease | 1 | 2% |
| | Gratuitous bailment | 6 | 13% |
| | Constitution of real estate leasing | 1 | 2% |
| | Destination / provisional deposit | 32 | 71% |
| | Assets received by the victim reparations fund | 1 | 2% |
| | Exchange of rights and shares | 4 | 9% |
| **Total Casanare** | | **45** | **100%** |
| Meta | Lease | 7 | 3% |
| | Gratuitous bailment | 4 | 2% |
| | Constitution of real estate leasing | 1 | 0% |
| | Destination / interim deposit | 213 | 95% |
| **Total Meta** | | **225** | **100%** |
| Vichada | Commodatum | 1 | 100% |
| **Total Vichada** | | **1** | **100%** |

Source: UPRA © 2022 based on information SNR 2021

From the CNA, based on the information of the agricultural production units (UPA in Spanish) in relation to question 39 on the form of tenancy declared by the producers, 6% of the total number of UPAs in the region (78.118) indicated that they were in lease, 0,3% in sharecropping and only 0,1% in commodatum, as shown in the following table.

Table 129. UPA mere tenancy – Orinoquia

| Type | UPA | % UPA | UPA Area | % UPA Area |
|---|---|---|---|---|
| Lease | 4428 | 6% | 352574 | 1.4% |
| Sharecropping | 207 | 0.3% | 6008 | 0.02% |
| Commodatum | 93 | 0.1% | 9078 | 0.04% |

Source: UPRA © 2022 based on information from CNA 2014

At the departmental level, the same trend is maintained in the UPAs of each department in the region, as shown in the following table.

Table 130. UPA mere tenancy by department – Orinoquia

| Department | Type | UPA | % UPA | UPA Area | % UPA Area |
|---|---|---|---|---|---|
| Arauca | Lease | 321 | 3% | 39738 | 2% |
| | Sharecropping | 22 | 0.2% | 380 | 0.02% |
| | Commodatum | 5 | 0.04% | 114 | 0.005% |
| Casanare | Lease | 683 | 3% | 49280 | 1% |
| | Sharecropping | 16 | 0.1% | 645 | 0.02% |
| | Commodatum | 13 | 0.1% | 785 | 0.02% |
| Meta | Lease | 3376 | 9% | 201727 | 2% |
| | Sharecropping | 163 | 0.4% | 4916 | 0.1% |
| | Commodatum | 74 | 0.2% | 8154 | 0.1% |
| Vichada | Lease | 48 | 1% | 61830 | 1% |
| | Sharecropping | 6 | 0.1% | 67 | 0.001% |
| | Commodatum | 1 | 0.02% | 26 | 0.0003% |

Source: UPRA © 2022 based on information from CNA 2014

It should be noted that in the region, acts of mere tenure are not representative of the information from the registry of public instruments as compared to that reported by the CNA, which confirms that although they are subject to registration, they are not necessarily registered, which does not affect ownership. Traditionally, tenure titles are registered by deed and normally with State entities.

# 34. RURAL LAND MARKET

In different parts of this document, it has been argued that the main focus of the BioCarbon ERP should be centered on private properties under formal conditions, because these are properties that have some legal security and on which agreements on sustainable projects could be advanced, as long as the carbon right is clearly determined. However, within the formality of land, there may also be limitations related to other uses or other types of projects being developed in the region. In this sense, it is pertinent to carry out a diagnosis of the dynamics of the real estate market, to identify the transactions that are being advanced in the departments, in order to complete the panorama of potential uses, restrictions and possible confrontations for land use, within the framework of the ERPD.

## 34.1. Rural formal real estate market dynamics

According to the regulations and laws, in Colombia the registry of public instruments is the service or mechanism of the State in which the historical and legal information of real estate is related, carried out through the real estate registration folios, recording the acts that affect the relationship of tenancy with the property, such as the legal acts that confer rights, restrictions, responsibilities, mortgages and publicity. In this way, the registry of public instruments is constituted as the mechanism that determines ownership.
The Superintendency of Notaries and Registry (SNR in Spanish) is the Entity that regulates, guides and exercises inspection, surveillance and control over the notary service activities and the registry of public instruments (Decree 2723 of December 29, 2014).

Table 131. Public Instruments Offices – Orinoquia

| Departments | Name - Public Instruments Offices (ORIP in Spanish) |
|---|---|
| Arauca | Arauca |
| Casanare | Orocue |
| | Paz de Ariporo |
| | Yopal |
| Meta | Acacias |
| | Puerto López |
| | San martín |
| | Villavicencio |
| Vichada | Puerto Carreño |

Source: UPRA © 2022 based on information SNR 2019, 2021

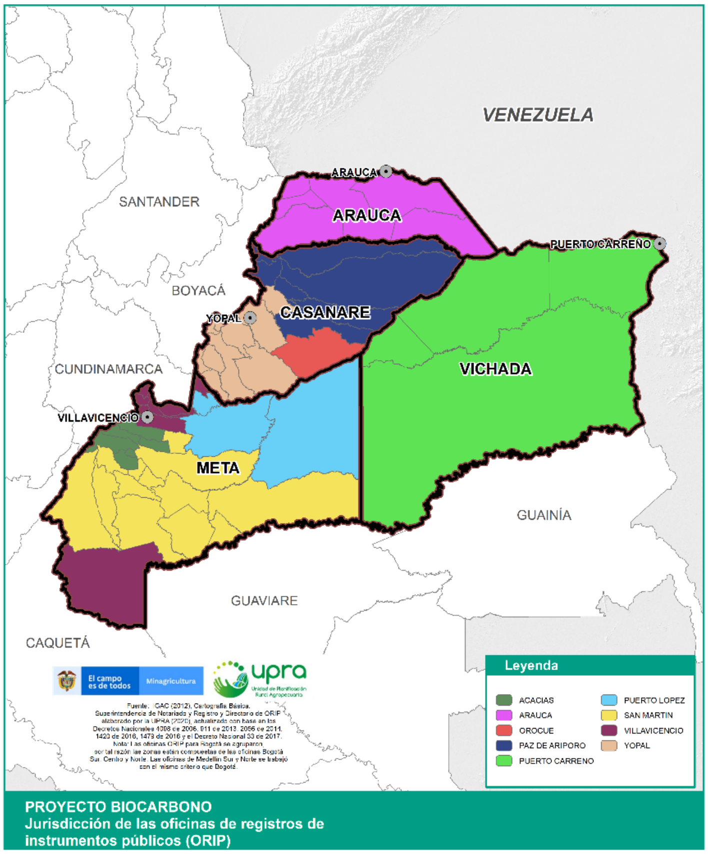



Figure 106. ORIP jurisdiction – Orinoquia
Source: UPRA © 2022 based on information SNR 2019, 2021

For the exercise of its management, the SNR currently has 195 public instruments registry offices (ORIP in Spanish) throughout the country, of which, in the Orinoco region there are nine (9), present in the four (4) departments, as shown in **Table *131*** and ***Figure 106***, which reflect the jurisdiction of each of these, since each ORIP has jurisdiction over 1 or more municipalities.

The UPRA has information on registry acts of the time series 2015 - 2019, which allows to know trends or behaviors of the dynamics of the formal rural land market in the region, and according to the above allows to complement the diagnosis since it is information of the entity that determines the property, that represents a form of land tenure.

The available information has a series of acts of a legal nature, that for the purpose of the analysis were grouped according to the criteria established in the document

"Analysis of the dynamics of the Colombian rural formal land market for the period 2015 - 2019" (UPRA, 2021)[205], as follows:

Table 132. Grouping Registered events 2015-2019

| Legal act |
|---|
| Sale and purchase |
| Partial sale |
| Mortgage |
| Garnishment |
| Construction declaration |
| Vacant properties adjudication |
| Auction adjudication |
| Swap |

Source: UPRA © 2022 based on information SNR 2019, 2021

The following section shows the behavior and distribution of real estate transactions or rural registry acts at the departmental, ORIP and municipal levels, with respect to the total for 2015 to 2019.

## 35. Departmental Level

According to available information, the region has a total of 77.246 legal acts, of which 70% correspond to the department of Meta, followed by Casanare with 15% and finally Vichada with 2%, showing the same behavior as the number of rural properties reported by cadastre, Table 133.

Table 133. Total legal acts registered 2015-2019

| Department | Total Legal acts | % Legal acts | Properties cadastre | % acts vs properties cadastre |
|---|---|---|---|---|
| Meta | 54.071 | 70% | 136.407 | 40% |
| Casanare | 11.965 | 15% | 71.160 | 17% |
| Arauca | 9.668 | 13% | 25.277 | 38% |
| Vichada | 1.542 | 2% | 7.929 | 19% |
| **Total** | **77.246** | **100%** | **240.773** | **32%** |

Source: UPRA © 2022 based on information SNR 2019, 2021

[205] https://www.upra.gov.co/documents/10184/194872/20210609_ANA_BD_SNR_V11+%281%29.pdf/05eb6916-6dde-42f5-b082-8828518331f4

For reference purposes only, when verifying the legal acts with respect to the rural properties in the cadastre, it is observed that approximately[206] 32% of the properties in the region have legal acts of registration, being Meta the most representative with 40% of its properties, followed by Arauca with 38%.
In terms of legal acts, purchase and sale is the most frequent with 70% of the total number of acts, followed by foreclosure with 13%. The opposite is observed in the case of exchange and auction, which together account for less than 1%, as shown in Table 134.
Likewise, the trend is maintained where legal acts are concentrated mainly in the Meta department, except for the partial purchase and sale, which in more than 70% of them are registered in Arauca with 1.685.

Table 134. Details of legal acts

| Legal acts | Total acts | % acts |
|---|---|---|
| Buying and selling | 54279 | 70% |
| Garnishment | 10347 | 13% |
| Mortgage | 7407 | 10% |
| Construction declaration | 1679 | 2% |
| Partial Purchase and Sale | 2394 | 3% |
| Vacant properties adjudication | 818 | 1% |
| Swap | 203 | 0.3% |
| Auction Adjudication | 119 | 0.2% |
| **Total** | **77246** | **100%** |

Source: UPRA © 2022 based on information SNR 2019, 2021

Table 135. Legal acts 2015-2019 - Departmental

| Legal acts | Meta | Casanare | Vichada | Arauca | Total |
|---|---|---|---|---|---|
| Buying and selling | 39.865 | 7.473 | 1.075 | 5.866 | **54.279** |
| Garnishment | 6.921 | 2.365 | 238 | 823 | **10.347** |
| Mortgage | 5.127 | 1.126 | 68 | 1.086 | **7.407** |
| Partial Purchase and Sale | 344 | 356 | 9 | 1.685 | **2.394** |

[206] **It is of reference, considering that it is possible that the same property may have more than 1 legal act registered.**

| | | | | | |
|---|---|---|---|---|---|
| Construction declaration | 1.213 | 344 | 1 | 121 | **1.679** |
| Vacant properties adjudication | 350 | 251 | 141 | 76 | **818** |
| Auction Adjudication | 94 | 17 | 1 | 7 | **119** |
| Swap | 157 | 33 | 9 | 4 | **203** |
| **Total** | **54.071** | **11.965** | **1.542** | **9.668** | **77.246** |

Source: UPRA © 2022 based on information SNR 2019, 2021

When verifying the number of legal acts by year, there is a uniform distribution, that is, the dynamics is maintained year by year as shown in Figure 107, being in 2016 where there is an increase compared to the other years of the period with 22% of the acts, the following table details the amounts of acts by year and department.

Table 136. Legal acts 2015-2019 - Year

| **Departments** | **2015** | | **2016** | | **2017** | | **2018** | | **2019** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Amount** | **%** | **Amount** | **%** | **Amount** | **%** | **Amount** | **%** | **Amount** | **%** |
| Meta | 10.768 | 14% | 11.484 | 15% | 10.869 | 14% | 10.720 | 14% | 10.230 | 13% |
| Casanare | 2.153 | 3% | 2.530 | 3% | 2.293 | 3% | 2.288 | 3% | 2.701 | 3% |
| Vichada | 406 | 1% | 322 | 0% | 239 | 0% | 299 | 0% | 276 | 0% |
| Arauca | 2.507 | 3% | 2.479 | 3% | 1.535 | 2% | 1.618 | 2% | 1.529 | 2% |
| **Total** | **15.834** | **20%** | **16.815** | **22%** | **14.936** | **19%** | **14.925** | **19%** | **14.736** | **19%** |

Source: UPRA © 2022 based on information SNR 2019, 2021

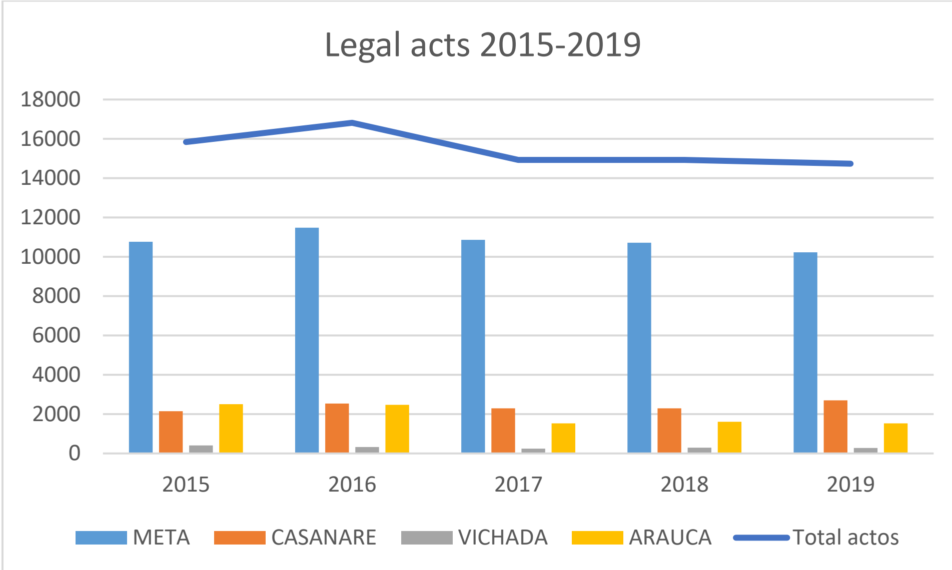



Figure 107. Behavior of legal acts by year
Source: UPRA © 2022 based on information SNR 2019, 2021.

**The annual comparison of the acts makes it possible to know the year-by-year increases and decreases, identifying specific dynamics. For Orinoquia, it is observed that decreases predominate, especially in 2017 compared to 2016 where the reduction was -11% and there was only an increase of 6% in 2016 compared to 2015.**

Table 137. Increases and decreases in legal acts 2015-2019 - department

| Departments | 2015 | 2016 | 2017 | 2018 | 2019 | 2015-2016 | 2016-2017 | 2017-2018 | 2018-2019 |
|---|---|---|---|---|---|---|---|---|---|
| Meta | 10768 | 11484 | 10869 | 10720 | 10230 | 7% | -5% | -1% | -5% |
| Casanare | 2153 | 2530 | 2293 | 2288 | 2701 | 18% | -9% | -0.2% | 18% |
| Vichada | 406 | 322 | 239 | 299 | 276 | -21% | -26% | 25% | -8% |
| Arauca | 2507 | 2479 | 1535 | 1618 | 1529 | -1% | -38% | 5% | -6% |
| **Total** | **15834** | **16815** | **14936** | **14925** | **14736** | **6%** | **-11%** | **-0.1%** | **-1%** |

Source: UPRA © 2022 based on information SNR 2019, 2021

At the departmental level, Vichada presents the largest increase with 25% in 2018 compared to 2017 and the largest decrease is presented by Arauca with -38% in 2017 compared to 2016. Table 137 lists the detail of the increases presented and the figure shows the related changes.

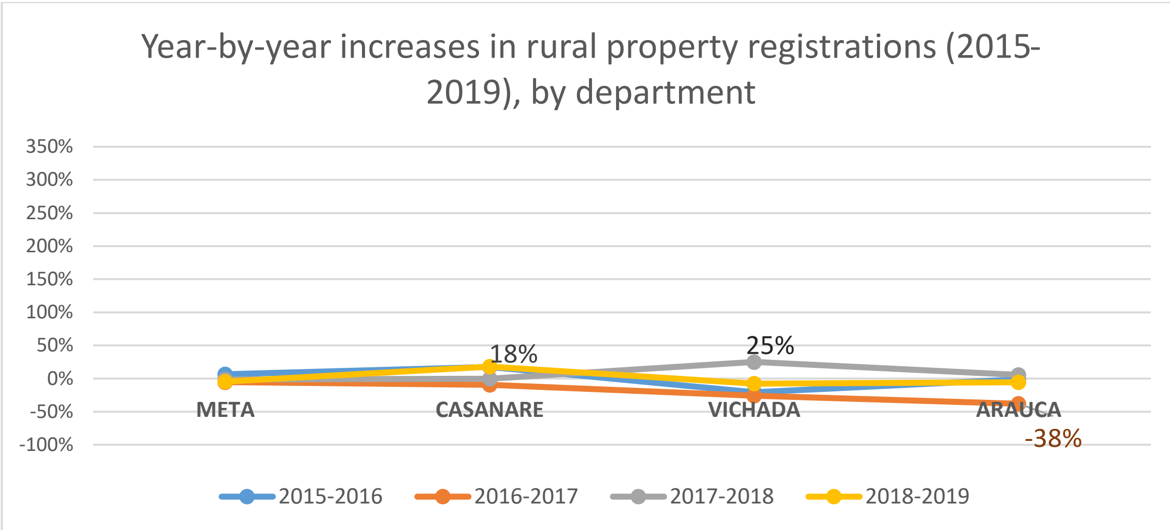



Figure 108. Legal act behavior - department
Fuente: UPRA © 2022 based on information SNR 2019, 2021

## 36. Office of Public Instruments Registry Level (ORIP in Spanish)

As indicated above, the management of the public instruments registration is carried out through nine (9) ORIPs. From this level it can be shown that 80% of the region legal acts are concentrated in 4 ORIPs (Villavicencio, Arauca, San Martín and Yopal), being the Villavicecio ORIP  the one that covers more with 47% of the legal acts distributed in the seven (7) municipalities of its jurisdiction, followed by the Arauca ORIP with 13% of the total of the acts distributed in the whole department, since this one has only 1 ORIP. The following table shows the proportion of acts for each of the ORIPs in the region.

**Table 138. Total legal acts registered 2015-2019 - ORIP**

| Name ORIP | Jurisdiction (municipalities) | | Total legal acts | % legal acts |
|---|---|---|---|---|
| Villavicencio | 7 | Villavicencio, Barranca de Upía, Cumaral, El Calvario, La Macarena, Restrepo, San Juanito | 36438 | 47% |
| Arauca | 7 | Arauca, Arauquita, Cravo Norte, Fortul, Puerto Rondón, Saravena, Tame | 9668 | 13% |
| San Martin | 13 | Fuente de Oro, Granada, Mapiripán, Mesetas, Uribe, Lejanías, Puerto Concordia, Puerto | 8011 | 10% |

| | | | | |
|---|---|---|---|---|
| | | Lleras, Puerto Rico, San Carlos de Guaroa, San Juan de Arama, San Martín, Vistahermosa | | |
| Yopal | 10 | Yopal, Aguazul, Chámeza, Maní, Monterrey, Nunchía, Recetor, Sabanalarga, Tauramena, Villanueva | 7841 | 10% |
| Acacias | 6 | Acacías, Castilla La Nueva, Cubarral, El Castillo, El Dorado, Guamal | 5585 | 7% |
| Puerto López | 3 | Cabuyaro, Puerto Gaitán, Puerto López | 4037 | 5% |
| Paz de Ariporo | 8 | Paz de Ariporo, Hato Corozal, La Salina, Pore, Sácama, San Luis de Palenque, Támara, Trinidad | 3790 | 5% |
| Puerto Carreño | 4 | Puerto Carreño, La Primavera, Santa Rosalía, Cumaribo | 1542 | 2% |
| Orocué | 1 | Orocué | 334 | 0.4% |
| **Total** | **59** | | **77246** | **100%** |

Source: UPRA © 2022 based on information SNR 2019, 2021

**Considering the detail of legal acts, the Villavicencio ORIP registers the highest number of acts, with the highest proportion of sales, representing 36% of the total number of acts, except for partial sales, where the Arauca ORIP has the highest number, representing 2% of the total number of acts. It is worth noting that the highest proportion of vacant properties is in the Paz de Ariporo ORIP, as detailed in Table 139. Regarding the amounts per year, according to the number of acts, the ORIP of Villavicencio has the highest participation in all years as shown in based on *information SNR 2019, 2021***

***Table 140*.**

## Table 139. Details of legal acts - ORIP

| Name ORIP | Purchase and sale | | Foreclosure | | Mortgage | | Partial sale | | Construction declaration | | Vacant properties adjudication | | Auction adjudication | | Exchange | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Amount | % | Amount | % | Amount | % | Amount | % | Amount | % | Amount | % | Amount | % | Amount | % |
| Villavicencio | 27.436 | 36% | 4.157 | 5% | 3.787 | 5% | 246 | 0.3% | 592 | 1% | 49 | 0.1% | 51 | 0.1% | 120 | 0.2 |
| Arauca | 5.866 | 8% | 823 | 1% | 1.086 | 1% | 1.685 | 2% | 121 | 0.16% | 76 | 0.1% | 7 | 0.01% | 4 | 0.01 |
| San martin | 5.549 | 7% | 1.112 | 1% | 698 | 1% | 66 | 0.1% | 428 | 1% | 130 | 0.2% | 10 | 0.01% | 18 | 0.02 |
| Yopal | 4.660 | 6% | 1.669 | 2% | 837 | 1% | 257 | 0.3% | 329 | 0.4% | 60 | 0.1% | 15 | 0.02% | 14 | 0.02 |
| Acacias | 4.103 | 5% | 824 | 1% | 411 | 1% | 13 | 0.02% | 169 | 0.2% | 36 | 0.05% | 17 | 0.02% | 12 | 0.02 |
| Puerto Lopez | 2.777 | 4% | 828 | 1% | 231 | 0.3% | 19 | 0.02% | 24 | 0.03% | 135 | 0.2% | 16 | 0.02% | 7 | 0.01 |
| Paz de Ariporo | 2.620 | 3% | 606 | 1% | 257 | 0.3% | 84 | 0.1% | 15 | 0.02% | 188 | 0.2% | 2 | 0.003% | 18 | 0.02 |
| Puerto Carreno | 1.075 | 1% | 238 | 0.3% | 68 | 0.1% | 9 | 0.01% | 1 | 0.001% | 141 | 0.2% | 1 | 0.001% | 9 | 0.01 |
| Orocue | 193 | 0.2% | 90 | 0.1% | 32 | 0.04% | 15 | 0.02% | | 0% | 3 | 0.004% | | 0% | 1 | 0.001 |
| **Total** | **54.279** | **70%** | **10.347** | **13%** | **7.407** | **10%** | **2.394** | **3%** | **1.679** | **2%** | **818** | **1%** | **119** | **0.2%** | **203** | **0.3** |

Source: UPRA © 2022 based on information SNR 2019, 2021

## Table 140. Total legal acts per year

| Nombre ORIP | 2015 | | 2016 | | 2017 | | 2018 | | 2019 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Amount | % | Amount | % | Amount | % | Amount | % | Amount | % | Amount | % |
| Villavicencio | 7.502 | 10% | 7.415 | 10% | 7.547 | 10% | 7.504 | 10% | 6.470 | 8% | 36.438 | 47% |
| Arauca | 2.507 | 3% | 2.479 | 3% | 1.535 | 2% | 1.618 | 2% | 1.529 | 2% | 9.668 | 13% |
| San martin | 1.442 | 2% | 1.723 | 2% | 1.283 | 2% | 1.459 | 2% | 2.104 | 3% | 8.011 | 10% |
| Yopal | 1.197 | 2% | 1.774 | 2% | 1.496 | 2% | 1.458 | 2% | 1.916 | 2% | 7.841 | 10% |
| Acacias | 1.092 | 1% | 1.545 | 2% | 1.204 | 2% | 950 | 1% | 794 | 1% | 5.585 | 7% |
| Puerto Lopez | 732 | 1% | 801 | 1% | 835 | 1% | 807 | 1% | 862 | 1% | 4.037 | 5% |
| Paz de Ariporo | 891 | 1% | 705 | 1% | 723 | 1% | 754 | 1% | 717 | 1% | 3.790 | 5% |
| Puerto Carreno | 406 | 1% | 322 | 0.4% | 239 | 0.3% | 299 | 0.4% | 276 | 0.4% | 1.542 | 2% |
| Orocue | 65 | 0% | 51 | 0.1% | 74 | 0.1% | 76 | 0.1% | 68 | 0.1% | 334 | 0.4% |
| **Total** | **15.834** | **20%** | **16.815** | **22%** | **14.936** | **19%** | **14.925** | **19%** | **14.736** | **19%** | **77.246** | **100%** |

Source: UPRA © 2022 based on information SNR 2019, 2021

## 37. Municipal Level

At the municipal level, 80% of the legal acts are concentrated in 14 municipalities of the region, where Villavicencio concentrates a large number of acts, except for the partial purchase and sale, which has its highest incidence in the municipality of Tame - Arauca, and the adjudication of vacant properties, that has the highest number in the Puerto Gaitán - Meta and Paz de Ariporo - Casanare municipalities. Table 141 shows the acts distribution in the municipalities with the highest number.

**Table 141. Municipalities with the highest number of legal acts**

| Municipality | Purchase and sale | Foreclosure | Mortgage | Partial sale | Construction declaration | Vacant properties adjudication | Auction adjudication | Exchange |
|---|---|---|---|---|---|---|---|---|
| Villavicencio | 20.262 | 3.248 | 2.755 | 122 | 381 | 10 | 41 | 96 |
| Restrepo | 4.507 | 605 | 919 | 88 | 89 | 1 | 8 | 16 |
| Yopal | 2.861 | 871 | 543 | 39 | 280 | 7 | 5 | 5 |
| Granada | 3.031 | 229 | 197 | 8 | 324 | 6 | 3 | 10 |
| Tame | 2.165 | 241 | 343 | 651 | 18 | 35 | 2 | |
| Cumaral | 2.425 | 263 | 80 | 34 | 122 | 20 | 2 | 8 |
| Puerto Lopez | 2.118 | 493 | 145 | 14 | 18 | 31 | 8 | 5 |
| Acacias | 1.845 | 436 | 161 | 3 | 33 | 33 | 8 | 7 |
| Saravena | 1.415 | 86 | 179 | 92 | | | 1 | 3 |
| Arauquita | 974 | 176 | 288 | 193 | 1 | 15 | 2 | |
| Paz de Ariporo | 1.167 | 219 | 85 | 20 | 9 | 80 | | 6 |
| Guamal | 1.022 | 113 | 75 | 1 | 36 | | 1 | 3 |
| Arauca | 627 | 209 | 89 | 161 | 2 | 12 | 2 | 1 |
| Puerto Gaitán | 550 | 282 | 71 | 3 | 6 | 82 | 2 | 2 |

Source: UPRA © 2022 based on information SNR 2019, 2021.

When checking annually the acts to know the inter-annual variations at municipal level, it is found that the municipality of Sácama - Casanare presents the largest increase of 1000% in 2017 compared to 2016 going from 1 act to 11, on the other hand, the largest decrease is presented by San Carlos de Guaroa - Meta with -85% in 2017 compared to 2016 going from 264 acts to 39 acts. The following table shows the detail of the increases presented at the municipal level.

**Table 142. Variation in the number of legal acts 2015-2019 - municipality**

| Municipality | 2015 | 2016 | 2017 | 2018 | 2019 | Total | 2015-2016 | 2016-2017 | 2017-2018 | 2018-2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| San Carlos de Guaroa | 35 | 264 | 39 | 25 | 39 | 402 | 654% | -85% | -36% | 56% |
| Sabanalarga | 28 | 60 | 54 | 55 | 50 | 247 | 114% | -10% | 2% | -9% |
| San Juan de Arama | 62 | 127 | 72 | 73 | 66 | 400 | 105% | -43% | 1% | -10% |
| Yopal | 521 | 1021 | 921 | 894 | 1254 | 4611 | 96% | -10% | -3% | 40% |
| Villanueva | 71 | 131 | 69 | 42 | 62 | 375 | 85% | -47% | -39% | 48% |
| Restrepo | 998 | 1760 | 1000 | 1341 | 1134 | 6233 | 76% | -43% | 34% | -15% |
| Guamal | 291 | 467 | 209 | 154 | 130 | 1251 | 60% | -55% | -26% | -16% |
| Puerto Gaitán | 130 | 208 | 122 | 207 | 331 | 998 | 60% | -41% | 70% | 60% |
| Acacias | 501 | 734 | 582 | 402 | 307 | 2526 | 47% | -21% | -31% | -24% |
| El castillo | 40 | 53 | 55 | 43 | 53 | 244 | 33% | 4% | -22% | 23% |
| Cubarral | 121 | 158 | 129 | 145 | 184 | 737 | 31% | -18% | 12% | 27% |
| Recetor | 10 | 13 | 15 | 22 | 9 | 69 | 30% | 15% | 47% | -59% |
| Monterrey | 76 | 96 | 83 | 74 | 87 | 416 | 26% | -14% | -11% | 18% |
| Lejanías | 94 | 117 | 110 | 86 | 111 | 518 | 24% | -6% | -22% | 29% |
| Barranca de Upía | 22 | 26 | 7 | 16 | 15 | 86 | 18% | -73% | 129% | -6% |
| Mapiripán | 17 | 19 | 20 | 23 | 23 | 102 | 12% | 5% | 15% | 0% |
| Tauramena | 81 | 89 | 86 | 78 | 109 | 443 | 10% | -3% | -9% | 40% |
| Puerto Lleras | 113 | 124 | 107 | 106 | 141 | 591 | 10% | -14% | -1% | 33% |
| San Luis de Palenque | 94 | 103 | 92 | 67 | 52 | 408 | 10% | -11% | -27% | -22% |
| Granada | 602 | 634 | 525 | 750 | 1297 | 3808 | 5% | -17% | 43% | 73% |
| Chameza | 21 | 22 | 20 | 11 | 9 | 83 | 5% | -9% | -45% | -18% |
| El Calvario | 23 | 24 | 16 | 17 | 10 | 90 | 4% | -33% | 6% | -41% |

| Municipality | 2015 | 2016 | 2017 | 2018 | 2019 | Total | 2015-2016 | 2016-2017 | 2017-2018 | 2018-2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| Puerto Concordia | 28 | 29 | 26 | 27 | 15 | 125 | 4% | -10% | 4% | -44% |
| San Juanito | 2 | 2 | 1 | 1 | 1 | 7 | 0% | -50% | 0% | 0% |
| Puerto López | 556 | 554 | 686 | 557 | 479 | 2832 | 0% | 24% | -19% | -14% |
| Castilla la Nueva | 98 | 94 | 105 | 166 | 82 | 545 | -4% | 12% | 58% | -51% |
| El dorado | 41 | 39 | 124 | 40 | 38 | 282 | -5% | 218% | -68% | -5% |
| La Macarena | 35 | 33 | 27 | 28 | 30 | 153 | -6% | -18% | 4% | 7% |
| Fuente de Oro | 147 | 137 | 110 | 132 | 129 | 655 | -7% | -20% | 20% | -2% |
| Aguazul | 215 | 200 | 144 | 186 | 190 | 935 | -7% | -28% | 29% | 2% |
| Puerto Carreño | 227 | 211 | 152 | 207 | 188 | 985 | -7% | -28% | 36% | -9% |
| Uribe | 12 | 11 | 27 | 9 | 32 | 91 | -8% | 145% | -67% | 256% |
| Puerto Rico | 82 | 74 | 91 | 48 | 78 | 373 | -10% | 23% | -47% | 63% |
| Tamara | 49 | 43 | 33 | 24 | 31 | 180 | -12% | -23% | -27% | 29% |
| Mani | 88 | 77 | 54 | 39 | 91 | 349 | -13% | -30% | -28% | 133% |
| Cumaral | 613 | 536 | 823 | 516 | 466 | 2954 | -13% | 54% | -37% | -10% |
| Villavicencio | 5809 | 5034 | 5673 | 5585 | 4814 | 26915 | -13% | 13% | -2% | -14% |
| Cabuyaro | 46 | 39 | 27 | 43 | 52 | 207 | -15% | -31% | 59% | 21% |
| Paz de Ariporo | 310 | 252 | 264 | 403 | 357 | 1586 | -19% | 5% | 53% | -11% |
| Trinidad | 104 | 83 | 78 | 54 | 63 | 382 | -20% | -6% | -31% | 17% |
| Orocué | 65 | 51 | 74 | 76 | 68 | 334 | -22% | 45% | 3% | -11% |
| Nunchia | 86 | 65 | 50 | 57 | 55 | 313 | -24% | -23% | 14% | -4% |
| San martín | 151 | 114 | 95 | 120 | 100 | 580 | -25% | -17% | 26% | -17% |
| Vistahermosa | 48 | 36 | 17 | 22 | 38 | 161 | -25% | -53% | 29% | 73% |

| Municipality | 2015 | 2016 | 2017 | 2018 | 2019 | Total | 2015-2016 | 2016-2017 | 2017-2018 | 2018-2019 |
|---|---|---|---|---|---|---|---|---|---|---|
| Mesetas | 51 | 37 | 44 | 38 | 35 | 205 | -27% | 19% | -14% | -8% |
| Cumaribo | 54 | 39 | 27 | 35 | 25 | 180 | -28% | -31% | 30% | -29% |
| Hato Corozal | 116 | 83 | 73 | 79 | 66 | 417 | -28% | -12% | 8% | -16% |
| Pore | 209 | 138 | 171 | 120 | 141 | 779 | -34% | 24% | -30% | 18% |
| La Primavera | 111 | 65 | 56 | 47 | 55 | 334 | -41% | -14% | -16% | 17% |
| Santa Rosalia | 14 | 7 | 4 | 10 | 8 | 43 | -50% | -43% | 150% | -20% |
| La Salina | 4 | 2 | 1 | 3 | 2 | 12 | -50% | -50% | 200% | -33% |
| Sacama | 5 | 1 | 11 | 4 | 5 | 26 | -80% | 1000% | -64% | 25% |
| Arauca | 224 | 288 | 236 | 225 | 206 | 1179 | 29% | -18% | -5% | -8% |
| Arauquita | 400 | 417 | 300 | 334 | 328 | 1779 | 4% | -28% | 11% | -2% |
| Cravo Norte | 29 | 18 | 22 | 35 | 21 | 125 | -38% | 22% | 59% | -40% |
| Fortul | 198 | 359 | 199 | 113 | 104 | 973 | 81% | -45% | -43% | -8% |
| Puerto Rondón | 34 | 37 | 22 | 37 | 25 | 155 | 9% | -41% | 68% | -32% |
| Saravena | 464 | 673 | 318 | 272 | 275 | 2002 | 45% | -53% | -14% | 1% |
| Tame | 1158 | 687 | 438 | 602 | 570 | 3455 | -41% | -36% | 37% | -5% |

Source: UPRA © 2022 based on information SNR 2019, 2021

## 37.1. Rural real estate market dynamics indicator

Based on the information presented in the previous section on the legal acts registered in the region for the 2015-2019 time period provided by the SNR, a qualitative type indicator is established to obtain a better interpretation of the municipalities dynamics in the region at the departmental and regional level.

To calculate the indicator, the Dalenius-Hodges - DH (1959) method was used, which allows obtaining homogeneous groups by minimizing the variance within them, and to attenuate the intertemporal effect, a simulation was prepared for 10 thousand pseudo-random numbers using the set.seed()207 function of the R statistical package, based on a Gamma distribution with the shape and scale parameters calculated from the mean of the data set corresponding to the period of analysis.
As a result, two cut-off points "x" and "y" are expected to be obtained, which allow for the classification construction of the real estate dynamics as follows:

**Table 143. Resulting cuts for dynamic land market indicator**

| Cut-off point | Description of classification range | Name of classification |
|---|---|---|
| *x* | Up to "x" number of acts registered in the municipality | Low real estate dynamics |
| *y* | Greater than "x" number of acts registered in the municipality and up to ("y"-1) number of acts registered in the municipality. | Medium real estate dynamics |
| N.A. | Greater than and equal to "y" number of acts registered in the municipality | High real estate dynamics |

Source: UPRA © 2022

As an analysis universe, the legal acts that have a direct relation of ownership transfer were selected, going from 77.246 acts to 65.220 acts:

**Table 144. Total legal actions for land market dynamics indicator calculation**

| Legal Registration Act | 2015 | 2016 | 2017 | 2018 | 2019 | Total period |
|---|---|---|---|---|---|---|
| Adjudicates vacant properties | 462 | 94 | 62 | 81 | 119 | 818 |
| Purchase and sale | 11.293 | 12.709 | 11.036 | 10.827 | 10.808 | 56.673 |
| Swap | 55 | 48 | 30 | 34 | 36 | 203 |
| Mortgage | 2.414 | 2.002 | 1.042 | 1.030 | 919 | 7.407 |

[207] See: https://r-coder.com/fijar-semilla-r/

| | | | | | | |
|---|---|---|---|---|---|---|
| Auction | 21 | 29 | 23 | 22 | 24 | 119 |
| **Total** | **14.245** | **14.882** | **12.193** | **11.994** | **11.906** | **65.220** |

Source: UPRA © 2022

Applying the statistical processing for the Orinoquia region in the years of the information period, the following intervals of transactions or registered acts were obtained to establish the real estate dynamics.

**Table 145. Real estate dynamics intervals - Orinoquia**

| Real Estate Dynamics | Transactions recorded Range |
|---|---|
| Low dynamics | Up to 288 |
| Medium dynamics | Greater than 288 and less than or equal to 1729 |
| High Dynamics | Greater than 1729 |

Source: UPRA © 2022

When locating the number of registry acts or transactions by municipality, in the region there is a predominance of low real estate dynamics with more than 80% of the municipalities with more than 22% of the registered acts, contrary to the high dynamics that corresponds to 2% of the municipalities in all years, being Villavicencio the only municipality located in the department of Meta.
For the 2019 period, 85% (50) of the municipalities are in low dynamics, being all the municipalities in the department of Vichada, most of Arauca and 24 in Meta, 8 in medium dynamics located mostly in the Meta department, and 1 in high dynamics which as indicated corresponds to the Villavicencio municipality, this can be seen in the following table.

**Table 146. Real estate dynamics by year - Orinoquia**

| Real Estate Dynamics | 2015 | | 2016 | | 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act |
| Low dynamics | 81% | 24% | 80% | 22% | 86% | 28 % | 83% | 22 % | 85% | 24% |
| Medium dynamics | 17% | 38% | 19% | 47% | 12% | 34 % | 15% | 39 % | 14% | 42% |
| High Dynamics | 2% | 38% | 2% | 31% | 2% | 38 % | 2% | 38 % | 2% | 34% |

Source: UPRA © 2022


**Figure 109. Real estate dynamics 2019 - Orinoquia**
Source: UPRA © 2022

Observing the results, it is evident that the Meta department, by presenting a greater number of legal acts registered in some of its municipalities, shows a tendency to low dynamics at the regional level, so it is considered pertinent to carry out the exercise at the departmental level.

## 38. Arauca

In order to calculate the real estate dynamics indicator in the Arauca department, the universe of data is shown in Table 147:

**Table 147. Total legal acts for land market dynamics indicator calculation - Arauca**

| Legal Registration Act | 2015 | 2016 | 2017 | 2018 | 2019 | Total period |
|---|---|---|---|---|---|---|
| Adjudicates vacant properties | 60 | 6 | 6 | 3 | 1 | 76 |
| Purchase and sale | 1981 | 1967 | 1163 | 1256 | 1184 | 7551 |
| Exchange | 1 | | | | 3 | 4 |
| Mortgage | 338 | 346 | 161 | 126 | 115 | 1086 |
| Auction | 2 | | 2 | 2 | 1 | 7 |
| **Total** | **2382** | **2319** | **1332** | **1387** | **1304** | **8724** |

Source: UPRA © 2022

After applying the defined statistical processing, the cut-off points or intervals listed below were obtained:

**Table 148. Real estate dynamics intervals - Arauca**

| Real Estate Dynamics | Transactions recorded range |
|---|---|
| Low dynamics | Less than or equal to 217 |
| Medium dynamics | Greater than 217 and less than or equal to 543 |
| High Dynamics | Greater than 543 |

Source: UPRA © 2022

Taking the departmental parameters, Arauca had a high dynamic in 2015 and 2016, which significantly marked the trend, specifically in the Tame and Saravena municipalities. The 57% of the municipalities (4) are in a low dynamic, it is noteworthy that within these is the capital the municipality of Arauca.

**Table 149. Real estate dynamics by year – Arauca**

| Real Estate Dynamics | 2015 | | 2016 | | 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act |
| Low dynamics | 57% | 18% | 29% | 2% | 57% | 31% | 57% | 23% | 57% | 20% |
| Medium dynamics | 29% | 34% | 43% | 42% | 43% | 69% | 43% | 77% | 43% | 80% |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| High Dynamics | 14% | 47% | 29% | 55% | 0% | 0% | 0% | 0% | 0% | 0% | |

Source: UPRA © 2022

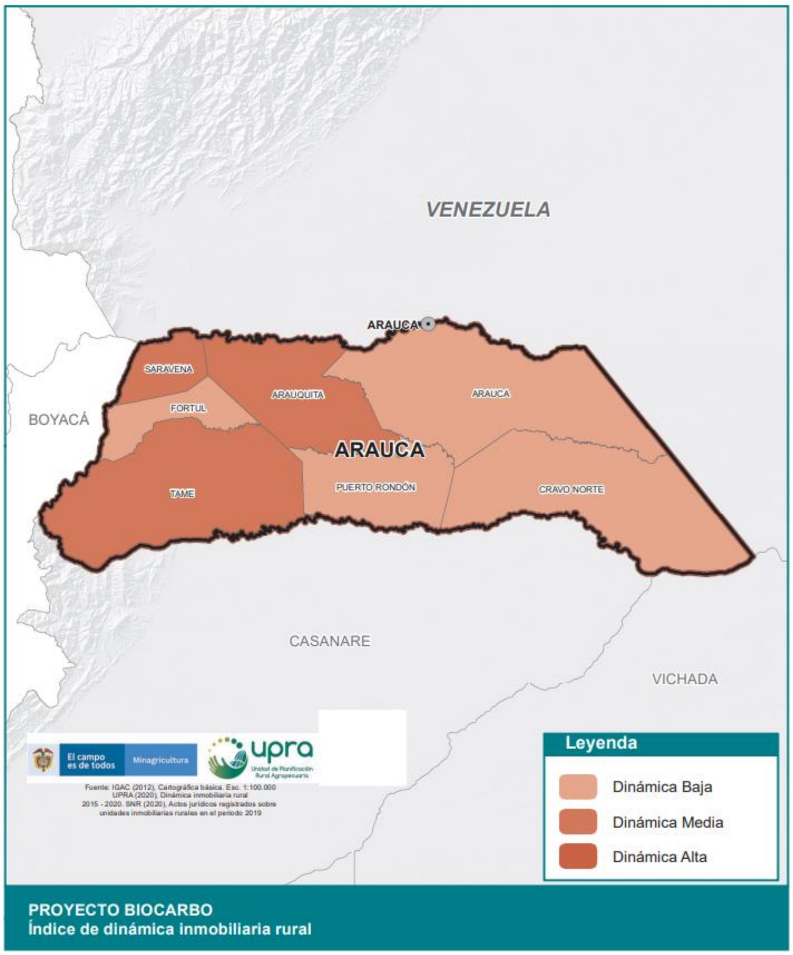



**Figure 110. Real estate dynamics 2019 - Arauca**
Source: UPRA © 2022

## 39. Casanare

In order to calculate the real estate dynamics indicator in the Casanare department, the data universe is shown in Table 150:

**Table 150. Total legal acts for land market dynamics indicator calculation - Casanare**

| Legal Registration Act | 2015 | 2016 | 2017 | 2018 | 2019 | Total period |
|---|---|---|---|---|---|---|
| Adjudicates vacant properties | 205 | 10 | 1 | 13 | 22 | 251 |
| Purchase and sale | 1.265 | 1.834 | 1.460 | 1.456 | 1.814 | 7.829 |
| Exchange | 4 | 13 | 4 | 5 | 7 | 33 |
| Mortgage | 256 | 241 | 331 | 170 | 128 | 1.126 |
| Auction | 2 | 4 | 1 | 4 | 6 | 17 |
| **Total** | **1.732** | **2.102** | **1.797** | **1.648** | **1.977** | **9.256** |

Source: UPRA © 2022

After applying the defined statistical processing, the cut-off points or intervals listed below were obtained:

**Table 151. Real estate dynamics intervals - Casanare**

| Real Estate Dynamics | Transactions recorded interval |
|---|---|
| Low dynamics | Less than or equal to 102 |
| Medium dynamics | Greater than 102 and less than or equal to 357 |
| High Dynamics | Greater than 357 |

Source: UPRA © 2022

Taking the departmental parameters, it can be seen that for Casanare there were high dynamics in all the periods except 2015 with 5% of the municipalities of the department, which corresponds to the Yopal municipality. 74% of the municipalities present low dynamics.

**Table 152. Real estate dynamics by year - Casanare**

| Real Estate Dynamics | 2015 | | 2016 | | 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act |
| Low dynamics | 74% | 38% | 74% | 30% | 79% | 34% | 84% | 35% | 79% | 24% |
| Medium dynamics | 26% | 62% | 21% | 30% | 16% | 26% | 11% | 26% | 16% | 28% |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| High Dynamics | 0% | 0% | 5% | 40% | 5% | 40% | 5% | 39% | 5% | 48 % |

Source: UPRA © 2022

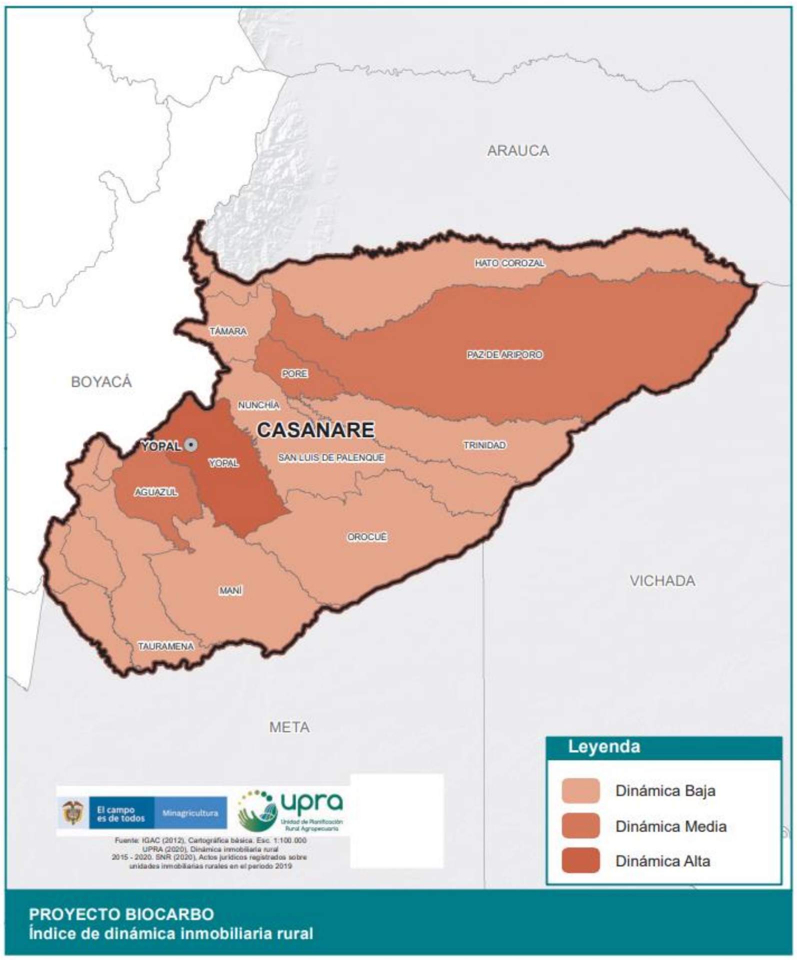



Figure 111. Real estate dynamics 2019 - Casanare
Source: UPRA © 2022

## 40. Meta

In order to calculate the real estate dynamics indicator in the Meta department, the universe of data is shown in Table 153:

**Table 153. Total legal acts for land market dynamics indicator calculation - Meta**

| Legal Registration Act | 2015 | 2016 | 2017 | 2018 | 2019 | Total period |
|---|---|---|---|---|---|---|
| Adjudicates vacant properties | 96 | 65 | 49 | 49 | 91 | 350 |
| Purchase and sale | 7801 | 8649 | 8244 | 7899 | 7616 | 40209 |
| Exchange | 45 | 33 | 24 | 29 | 26 | 157 |
| Mortgage | 1799 | 1397 | 538 | 725 | 668 | 5127 |
| Auction | 16 | 25 | 20 | 16 | 17 | 94 |
| **Total** | **9757** | **10169** | **8875** | **8718** | **8418** | **45937** |

Source: UPRA © 2022

After applying the defined statistical processing, the cut-off points or intervals listed below were obtained:

**Table 154. Real estate dynamics interval – Meta**

| Real Estate Dynamics | Transactions recorded range |
|---|---|
| Low dynamics | Less than or equal to 392 |
| Medium dynamics | Greater than 392 and less than or equal to 2352 |
| High Dynamics | Greater than 2352 |

Source: UPRA © 2022

Taking the departmental parameters, it can be seen that the Meta department presented a high dynamic in all the periods with 3% of the municipalities of the department, which corresponds only to the Villavicencio municipality. More than 76% of the municipalities present low dynamics, being extreme in 2018 and 2019 with 90% of the municipalities of the department.

**Table 155. Real estate dynamics by year – Meta**

| Real Estate Dynamics | 2015 | | 2016 | | 2017 | | 2018 | | 2019 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act |
| Low dynamics | 79% | 15% | 76% | 14% | 83% | 18% | 90% | 26% | 90% | 26% |
| Medium dynamics | 17% | 30% | 21% | 40% | 14% | 30% | 7% | 21% | 7% | 26% |
| High Dynamics | 3% | 55% | 3% | 45% | 3% | 52% | 3% | 53% | 3% | 48% |

Source: UPRA © 2022

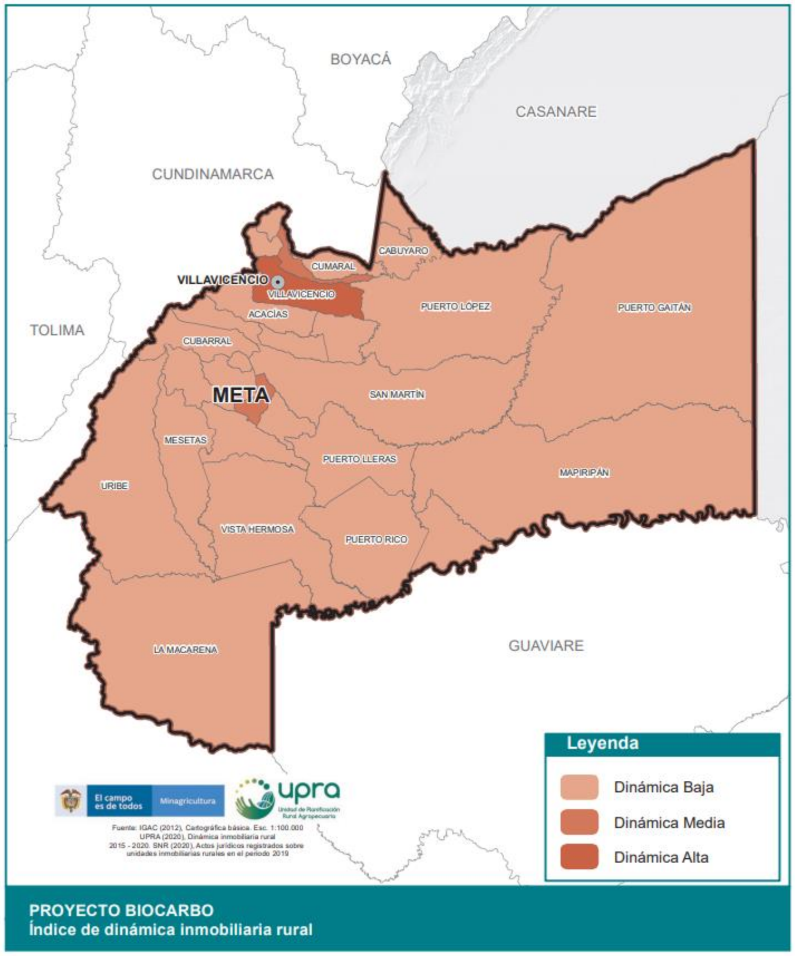



**Figure 112. Real estate dynamics 2019 – Meta**
Source: UPRA © 2022

## 41. Vichada

In order to calculate the real estate dynamics indicator in the department of Vichada, the data universe is shown in Table 156:

**Table 156. Total legal acts for land market dynamics indicator calculation - Vichada**

| Legal Registration Act | 2015 | 2016 | 2017 | 2018 | 2019 | Total period |
|---|---|---|---|---|---|---|
| Adjudicates vacant properties | 101 | 13 | 6 | 16 | 5 | 141 |
| Purchase and sale | 246 | 259 | 169 | 216 | 194 | 1084 |
| Exchange | 5 | 2 | 2 | | | 9 |
| Mortgage | 21 | 18 | 12 | 9 | 8 | 68 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Auction | 1 | | | | | 1 |
| **Total** | **374** | **292** | **189** | **241** | **207** | **1303** |

Source: UPRA © 2022

After applying the defined statistical processing, the cut-off points or intervals listed below were obtained:

**Table 157. Real estate dynamics intervals – Vichada**

| Real Estate Dynamics | Transactions recorded interval |
|---|---|
| Low dynamics | Less than or equal to 56 |
| Medium dynamics | Greater than 56 and less than or equal to 168 |
| High Dynamics | Greater than 168 |

Source: UPRA © 2022

Taking the departmental parameters, the Vichada department presented high dynamics only in 2015, 2016 and 2018 with 25% of the municipalities of the department, which corresponds to the Puerto Carreño municipality, for the other periods this municipality is in medium dynamics. In most of the periods, low dynamics predominate, except for the La Primavera municipality, which only in 2015 presented medium dynamics.

**Table 158. Real estate dynamics by year – Vichada**

| Real Estate Dynamics | 2015 | | 2016 | | 2017 | | 2018 | | 2019 |
|---|---|---|---|---|---|---|---|---|---|
| | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipality | % Act | % Municipalit |
| Low dynamics | 50% | 16% | 75% | 30% | 75% | 29% | 75% | 23% | 75 |
| Medium dynamics | 25% | 28% | 0% | 0% | 25% | 71% | 0% | 0% | 25 |
| High Dynamics | 25% | 56% | 25% | 70% | 0% | 0% | 25% | 77% | 0 |

Source: UPRA © 2022

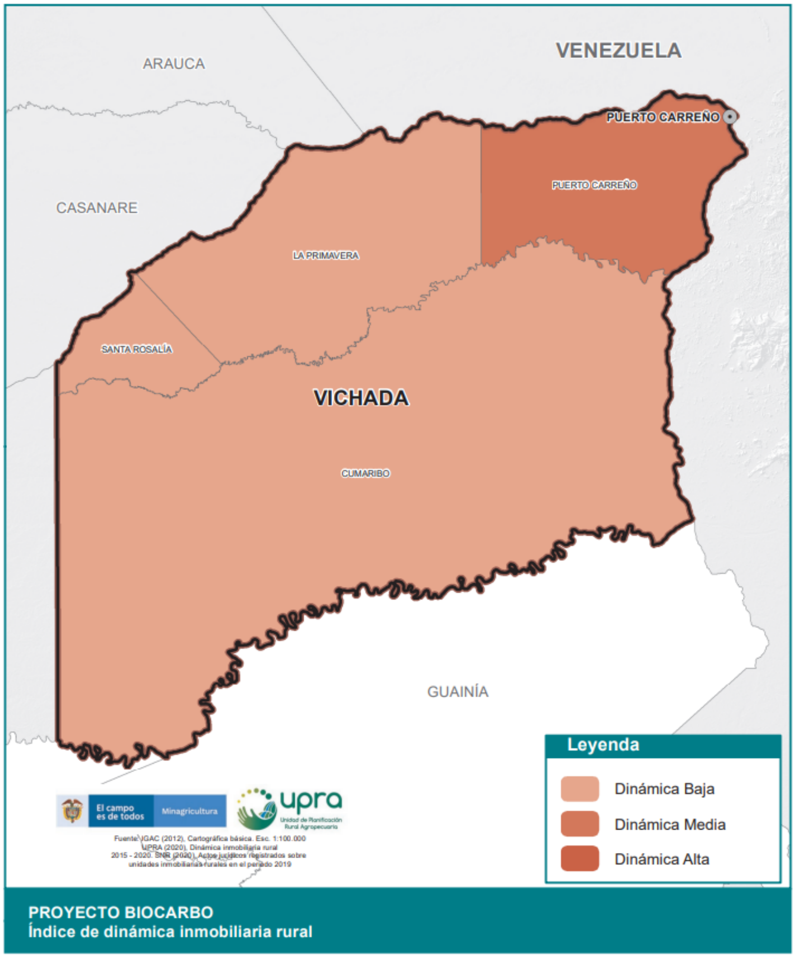



**Figure 113. Real estate dynamics 2019– Vichada**
Souurce: UPRA © 2022

## 41.1. Total Management Index of the Unified Rural Property Tax – (IGT IPUR in Spanish)

The unified property tax is an important source of income for the municipalities, since the State granted them the autonomy to collect it in order to favor improvements in quality of life, investing it in the different programs and projects framed in the municipal development plans.
Taking into account the importance of the collection of this tax, directly related to municipal development, UPRA has developed a collection management index or indicator, classified as follows:

**Table 159. Classification of rural unified property tax management indexes. 2019**

| Index range | Index level | Index condition |
|---|---|---|
| Greater than 0.80 | High | Outstanding |
| Greater than 0.60 to 0.80 | Medium high | Acceptable |
| Greater than 0.40 to 0.60 | Medium | Unsatisfactory |
| Greater than 0.20 to 0.40 | Low | Poor |
| Greater than 0.20 to 0.20 | Very Low | Critical |

Source: UPRA © 2022

For the IGT IPUR calculation, 2 parameters or inputs are required, which are transferred to indexes to perform the aggregation:

- Collection data reported by the municipalities to the Ministry of Finance and the General Accounting Office of the Nation in the CHIP-FUT[208]. This document works with information for 2019 for the rural area. It is important to clarify that this data depends on the report of each municipality, therefore, the available information is not found for all municipalities. Table *160* lists the number of municipalities by department for which information is available for the Orinoquia region, with the Meta department reporting the most municipalities with 62%, contrary to Vichada which only has information for 1 municipality (Puerto Carreño).

**Table 160. Municipalities by department with available information for the index calculation.**

| Departments | Municipalities with CHIP-FUT information | Total municipalities department | % Municipalities with CHIP-FUT information |
|---|---|---|---|
| Meta | 18 | 29 | 62% |
| Casanare | 10 | 19 | 53% |
| Arauca | 3 | 7 | 43% |
| Vichada | 1 | 4 | 25% |

**[208] Article 31 of Law 962 of 2005 requests the the Interior and Justice Ministry to coordinate the design and application of a single common form for national entities to collect the information required from territorial entities; in this sense, Decree 3402 of 2007 adopted the Single Territorial and Consolidated Form for Finance and Public Information (CHIP): The CHIP is an information system of the MHCP that channels financial, economic, social and environmental information from public entities (national, departmental, district and municipal) to the central government, control agencies and citizens in general, to support decision-making in macroeconomic and fiscal policy, as well as the definition, execution and administration of government plans.**

Source: UPRA © 2022 based on information CHIP-FUT 2019

- Validity of the cadastral appraisal update, considering that the cadastre is the basis for the property tax liquidation and the appropriate charges to the existing properties depend on its update.

## 42. Collection Management Index (IGR IPUR in Spanish)

It is defined as the level reached by the effective collection (the revenue collected by IPUR) with respect to the potential collection (the revenue that would be collected if all property owners paid the IPUR), in the evaluated period. This is how this index is calculated. The information required to calculate the potential collection is not easily obtained, so it is calculated as a proxy through the ratio between the effective rate and the appropriate nominal rate. IGR IPUR indicates the percentage of collection with respect to what should have been collected. For clarity, the definitions of the above rates are presented below.

- **Nominal rate:** it is equal to the income that the municipality should receive when all taxpayers pay the IPUR, divided by the cadastral appraisal. It is expressed in terms of per thousand.
- **Effective rate:** is the income actually received for IPUR, divided by the cadastral appraisal, expressed in terms of per thousand.
- **Adequate nominal rate:** this is the minimum nominal rate that the municipality is considered to have according to its category under Law 617 of 2000, as follows: category 1 and special, 10 per thousand; category 2 and 3, 9 per thousand; category 4 and 5, 8 per thousand; and category 6, 7 per thousand.

The IPUR collection, which is in charge of the treasuries or the municipal finance secretaries, is one of the variables that most impacts the condition of the aforementioned index, because in those municipalities where there are no appropriate rates, the expected resources are not obtained, a shortcoming that is evidenced in the critical condition of the IGR IPUR, with a higher percentage found in the Casanare department with 5 of the municipalities reported, the Vichada department is in an acceptable condition, but the data is biased considering that the information is processed in only one of the department's municipalities.

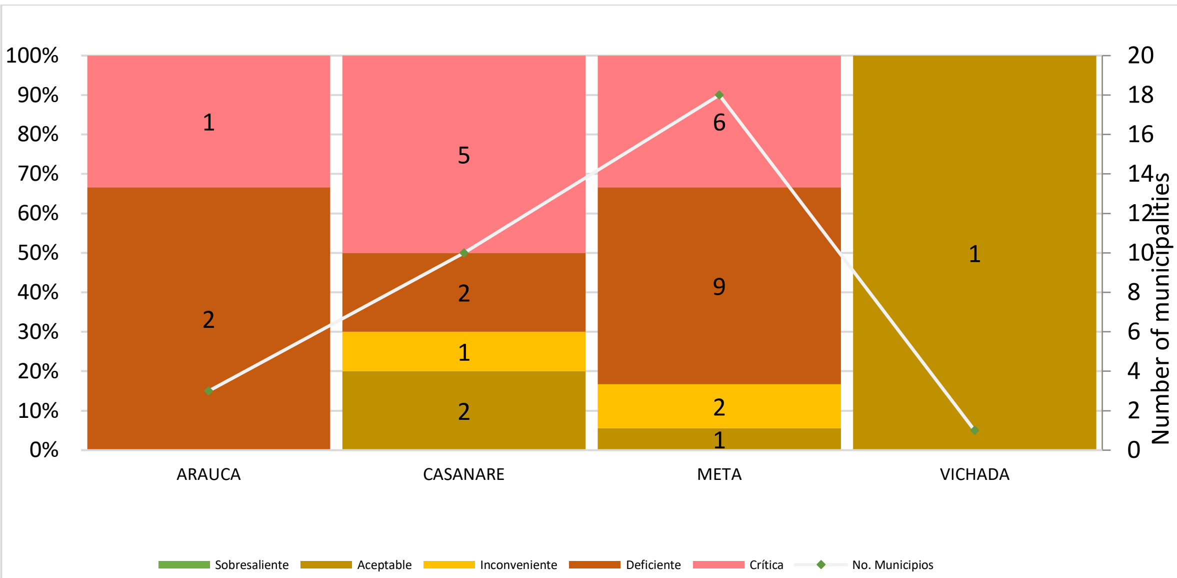



Figure 114. Number of municipalities according to collection status by department

Source: UPRA © 2022 based on information CHIP-FUT 2019

The following figure shows that nearly 47% of the region's municipalities are classified as critical and deficient in terms of collection management, which indicates that these 15 municipalities can improve their collection management under the current conditions.

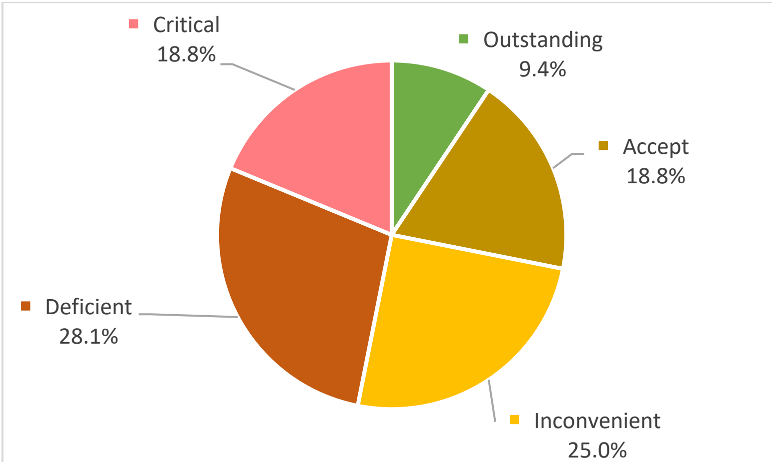



Figure 115. Collection Management Index, percentage of participation

Source: UPRA © 2022 based on information CHIP-FUT 2019

## 43. Cadastral appraisal update index (IAAC in Spanish)

It is equal to a value between 0 and 1 according to the age of updating or formation of the municipality's rural cadastre and indicates its level of updating. It is equal to a value between 0 and 1 according to the age of updating or formation of the municipality's rural cadastre and indicates its level of updating. Traditionally, cadastres have been classified as updated or outdated, depending on whether they are more or less than 5 years old. Legally, the cadastral appraisal is considered updated up to five years after the formation or the last cadastral update, period for which the IAAC is equal to 1. Table 161 shows the assigned classification:

Table 161. Classification of the rural cadastral appraisal update index

| Years since last update | Index condition |
|---|---|
| 0 a 5 | Outstanding |
| 6 | Acceptable |
| 7 | Unsatisfactory |
| 8 y 9 | Poor |
| Over 10 | Critical |

Source: UPRA © 2022

As described in chapter 2.1 of this document, there is a high level of outdated cadastral information in the region, directly affecting the collection management.

The following figures show a large number of municipalities in critical condition, that is, with more than 10 years of outdated information, especially in the Arauca department, where all the municipalities reported are in this condition.

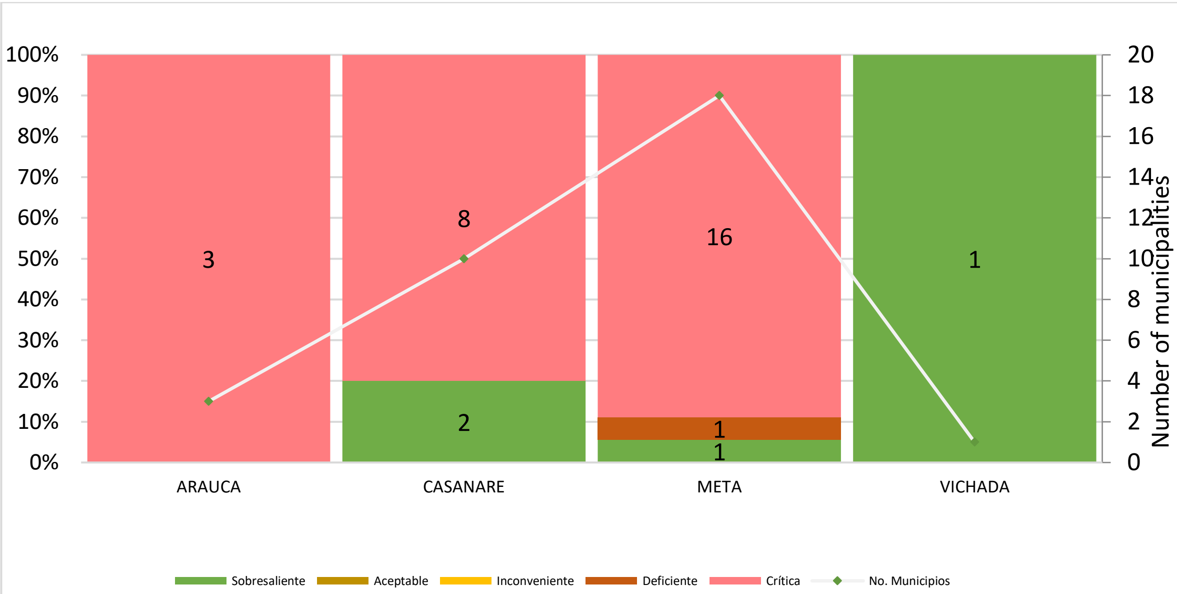



Figure 116. Number of municipalities according to condition of appraisal update by department

Source: UPRA © 2022 based on information IGAC 2019

At the regional level, nearly 72% of the municipalities with available information are in critical and deficient condition, i.e., more than 8 years out of date.

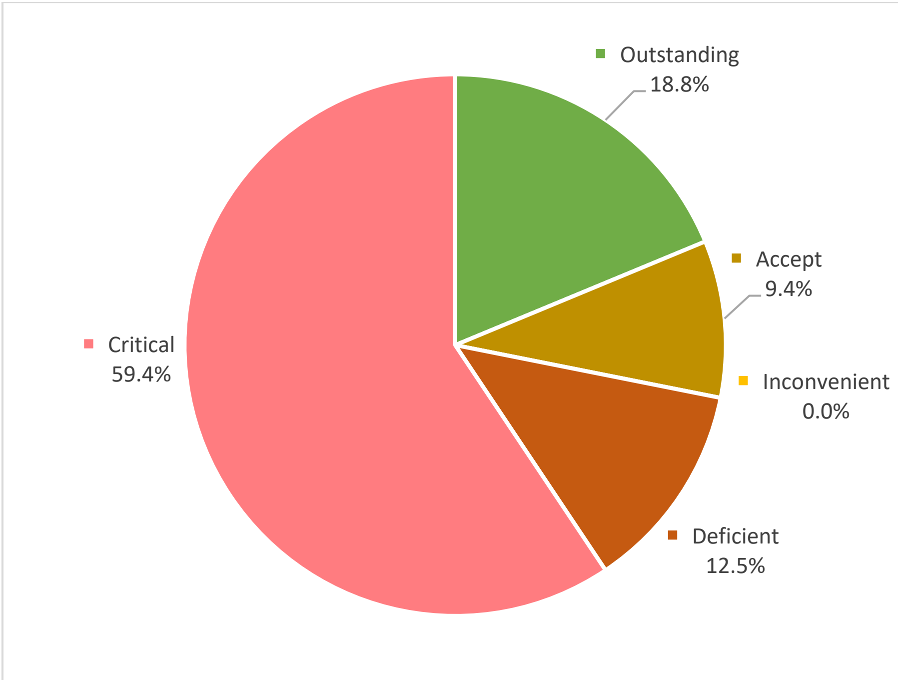



Figure 117. Cadastral Appraisal Update Management Index

Source: UPRA © 2022 based on information IGAC 2019

## 44. IPUR Total Management of the Unified Rural Property Tax index (IGT IPUR in Spanish)

The IGT IPUR is a composite index resulting from the aggregation of the IGR IPUR and the IAAC. The regional average of the IGT IPUR calculated for 2019 is 0,37 in poor condition; the lowest is the department of Arauca with levels below 0,2, i.e. critical, the highest is Vichada in acceptable condition, but it is recalled that it is on a single municipality (Puerto Carreño), the detail of the index is shown in the following figure.

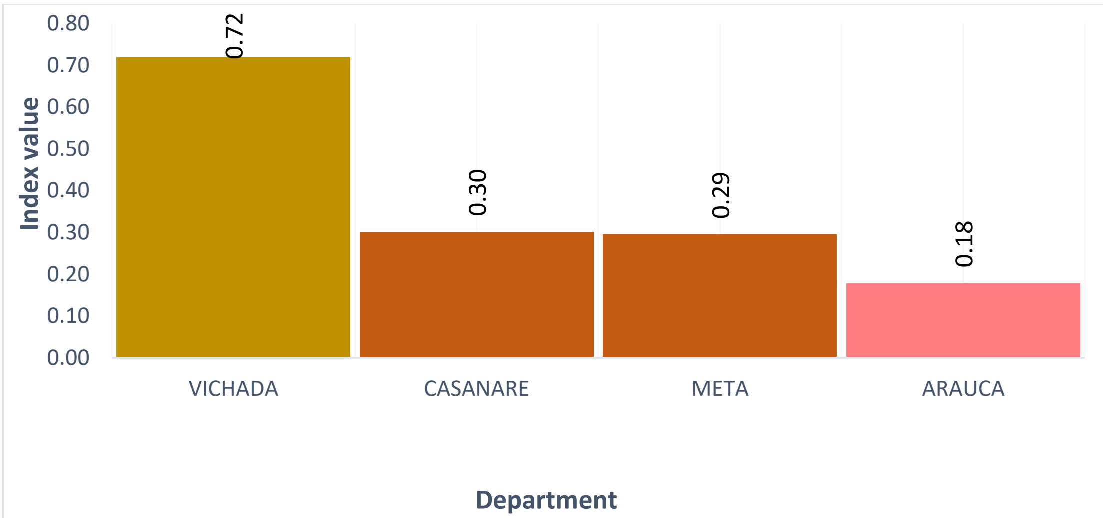



Figure 118. Total Management Index IPUR - department
Source: UPRA © 2022 based on information CHIP-FUT 2019, IGAC 2019

In relation to the rurality categories, the municipalities present low levels in terms of property tax management, which means that the condition of the index is deficient.

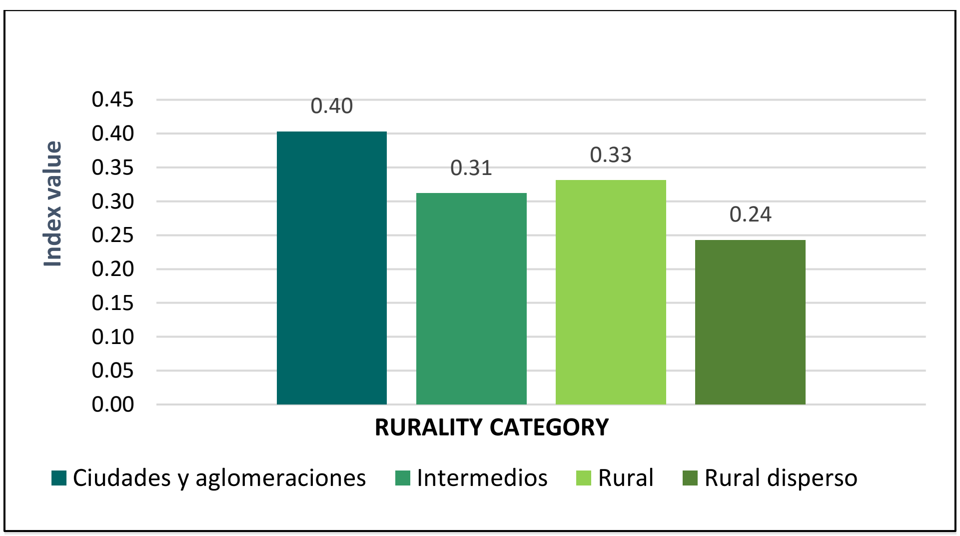



Figure 119. Total Management Index IPUR, according to rurality categories
Source: UPRA © 2022 based on information CHIP-FUT 2019, IGAC 2019, DNP 2019

It can also be determined that there are no municipalities with an outstanding index. The municipalities in the rural category of cities and agglomerations have 50% in a critical index and 50% in an acceptable index, with 2 municipalities in this category. The municipalities in the rural category are in an index condition between inconvenient and critical, with a higher percentage in deficient.

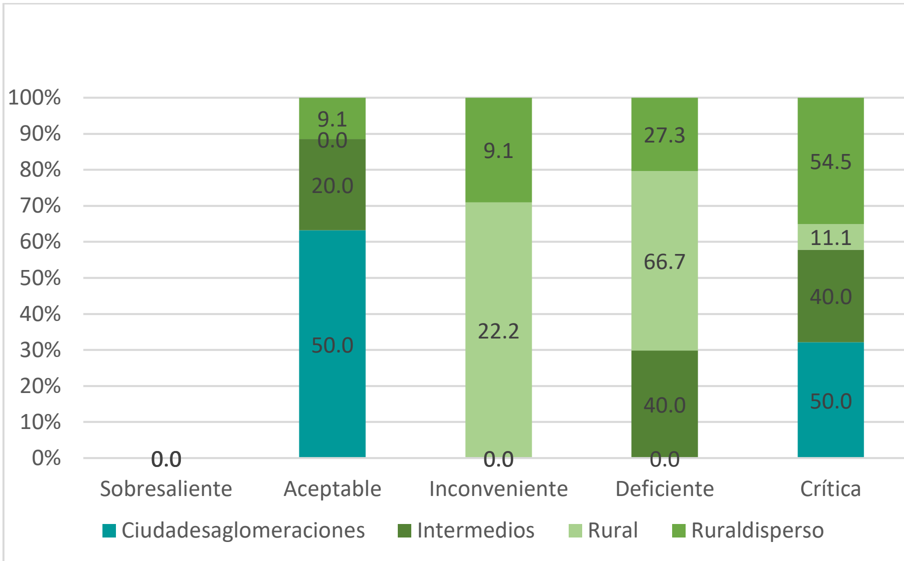



Figure 120. Total Management Index IPUR by rurality category
Source: UPRA © 2022 based on information CHIP-FUT 2019, IGAC 2019, DNP 2019

It can be determined that of the region's municipalities, 37,5% are in critical condition, 40,6% are in deficient condition, 9,4% are in poor condition, 12,5% are in acceptable condition and none are in outstanding condition.

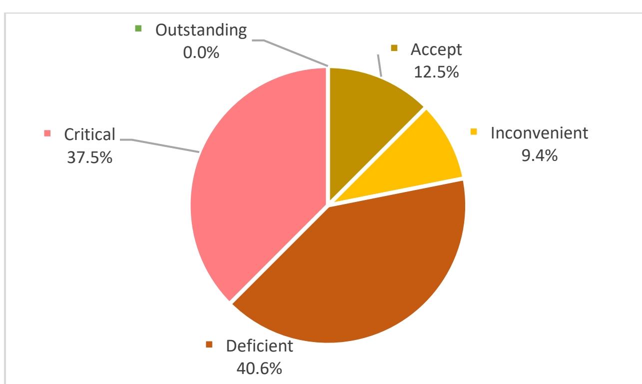



Figure 121. Total Management Index IPUR, percentage share
Source: UPRA © 2022 based on information CHIP-FUT 2019, IGAC 2019, DNP 2019

Most of the 32 municipalities in the region are in deficient and critical condition. Of the deficient condition that most municipalities have, none is in the category of cities and agglomerations, 4 are in the intermediate category, 6 in rural and 3 in rural dispersed.

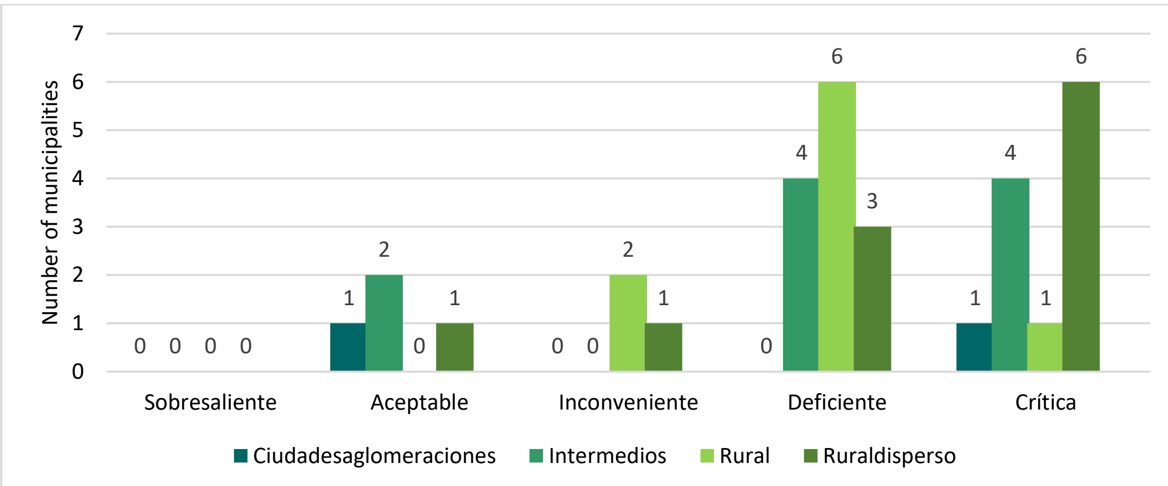



Figure 122. Number of municipalities by IGT IPUR status and rurality category
Source: UPRA © 2022 based on information CHIP-FUT 2019, IGAC 2019, DNP 2019

The analysis of the 32 municipalities shows the need to implement improvement actions as mentioned above, either to increase municipal property collections, update cadastral data or modernize collection, or even reduce IPUR rates.

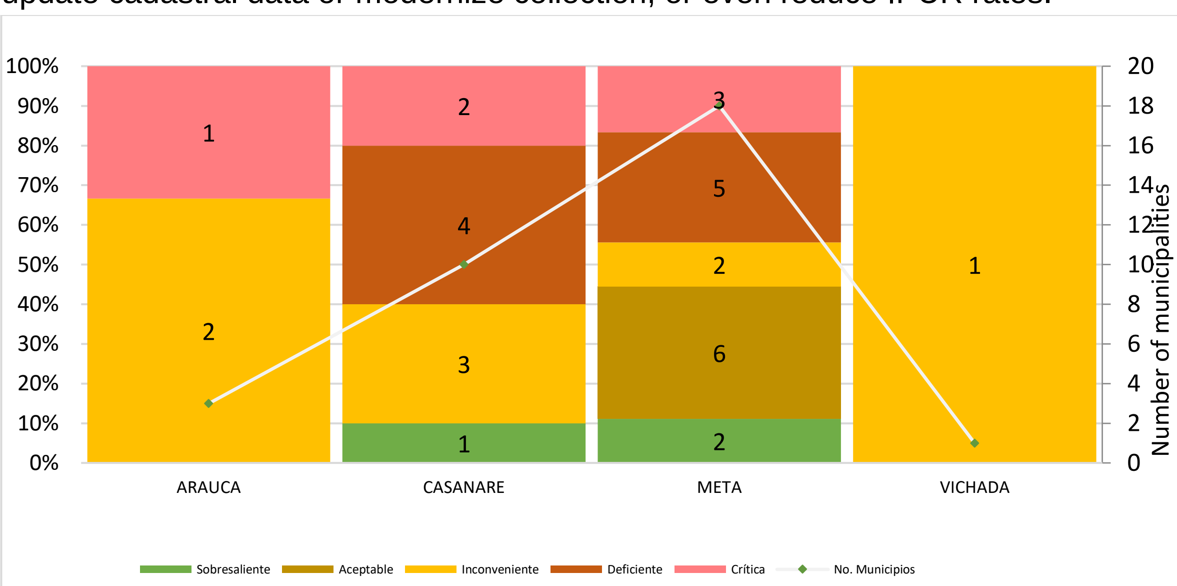


Figure 123. Number of municipalities according to collection status by department
Source: UPRA © 2022 based on information CHIP-FUT 2019, IGAC 2019, DNP 2019

It is considered convenient, given the project's presence in the territory, to provide this information to the municipalities, which is useful to identify the collection management, and to have the opportunity to implement improvement actions to increase the quality of life of their inhabitants.

### 44.1. Limitations to the ownership and use

## 45. Limitations to the ownership

The information provided by the SNR makes it possible to identify the types of legal acts, among these, those of limitations to the ownership or that confer restrictions, coded with 0300. For the Orinoquia region, from the information available for 2015-2019, those considered to directly affect tenancy in rural folios were selected.
In general, the acts with limitations to ownership are found mainly in the Meta department with 82% of the total number of acts, followed by Casanare with 12% (Table 162). Regarding cadastral properties, approximately 11% of the properties in the region have limitations to the ownership, concentrated, as indicated, in the Meta, where 82% of its properties would have this condition.

**Table 162. Total legal acts limitations to ownership**

| Departments | Number of acts | % acts | Properties Cadastre | % acts vs properties Cadastre |
|---|---|---|---|---|
| Arauca | 1118 | 4% | 136407 | 1% |
| Casanare | 3116 | 12% | 71160 | 4% |
| Meta | 20792 | 82% | 25277 | 82% |
| Vichada | 371 | 1% | 7929 | 5% |
| **Total** | **25397** | **100%** | **240773** | **11%** |

Source: UPRA © 2022 based on SNR information

Regarding the detail of the legal acts of limitations to ownership, 76% of the total corresponds to purchase and sale of quota rights[209], followed by easements[210] with 14%. Tabla 163 shows the acts available for the period indicated and their share.
Considering the details of the easements, the most frequent in the region is the passive transit easement[211] with 27% of the total, mainly in Villavicencio, followed by the passive aqueduct easement with 23% and the legal hydrocarbon easement with 17% (Table 164).

**Tabla 163. Legal acts limitations to the ownership**

| Legal act | Number of acts | % acts |
|---|---|---|
| Purchase and sale of quota rights | 19.330 | 76% |
| Easements | 3.473 | 14% |
| Civil trusts constitution | 564 | 2% |
| During the following five (5) years after its adjudication, it may only be mortgaged for agricultural credits (art.73 law 160/94). | 475 | 2% |
| Sale and purchase of bare ownership | 472 | 2% |
| Usufruct constitution | 372 | 1% |
| Ownership limitation | 243 | 1% |
| Declaration of reservation, boundary and creation areas of the PNN and PNR system. | 146 | 1% |
| Right of option to acquire INCODER according to art.73 law 160/94. | 91 | 0.4% |
| Sale and purchase usufruct | 86 | 0.3% |
| Adjudication liquidation of the conjugal partnership right of quota / bare ownership. | 75 | 0.3% |
| Donation of bare property / usufruct | 35 | 0.1% |
| Adjudication of bare property succession | 24 | 0.1% |

**209 Colombian Civil Code, Articles 2322, 2323, 2340, 1401. It is a contract in which a co-owner, being the owner of a right in proindiviso of a common property, of which he may dispose as such, but is not the owner of the entire common property or of a determined part thereof, transfers to a third party his share of the thing, without the consent of the other co-owners, without being entitled to that right until the partition and adjudication of the common property is carried out.**
**210 Colombian Civil Code, Article 879. It is a lien imposed on a property for the benefit of another property of a different owner.**
**211 Colombian Civil Code, Article 905. It is a servient property that suffers the encumbrance to allow the communication, use and welfare of another property.**

| | | |
|---|---|---|
| Demarcation | 9 | 0.04% |
| Right of use | 2 | 0.01% |
| **Total** | **25397** | **100%** |

Source: UPRA © 2022 based on SNR information

**Table 164. Legal acts Easements**

| Legal act | Number | % |
|---|---|---|
| Passive transit easement | 921 | 27% |
| Passive aqueduct easement | 815 | 23% |
| Legal hydrocarbon easement | 593 | 17% |
| Active transit easement | 476 | 14% |
| Pipeline easement | 388 | 11% |
| Active aqueduct easement | 131 | 4% |
| Gas pipeline easement | 98 | 3% |
| Sewage easement | 36 | 1% |
| Active water easement | 10 | 0.3% |
| Mining easement | 3 | 0.1% |
| Passive water easement | 2 | 0.1% |
| **Total** | **3473** | **100%** |

Source: UPRA © 2022 based on information from SNR

## 46. Hydrocarbons

It is important to identify the areas where there are claims and defined use in the hydrocarbon sector, as it can serve as a criterion or reference for the project to guide the areas where it is feasible to develop emission reduction agreements, because the areas where the development of this sector is located would limit the implementation of the project.
Based on information provided by the National Hydrocarbons Agency (ANH in Spanish), 49% of the Orinoquia geographic area is affected by the sector, either in production, which accounts for 4% of the area, or in exploration, equivalent to 22% of the area. Table 165 shows the participation of land states related to the hydrocarbon process and Figure 124 shows the geographic location of the zoning of land block states in the Orinoquia.

**Table 165. Land status ANH - Orinoquia**

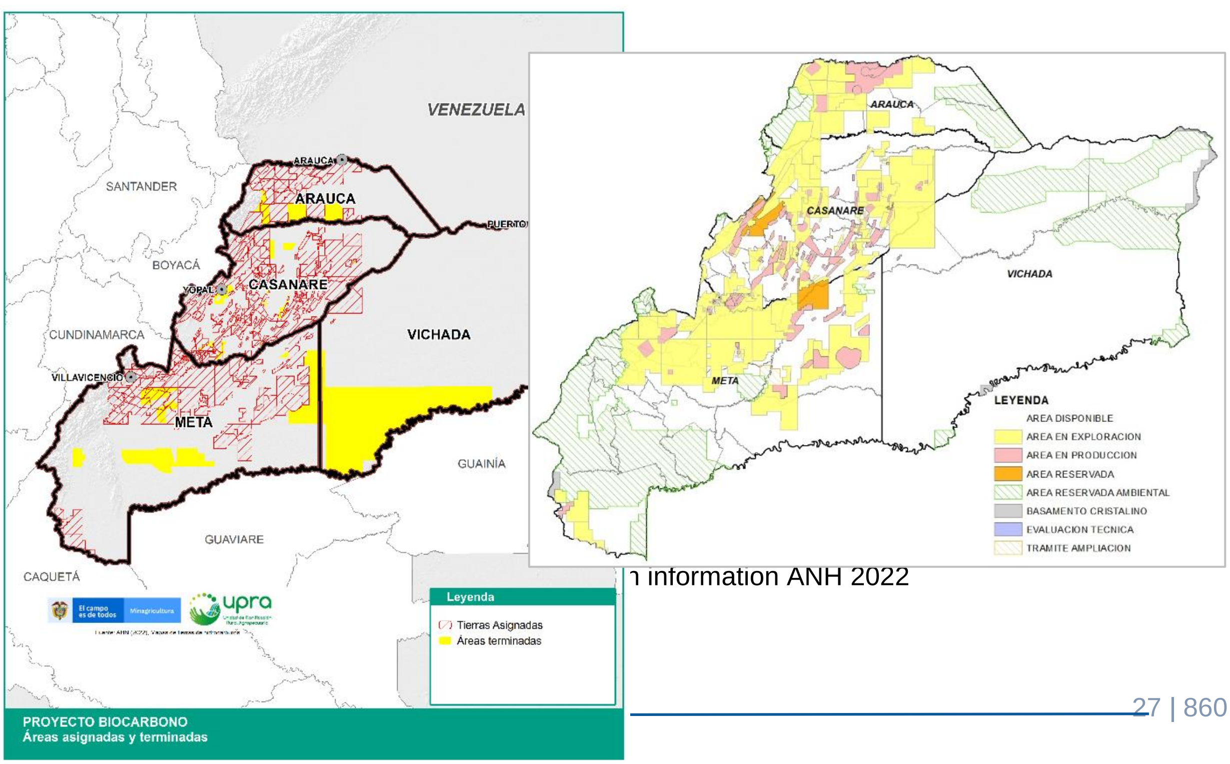
| Status | Area (ha) | % Area |
|---|---|---|

| | | |
|---|---|---|
| Available area | 11.626.191 | 51% |
| Reserved Environmental area | 4.909.736 | 22% |
| Under exploration area | 4.891.032 | 22% |
| Production area | 958.799 | 4% |
| Reserved area | 193.059 | 1% |
| Crystalline basement | 93.984 | 0.4% |
| Technical evaluation | 12 | 0.0001% |
| Expansion procedure | 48.129 | 0.2% |
| **Total** | **22.720.940** | **100%** |

Source: UPRA © 2022 based on information ANH 2022

Considering the status of the land blocks directly related to hydrocarbon activity, it is found that 43% of the area involved is in the Meta department, while the smallest proportion is located in Vichada, with 4% of the area. Specifically, the area in production exists in the 4 departments and has a greater presence in the Casanare with 44% of the area in this state. Likewise, in the area under exploration, Meta has the largest area with 46%. The reserved area is found in 2 departments, with the largest proportion in the Casanare department, with 62% of the area in this condition, see Table 166.

**Figure 124. Land map ANH - Orinoquia**




n information ANH 2022

**Table 166. State land ANH - Departments**

| Status | Arauca | | Casanare | | Meta | | Vichada | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Area (ha) | % Area | Area (ha) | % Area | Area (ha) | % Area | Area (ha) | % Area | |
| Under exploration area | 741.583 | 15% | 1.732.119 | 35% | 2.253.015 | 46% | 164.315 | 3% | 4.891.032 |
| Production area | 245.024 | 26% | 425.819 | 44% | 286.415 | 30% | 1.541 | 0.2% | 958.799 |
| Reserved area | | | 119.690 | 62% | 73.369 | 38% | | | 193.059 |
| Crystalline basement | | | | | 23.623 | 25% | 70.360 | 75% | 93.984 |
| Technical evaluation | | | 12 | 100% | | | | | 12 |
| Expansion procedure | | | 1.238 | 3% | 46.890 | 97% | | | 48.129 |
| **Total** | **986.607** | **16%** | **2.278.878** | **37%** | **2.683.311** | **43%** | **236.217** | **4%** | **6.185.013** |

Source: UPRA © 2022 based on information ANH 2022

Additionally, there are other blocks that indicate completed areas in terms of exploration and production processes as shown in Figure 124. Most of them are in the Vichada department with 63%, corresponding exclusively to exploration. Regarding finished production, most of the area is located in the Meta department with 87% of the area of this type.

**Table 167. Completed areas ANH - Departments**

| Completed area | Arauca | | Casanare | | Meta | | Vichada | | Total |
|---|---|---|---|---|---|---|---|---|---|
| | Area (ha) | % Area | Area (ha) | % Area | Area (ha) | % Area | Area (ha) | % Area | |
| Exploration | 205773 | 7% | 110303 | 4% | 668442 | 23% | 1925367 | 66% | 2909884 |
| Production | | | 16647 | 13% | 112899 | 87% | | | 129546 |
| **Total** | **205773** | **7%** | **126950** | **4%** | **781341** | **26%** | **1925367** | **63%** | **3039430** |

Source: UPRA © 2022 based on information ANH 2022

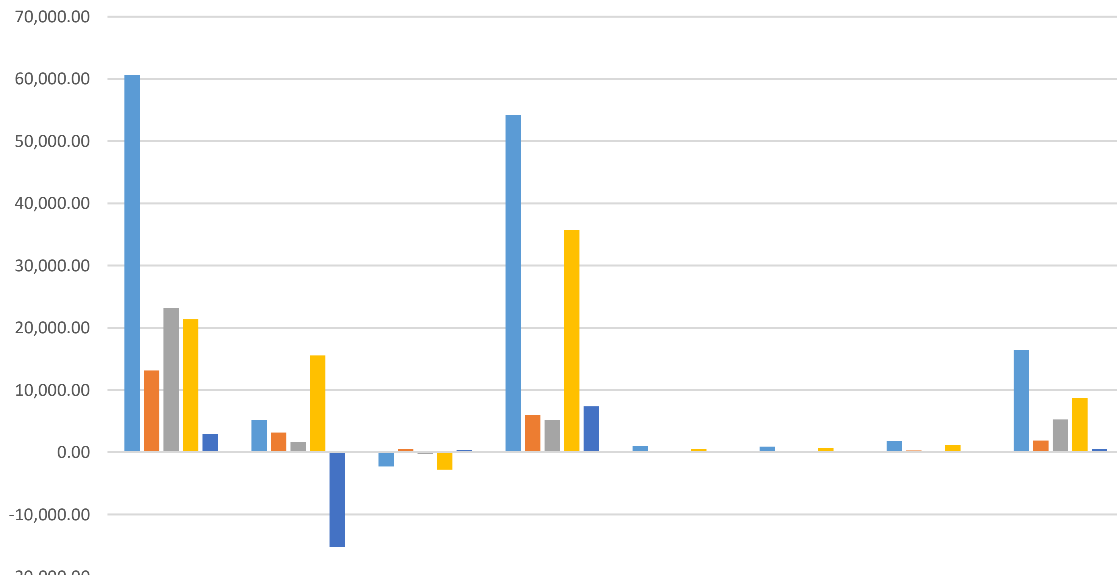
# 47. LAND USE CARBON EMISSIONS

Throughout this document it has been argued that the form of rural land tenure in the Orinoco region, typified by large properties in the hands of a few owners, with a focus on agricultural production, where extensive cattle ranching is especially

important, has some relationship with carbon emissions, particularly this form of cattle ranching. All of this is supported by empirical evidence obtained in other studies, such as the World Bank and DNP study ((Banco Mundial - DNP, 2012), which identifies extensive livestock farming as one of the main sources of emissions. However, so far, no statistical relationship has been formulated between some components of the Agriculture, Forestry and Land Use Change (AFOLU) sector and carbon emissions in the Orinoco region. For this reason, the objective of this chapter is to generate an approximation of the relationship between these variables, with the hypothesis of proving that the use of land for livestock is associated with an increase in carbon emissions.
To carry out the proposed exercise, the information provided by IDEAM on the maps of net carbon emissions by municipality and by different emission sources, for a period between 2010 and 2017, is used as a starting point. Then, the analysis is performed in two phases; i. In the first, a description of the cumulative net emissions between 2010 and 2017 is made to identify the main emission sources for the region and by department. ii. Once the emission sources are identified, in the second phase, 2 forms of log-linear ordinary least squares regression are formulated, which are applied for the whole region and each department. The objective of the regression is to identify the effect of the agricultural sector component on carbon emissions.

## 47.1. Descriptive carbon emissions analysis

The net carbon emissions identified by IDEAM are grouped into different groups and subgroups depending on the emission source. In the case of this analysis, emission sources associated with livestock, forestry, crops, pastures, wetlands, settlements, other land and aggregate sources and non-CO2 emissions from land are considered, as shown in Figure 125. According to this, the main sources of emissions are associated with livestock and pastures, which had a net emission in the Orinoco region of 60.624 and 54.202, respectively, equivalent to about 44% and 39% of emissions in the region. The departments that contributed most to emissions in these areas were, in the case of livestock, Casanare with about 38% and Meta with 35,2%, i.e., between the two departments they were responsible for about 73% of emissions associated with livestock. In the same sense, Meta was the main responsible for the net emissions related to pastures, with about 66% of the total.



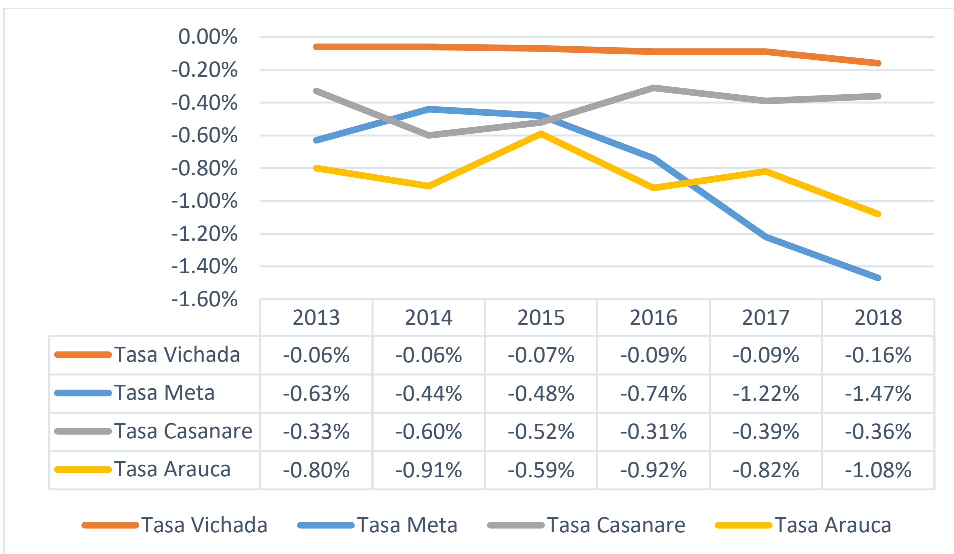

| | Ganadería | Forestales | Cultivo | Pastizales | Humedales | Asentamientos | Otras tierras | Fuentes_ag |
|---|---|---|---|---|---|---|---|---|
| Orinoquía | 60,624.74 | 5,170.34 | -2,303.43 | 54,202.25 | 982.19 | 875.76 | 1,840.22 | 16,402.84 |
| Arauca | 13,131.73 | 3,174.92 | 519.74 | 5,960.98 | 160.66 | 81.61 | 261.14 | 1,877.69 |
| Casanare | 23,178.59 | 1,676.85 | -309.34 | 5,158.94 | 159.69 | 64.31 | 245.73 | 5,288.43 |
| Meta | 21,382.45 | 15,563.56 | -2,828.87 | 35,722.07 | 515.48 | 633.99 | 1,143.99 | 8,722.11 |
| Vichada | 2,931.97 | -15,245.00 | 315.04 | 7,360.26 | 146.37 | 95.85 | 189.36 | 514.62 |

Orinoquía Arauca Casanare Meta Vichada

**Figure 125. Net $CO_2$ emissions from agricultural and livestock use**
UPRA © 2022 based on information from IDEAM

The results of emissions from livestock and pastures are consistent with the problems discussed in the section on property tenure, where it was identified that the Meta and Casanare departments are among the largest producers of bovine cattle in Colombia, and that the development of this product requires large extensions of territory, so that the tenure is characterized by large tracts of land owned by few owners, thus generating increases in carbon emissions.
On the other hand, Figure 125 also shows that the crops item shows a net reduction in emissions in the region equivalent to -2.303 units of $CO_2$, whose decrease is mainly due to the results of Casanare and Meta, which showed net reductions of -309,3 and -2.828, respectively.
A third interesting area of analysis is forestry. The land uses associated with this item have generated net emissions in the order of 5.170 units of $CO_2$, a result that seems counterintuitive in the case of forestry, since this use should generate carbon sequestration. However, what the emissions indicator is showing is that deforestation phenomena are occurring, thus causing forestry uses to increase $CO_2$ emissions because the capture capacity is reduced. In terms of forestry impact, Meta is the largest contributor to net emissions, with 15.563 units,

indicating possible deforestation to promote extensive cattle ranching activities. On the other hand, the Vichada department records a carbon sequestration of -15.245 units of CO2, showing that in this department forest plantations are being promoted that contribute to the reduction of carbon emissions.
To support the argument of deforestation as responsible for carbon emissions associated with forest use, Figure 126 presents the annual deforestation rate in each Orinoco department, whose results are consistent with the deforestation hypothesis, in the sense that the highest deforestation rate, measured as the loss of forest area, occurs in the Meta department, going from -0.63% in 2013, to a maximum of -1.47% of deforested area in 2018. At the other extreme, the Vichada department has the lowest historical deforestation rate, between -0.06% and -0.16% loss of area covered by forests.




| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|---|---|---|---|---|---|
| Tasa Vichada | -0.06% | -0.06% | -0.07% | -0.09% | -0.09% | -0.16% |
| Tasa Meta | -0.63% | -0.44% | -0.48% | -0.74% | -1.22% | -1.47% |
| Tasa Casanare | -0.33% | -0.60% | -0.52% | -0.31% | -0.39% | -0.36% |
| Tasa Arauca | -0.80% | -0.91% | -0.59% | -0.92% | -0.82% | -1.08% |

**Figure 126. Departmental deforestation rate (2013-2018)**
Source: UPRA © 2022 based on information from IDEAM

In summary, the behavior of the deforestation rate serves as an indicator to confirm that carbon emissions associated with forest use are caused by a decrease in forest area in the Department of Meta and a maintenance of this area in the Department of Vichada.
The initial analysis also shows that the crop typology registers reductions in net CO2 emissions. A detailed review of this item in Figure 127 presents the main crops that contribute to the reduction of emissions.

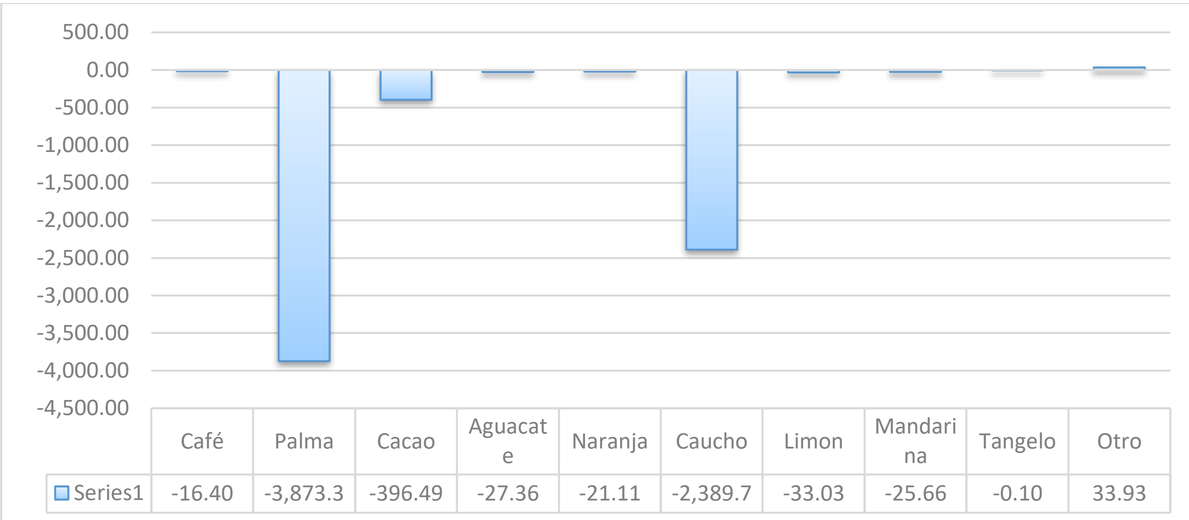



Figure 127. Net carbon emissions per crop in the Orinoco region
Source: UPRA © 2022 based on information from IDEAM

From the behavior of emissions by crop, it is clear that palm and rubber are classified as forestry crops, and these are the ones that generate the greatest reduction in emissions, with -3.873 and -2.389 units of CO2, respectively. At the departmental level, the main absorption crop for Arauca is cocoa, with -262,1, for Casanare it is palm, with -1.015, in Meta it is palm and rubber, with -2,806 and -2.274, respectively, and in Vichada it is mandarin, with -132,41.
The results of net emissions by crop can be taken as an indication of potentially beneficial crops for CO2 reductions by department, to focus efforts on promoting or expanding these crops. Likewise, the data are consistent with the productive focus that has been given in departments such as Meta, which has long been committed to the cultivation of oil palm, where 195.600 ha were planted in 2020 and produced about 32% of crude palm oil in the country. In a similar effort, the Vichada department has been working on expanding forest plantations, where it registers around 120 thousand ha, equivalent to 20% of the planted area at the national level, surpassed only by the department of Antioquia, which has 22% of the area (UPRA, 2021).
It is clear that the, net carbon emissions data seem to maintain a logical relationship with land use, in the sense that their behavior apparently responds to the implementation of certain modes of production that can increase or reduce CO2 emissions. In order to provide more support to this hypothesis, as well as to connect some locate indicators and property distribution with the level of emissions, a bases compilation at the municipal level was carried out to estimate the correlation between carbon emissions and use variables (agricultural, fallow, rest, stubble and forest), location variables (Arauca, Vichada, Casanare and

Meta) and distribution variables (Gini, Theil, lower disparity and upper disparity), as shown in Figure 128. According to the above, it can be observed that, in the first variables group, net carbon emissions show a positive correlation with agricultural uses, fallow land and stubble, with the order of 0,11, 0,2 and 0,09, respectively, while forest and rest land uses show a negative correlation, estimated at -0,17 for the former and -0,13 for the latter.
This first group of variables shows a sense of correlation in accordance with the initial hypothesis, because it is found that lands destined for uses close to livestock have a direct correlation with the level of carbon emissions, while conservation uses, such as forests, contribute to a lower level of emissions.

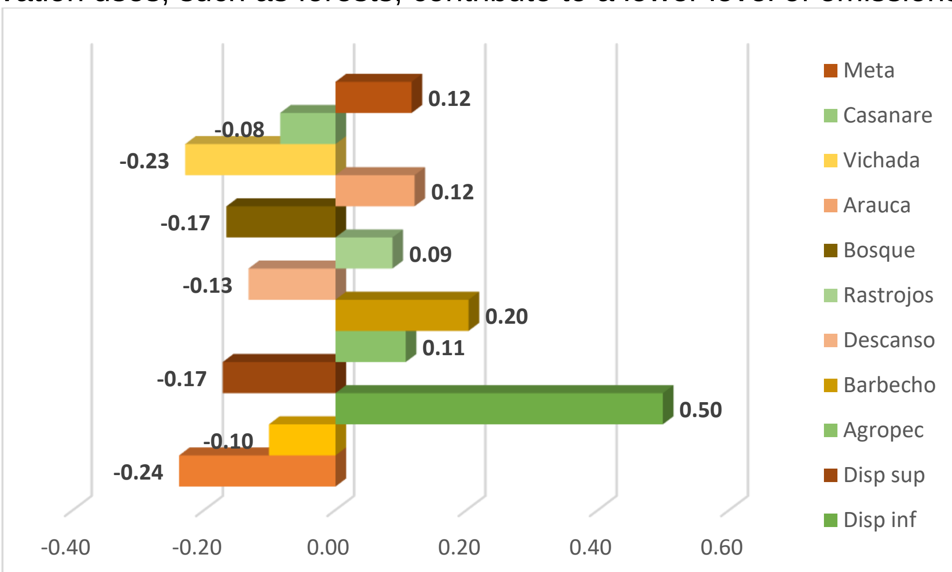



Figure 128. Correlation between carbon emissions and distribution variables
Source: UPRA © 2022 based on information from IDEAM

On the other hand, the correlation of the second group of variables shows that the Casanare and Vichada departments present a negative correlation, being particularly relevant in the latter, where a value of -0,23 was estimated, which shows the productive capacity that is being formed in Vichada to reduce carbon emissions, concentrated in forestry production. In the opposite direction, the Arauca and Meta departments reflect a positive correlation with emissions in the order of 0,12 for both, indicating that the prevailing form of production in these departments is contributing to higher net carbon emissions.
Finally, in the third group of variables, corresponding to distribution, the Gini, Theil and Superior Disparity indexes present a negative correlation, of -0,24, -0,10 and -0,17, respectively. According to these results, a greater inequality in land distribution, i.e., large properties owned by few persons, a higher heterogeneity in properties and an accumulation of area in the upper range of property area, contribute to a reduction in carbon emissions, a result that may be supported by

the fact that forest plantations require large properties, although it could also be a counterintuitive result because large properties destined to extensive cattle raising would tend to increase net emissions.
Correlation analysis seems to indicate that there is joint variability between carbon emissions and the three variables' groups. Now, to go a step further, it is necessary to apply a statistical inference exercise to validate or refute the descriptive results. Consequently, the following section formulates the econometric models that aim to calculate the estimators and possible relationships between land use and carbon emissions.

## 48. Econometric model - Model structure

To approximate the relationship between land use and carbon emissions in the Orinoco region, a log-linear model estimated by robust regression is proposed, using annual information on carbon emissions between 2010 and 2017 by emission source, distributed among the 4 departments of the Orinoco region. In total, there are 3.768 records in 10 variables.
In formal terms, the structure of the model is as follows:

$$\ln(EN_{it}) = \beta_0 + \beta_1 Livestock_{it} + \beta_2 Forestry_{it} + \beta_3 Wetlands_{it} + \beta_4 Pastures_{\ it} + \beta_5 Settlements_{it} + \beta_6 Others\_t_{it} + \beta_7 Sources\_Ag_{it} + \beta_8 Arauca_{it} + \beta_9 Casanare_{it} + \beta_{10} Meta_{it} + t + e_{it} \quad \textbf{(1)}$$

Equation 1 posits that the logarithm of net carbon emissions $\ln(EN_i)$[212], which refers to the difference between CO2 emissions in each department and what it captures of the same gas, is a function of use dummy variables, which identify whether the emission sources are caused by livestock, forestry, wetlands, grasslands, settlement or other land, as well as in other emission sources, between the years 2010 and 2017. In addition, location dummy variables are included to establish whether there are significant differences between departments to measure the change in emissions between locations for the same period. As a third component, a time variable (t) is included that captures the effect of the annual variation on carbon emissions, i.e., it corresponds to a control variable that isolates the effect of time and allows a more accurate estimation of the other explanatory variables effect.

**[212] When transforming the carbon emissions variable into natural logarithm, missing data were generated, therefore, the missing data were adjusted with the average of the rest of the sample.**

## 49. Results

The implementation of the robust regression for equation 1 generates the following results:

```
                    Robust linear Model Regression Results
==============================================================================
Dep. Variable:            log_emision1   No. Observations:                 3768
Model:                             RLM   Df Residuals:                     3756
Method:                           IRLS   Df Model:                           11
Norm:                           HuberT
Scale Est.:                        mad
Cov Type:                           H1
Date:                 Mon, 20 Feb 2023
Time:                         21:57:31
No. Iterations:                     23
=================================================================================
                    coef    std err          z      P>|z|      [0.025      0.975]
---------------------------------------------------------------------------------
const             1.9391      0.139     13.956      0.000       1.667       2.211
dum_gan           2.8874      0.108     26.622      0.000       2.675       3.100
dum_forest        0.8876      0.108      8.184      0.000       0.675       1.100
Humedales        -2.3766      0.108    -21.912      0.000      -2.589      -2.164
Pastizales        1.2283      0.108     11.325      0.000       1.016       1.441
Asentamientos    -1.6774      0.108    -15.466      0.000      -1.890      -1.465
Otras tierras    -1.5598      0.108    -14.381      0.000      -1.772      -1.347
Fuentes_ag        1.5631      0.108     14.411      0.000       1.350       1.776
Arauca            0.5650      0.132      4.289      0.000       0.307       0.823
Casanare         -0.3175      0.116     -2.738      0.006      -0.545      -0.090
Meta             -0.1992      0.113     -1.770      0.077      -0.420       0.021
t                -0.0486      0.012     -4.103      0.000      -0.072      -0.025
=================================================================================
```

**Figure 129. Robust log-linear regression model for carbon emissions**
Source: UPRA © 2022 based on information from IDEAM

The estimators of the different variables are statistically significant at 1% significance, with the exception of the dummy that identifies Meta, whose significance corresponds to 10%. Therefore, it can be affirmed that the selected variables justify the variability of the net carbon emission. With this first verification and before moving on to the indicators level, the following clarifications should be reiterated, i. The land use variables correspond to dummies that take the value of one when the emission data is associated with the selected use, and zero otherwise, then, to avoid the perfect multicollinearity problem, we exclude the crop variable, which is the one that presents the base scenario of the model, i.e., all the estimators of the other usage variables are taken in comparison with it. ii. The location variables are also dummy variables that take the value of 1 when the emission data corresponds to the reference department and 0 otherwise. As with the use variables, one variable is excluded, in this case Vichada, so the estimator of the other variables shows the change compared to the base scenario. iii. The time variable (t) is a categorical variable

that takes values between 1 and 8, to represent from the year 2010 with 1 to 2017 with 8.
After making the technical details of the model, the analysis continues with the behavior of the indicators. In this aspect, it can be affirmed that the presence of livestock use increases carbon emissions by 288%, pastures increase them by about 122% and forest use is associated with an increase of 88,7% in emissions. The estimators of livestock and pasture use are fundamental because they allow revalidating the initial hypothesis that extensive cattle raising is the main cause of carbon emissions in the Orinoco region, and therefore, it is a result that provides support to focus the efforts of the carbon emissions reduction program towards the reconversion of land used for extensive cattle raising for less polluting productive sectors, or to promote agreements with the cattle raising sector to reduce the amount of land used for cattle raising.
Another interesting estimator is the forest use, because it seems to show a counterintuitive result, reflected in the fact that its presence is generating increases in net emissions, when the opposite should be the case. However, what the indicator captures is that the presence of deforestation is generating an increase in carbon emissions within soils associated with forest use and, therefore, it is an indication that the reduction program should also focus on the promotion of reforestation programs in the territory as one of its central elements, or to be complemented with national conservation policy instruments.
In a complementary manner, the location aspect, which takes the Vichada department as the base scenario because it is the place where carbon is being captured in net terms, shows that, by changing the sample to the Arauca, an increase of 56% in net carbon emissions is generated. This effect is the opposite for Casanare and Meta departments, whose control leads to a 31,7% and 19,9% reduction in emissions with respect to the initial scenario. Finally, the time estimator indicates that each year emissions have been reduced by about 4,9% per year.
In summary, the model estimators allow consolidating the argument of the negative impact of the livestock sector on carbon emissions, together with a potential impact of deforestation and variability between departments, with the department of Arauca showing a greater negative effect. Based on these results, it is recommended that agreements to reduce carbon emissions in the Orinoco region focus on mitigating the impact of extensive cattle ranching, which is the predominant form in the region, together with the promotion of forest use to contribute to greater carbon sequestration, with special attention to the Arauca department.
As an additional exercise, starting from the fact that descriptive statistics showed an inverse relationship between crop use and net carbon emissions, an additional model is proposed to measure the relationship between different crop types as independent variables and the log net emissions as dependent variable, under a log-linear Ordinary Least Squares (MCO in Spanish) model, for the same period

between 2010 and 2017[213]. In formal terms, the following complementary model is formulated:

$$\ln(EN_i) = \beta_0 + \beta_1 Coffee_i + \beta_2 Palm_i + \beta_3 Cocoa_i + \beta_4 Avocado_i + \beta_5 Orange_i + \beta_6 Rubber_i + \beta_7 Mango_i + \beta_8 Lemon_i + \beta_9 tangerine_i + \beta_{10} Tangelo_i + \beta_{11} Arauca_i + \beta_{12} Meta_i + \beta_{13} Casanare_i + e_{it} \quad \textbf{(2)}$$

Equation 2 proposes that the logarithm of net carbon emissions $\ln(EN_i)$, is a function of crop type dummy variables, which identify whether the emission sources are caused by coffee, palm, cocoa, avocado, orange, rubber, mango, lemon, tangerine or tangelo crops. In addition, location dummy variables are included to establish if there are significant differences between departments to measure the change in emissions between locations, for the same period.
In summary, the results are shown in **Error! Reference source not found.**.

**[213] This regression does not include the time variable since there is not enough information to measure the change in carbon emissions for each year by crop type in a significant way. In this sense, we chose to approximate a cross-sectional analysis as the sum of emissions in all years.**

OLS Regression Results

| | | | |
|---|---|---|---|
| Dep. Variable: | log_Emision | R-squared: | 0.015 |
| Model: | OLS | Adj. R-squared: | 0.013 |
| Method: | Least Squares | F-statistic: | 6.079 |
| Date: | Sat, 14 May 2022 | Prob (F-statistic): | 2.10e-11 |
| Time: | 21:01:21 | Log-Likelihood: | 1267.2 |
| No. Observations: | 5181 | AIC: | -2506. |
| Df Residuals: | 5167 | BIC: | -2415. |
| Df Model: | 13 | | |
| Covariance Type: | nonrobust | | |

| | coef | std err | t | P>\|t\| | [0.025 | 0.975] |
|---|---|---|---|---|---|---|
| const | -1.4090 | 0.013 | -106.498 | 0.000 | -1.435 | -1.383 |
| cafe | -0.0908 | 0.012 | -7.343 | 0.000 | -0.115 | -0.067 |
| Palma | -0.0351 | 0.012 | -2.840 | 0.005 | -0.059 | -0.011 |
| Cacao | -0.0351 | 0.012 | -2.840 | 0.005 | -0.059 | -0.011 |
| Aguacate | -0.0351 | 0.012 | -2.840 | 0.005 | -0.059 | -0.011 |
| Naranja | -0.0329 | 0.012 | -2.663 | 0.008 | -0.057 | -0.009 |
| Caucho | -0.0351 | 0.012 | -2.840 | 0.005 | -0.059 | -0.011 |
| Mango | -0.0291 | 0.012 | -2.352 | 0.019 | -0.053 | -0.005 |
| Limon | -0.0369 | 0.012 | -2.982 | 0.003 | -0.061 | -0.013 |
| Mandarina | -0.0210 | 0.012 | -1.698 | 0.090 | -0.045 | 0.003 |
| Tangelo | -0.0351 | 0.012 | -2.840 | 0.005 | -0.059 | -0.011 |
| Arauca | -0.0207 | 0.013 | -1.616 | 0.106 | -0.046 | 0.004 |
| Casanare | -0.0347 | 0.011 | -3.074 | 0.002 | -0.057 | -0.013 |
| Meta | -0.0426 | 0.011 | -3.891 | 0.000 | -0.064 | -0.021 |

| | | | |
|---|---|---|---|
| Omnibus: | 2988.097 | Durbin-Watson: | 1.579 |
| Prob(Omnibus): | 0.000 | Jarque-Bera (JB): | 1144536.230 |
| Skew: | 1.496 | Prob(JB): | 0.00 |
| Kurtosis: | 75.752 | Cond. No. | 14.0 |

Figure 130. Log-linear regression of emissions by crop type
**Source:** UPRA © 2022 based on IDEAM information

This regression shows that the implementation of coffee, cocoa, avocado, orange, rubber, mango, lemon, tangerine and tangelo crops have inverse estimators to carbon emissions, that is, as each type of crop is increased by one unit, there is a reduction of between 9,8% in the case of coffee and 2,1% for tangerine crops.

The results of this last regression allow inferring that the indicated crops are the ones that could be promoted in the Orinoco departments, provided that the land use allows it, in order to contribute to the reduction of carbon emissions.

In general terms, the land tenure structure in the Orinoco region is designed to promote extensive cattle ranching and contributes to the deforestation of forest areas, because it is characterized by large properties owned by private landowners, with a high degree of inequality and focused on livestock production, with a high level of informality. Under these conditions, the success of the carbon emissions reduction program must involve the livestock sector to achieve land use reconversions or to promote an intensive livestock farming scheme. In addition, it was found that it is vitally important to increase the forest area to increase the capture of emissions, as is being done in Vichada with commercial forestry crops. Finally, it was noted that there are some crops that can contribute to reducing emissions, mainly tree products, which will require a more detailed study of their potential in the region, but which could be studied, such as rubber, palm and some citrus fruits, among others.

# 50. CONCLUSIONS

The tenure and property structure in the Orinoco region is characterized by few owners with large extensions of territory, where agricultural use predominates, especially cattle ranching, with greater participation of private property, although with a representative presence of collective territories and the State, mainly in the Department of Vichada.

Based on the tenure structure that characterizes the Orinoco region, and taking into account the diagnostic information, together with the identification of the range of rights in the region, approached from the individuals and communities relationship associated with land tenure, it is found that, in view of the proposal of an Emission Reduction Program - ERP -, it is feasible to recognize an effective participation of owners, holders, possessors, occupants, tenants, among others, in a hypothetical Emission Reduction Program and with its corresponding distribution of benefits, through agreements and Sub Agreements that should be managed in a concerted and participatory manner with all potential beneficiaries interested in participating in the program.

In the characterization process, it was found that the Orinoco region has diverse tenure typologies with varying formality degrees, with different conditions and permitted land uses. Therefore, in order to promote greater effectiveness of the ERP, it should involve all the agents involved and carry out a case-by-case analysis to establish how they can participate in the program.

Therefore, it is possible to identify that the agreements on this program could be approached from two main focuses. In the first one, there are agreements with large land owners, which are the ones with the largest land area. This would contribute to the generation of a greater impact with less management effort, since economies of scale could be taken advantage of in large sustainable projects and would contribute to a greater reduction of carbon emissions, although with economic benefits for a reduced group. In the second approach, it is relevant to work on collective agreements with small landowners (study the potential of ZRCs if they are established) to promote sustainable projects within the framework of the ERP, in such a way that a larger area is covered than would be achieved with individual agreements, and that in turn, economic benefits are distributed among a larger number of people who have land tenure relations.

However, for the materialization of any of the approaches, the analysis on tenure that has been carried out in the framework of the project must be considered, as well as the emissions that are reduced or retained, are associated to the relationship that exists between the individual, the community and the land. This indicates that the two approaches can be implemented, but prior to their application, legal clarity must be generated on the possibility of benefiting land tenure holders, with emphasis on landowners, with this program.

The condition of few owners in large extensions of territory, with a high participation of private owners with an agricultural focus and high inequality in land ownership, concludes that the productive scheme determined the carbon emissions generation because its focus is centered on extensive cattle raising, mainly in the Casanare and Meta departments. Although commercial forestry crops, such as palm and rubber, have also become important, especially in the municipalities of Meta and Vichada. In summary, two sectors are being promoted that have opposite effects on net carbon emissions, since extensive cattle ranching is one of the sectors with the highest emissions, while forestry is one of the absorption sectors.

Based on the statistical analysis, it has been concluded that carbon emissions in the Orinoco region are mainly associated with extensive cattle ranching and deforestation processes. This conclusion does not mean that a negative connotation should be given to cattle ranching, a practice that in addition to its economic impact also has cultural roots in the region, but rather that a useful approach would be to work hand in hand with livestock producers (large and small) to develop sustainable cattle ranching. Therefore, it is recommended that the livestock sector be involved in the ERP to ensure greater effectiveness of the program, looking for land use reconversion towards less polluting sectors or to explore the possibility of implementing intensive livestock farming schemes.

Regarding deforestation, there is a need to boost forest plantation programs such as those promoted in the Vichada and Meta departments. In the latter, the program should be accompanied by a preservation policy that guarantees the presence of institutions to raise awareness and prevent deforestation of environmental reserve areas. Here, the complementarity of national conservation policies in environmental protection areas and the dynamization of civil society reserves become relevant, as the most representative figures of social responsibility.

As a complement to the agreement approaches, it is necessary to specify that these should be developed in project areas that do not present conflicts associated with land tenure and should take into consideration the restriction generated by informality for the implementation of the ERP, since these are aspects that limit the scope of the project, especially in a region such as the Orinoco, where the informality index is around 46% of the area registered in the cadastral base. Under this precept, another of the fronts on which work must be done is the regularization of land tenure in the Orinoco region, where a high general incidence has been demonstrated and whose highest point is registered in Vichada with more than 60% of the registered area in informal conditions, and where municipalities such as Barranca de Upía in Meta reach levels of more than 80% of informality. In this regard, the ERPD should promote complementary regularization instruments for private tenure owners so that they can access the program and achieve a greater distribution of benefits, as well as a greater impact, because under current conditions, the margin for action would be restricted to the formal tenure portion, as long as the carbon sequestration rights are clear.

Advancing a land tenure regularization process will contribute to provide solutions to land use, occupation and tenure conflicts, thus clarifying the individuals and areas that may be beneficiaries of the program. According to the regularization strategy defined by (Borda, Otalora, Quintero, & Rodriguez, 2022) the process to be implemented is composed of two stages; preliminary and execution. The first stage proposes actions to be taken by the governments to generate the necessary conditions for the implementation of the regularization strategy. Among these actions, which are considered to be short and medium term, are: *i. Consultation meetings with institutions related to land formalization processes. ii. Formulation of a portfolio of land office services. iii. Information update related to the informality of land tenure and similar diagnoses. iv. Prioritization of municipalities to intervene. v. Inter-institutional roundtables for the operation of the Multipurpose Cadastre. vi. Inter-institutional roundtables for the updating of planning instruments. vii. Management of the local authorities in the articulation of the actors linked to the regularization processes. And viii. Interinstitutional planning process* (Borda, Otalora, Quintero, & Rodriguez, 2022). In general terms, the diagnosis in this document contributes to the regularization strategy, in the understanding that it provides information on the informality degree in the Orinoco region, through an analysis approached from the regional, departmental and municipal levels, from which it is possible to prioritize the territories that require greater attention from the strategy, according to the degree of informality that is occurring.

In addition to the general conditions, it is pertinent that the implementation of the ERP in the Orinoco region consider the collective territories, especially in Vichada where the indigenous communities have about 20% of the registered area, in order to determine the potentialities and limitations of advancing agreements with these actors in the territory. Based on this premise, the materialization of the ERP implies the realization of workshops and previous consultations with the communities, in order to socialize the program, benefits and responsibilities that their participation would generate, as well as to identify the availability of the communities to participate in the program. After the preparation or preliminary stage, the regularization strategy contemplates the execution stage, which (Borda, Otalora, Quintero, & Rodriguez, 2022) define as *"...the specific actions* *required for a suitable implementation that ensures and consolidates the maintenance of the ETGRPR in the long term...*".

In accordance with the above, bearing in mind respect for the indigenous rights through prior consultation, agreements must be reached with collective owners, such as indigenous reserves. Additionally, an area of risk was highlighted by identifying areas where requests have been made by these communities, either indigenous reservations or black communities that could eventually follow the legal process of adjudication and thus, change their regulations for the implementation of the program.

From the construction of the ERP, the strengthening of the institutional framework of the agricultural sector should be supported, in addition to working on property regularization issues, it is necessary to promote the integral strengthening of the agrarian and environmental sectors. This point is of particular relevance, since the regulation process requires the inter-institutional work of various entities, such as the National Land Agency, the Ministry of Agriculture, IDEAM, UPRA, IGAC, the governors and mayors' offices that are part of the Orinoco region, among others, which must work in a coordinated manner to make the regularization strategy proposed by the Biocarbon project viable.

In the absence of regularization of forest carbon ownership, in order to build an ERP, agreements and sub-agreements should be made with the individuals identified in the range of rights (owners, holders, possessors, indigenous communities, etc.), which will avoid conflicts and clarify aspects related to possible Benefit Sharing. In each case, a legal analysis will be required to determine the quality of the domain that each agent has over a given property, hence the regularization of tenure is fundamental.

Regarding the construction of the ERP, land use limitations outside the agricultural frontier should be considered. This aspect requires special attention because the frontier area represents about 70% of the registered area in the Orinoco and this would be the initial object of benefit from the emission reduction agreements. In the remaining 30% are the environmental conservation figures, whose function is to preserve an environmental balance, normally administered by the State, although with some properties managed by the private sector.

Precisely, the role of the areas outside the border in the framework of the ERPD is based on promoting reforestation processes and promoting conservation workshops in the areas that are presenting a change in the uses to which they are allowed.

During the characterization of the environmental figures in the Orinoco region, it was found that these correspond to large properties, mainly owned by the State or private owners, with a greater distribution of large properties to the State. It was also found that the main economic destination is agriculture and livestock. In general, for the purposes of implementing the carbon emission reduction program (ERPD in Spanish), in the environmental figure zones, agreements with private owners can be explored to implement sustainable projects, but it should also be taken into account that the State has a high importance in terms of area, so joint work with public environmental protection entities will be required to complement the program and generate synergies with the conservation instruments implemented by the State.

Likewise, it is relevant to evaluate the potential of social property management figures, especially the ZIDRES, which are conceived for implementation in remote territories. Therefore, the promotion of agreements within the framework of the ERP could generate indirect benefits associated with the reduction of carbon emissions, making the implementation of ZIDRES viable, which, given market conditions, have not shown the capacity to generate attractive economic benefits. Under this scenario, the adaptation of the ERP to the ZIDRES would make it possible to overcome their limitations in terms of minimum infrastructure for the transportation and marketing of products, isolation from the most important urban centers, and high costs of productive adaptation.

The implementation of the ERP may present limitations within the formal properties, due to the fact that there are other sectors that also have productive bets in the territory but do not necessarily go in the same direction of mitigating reduction emissions, such as explorations in the hydrocarbon and mining sectors. With this precedent, the ERP should consider the potential impacts that these sectors can generate, in terms of area limitation and increases in carbon emissions.

In addition to the aspects of land tenure and ownership, the implementation of the ERPD is framed within the interventions contained in chains IV and V of the BioCarbon program. The first is related to the reduction of deforestation, which includes: i. The generation of technical capacities to develop sectoral planning and management instruments to avoid deforestation. ii. Strengthening communication and citizen participation for forest conservation. iii. Strengthening of administrative capacities for the prosecution and management of environmental crimes. iv. The implementation of actions to control illegal economies that drive deforestation. And v. Generation of monitoring and follow-up schemes for territorial interventions associated with deforestation control.

The second chain includes: i. Environmental and productive management of the rural territory at different scales. ii. Strengthening of planning processes and capacities to make progress in climate change adaptation and mitigation. iii. Articulation of financial instruments and incentives to make the reduction emissions viable and increase the regional ecosystems resilience. And iv. Agricultural extension and environmental education aimed at low-carbon rural development.

The impact of a carbon emission reduction program depends on the capacity to promote complementary elements, such as the reconversion of the productive structure concentrated on extensive cattle ranching, the dynamization of the forestry sector, and institutional and community efforts to regularize land tenure and monitor deforestation activities.

Based on the results of the diagnostic, it is pertinent to affirm that the challenges associated with potential conflicts in land tenure and use should be addressed on a case-by-case basis to establish the relevance or impossibility of developing agreements and sub-agreements related to the ERP implementation in properties that are under any of these conditions. In this process, it will be very important to have close community participation, in association with an integral intervention of the executing and co-executing entities, in harmony and close collaboration with other state and private entities that can help identify and/or resolve potential conflicts that may arise in the implementation of the ERP.

Regularization measures must be promoted in close coordination with the various entities of the rural, environmental, territorial, registry and cadastral sectors, which have the obligation to plan in a coordinated manner and from the institutional point of view, the necessary steps to work in a comprehensive way in the regularization of the tenure existing forms in the territory.

This implies that the ERP should establish measures to strengthen and expand institutional capacity in the Orinoco, in an attempt to regularize land tenure in the territory and reduce conflicts associated with the confluence of several actors on the same property, as well as changes in land use. This conclusion is based on the analysis of land tenure, where it has been found that there is a high level of informality in the Orinoco region and little institutional presence in this territory, especially in the most remote municipalities.

In addition to institutional accompaniment, the capacity to generate benefits from the ERP should support the promotion of activities that contribute to the reduction of carbon emissions, such as the revitalization of the reforestation process (natural and commercial) and limiting the advancement of deforestation, which will require a greater presence of environmental authorities to prevent the expansion of the agricultural frontier at the expense of environmentally protected areas. In addition to these activities, the tenure analysis allows concluding that the agricultural production form in the region requires a reconversion towards sustainable schemes, particularly in the livestock sector, where it is necessary to advance projects that promote a more intensive land use and reduce the incidence of the sector in the generation of carbon emissions. Therefore, for the ERD implementation it is pertinent to include the most representative production sectors in the region, so that they are informed of the benefits of using sustainable forms of production and their participation in the program is encouraged.

# GLOSSARY

a. **Agricultural boundary:** boundary of rural land that separates areas where agricultural activities are permitted, from protected areas, those of special ecological importance, and other areas where agricultural activities are excluded by mandate of Law or regulation (UPRA, 2018).
b. **Biosphere Reserves:** These are areas internationally recognized by UNESCO, which maintain the sovereignty of their respective countries, selected for their scientific, ecological, biological and cultural interest, where socioeconomic, human and conservation activities are developed, seeking sustainability.
c. **Economic destination:** According to Article 44 of Resolution 070 of 2011, the economic destination is the classification for statistical purposes given to each property as a whole, at the time of property identification in accordance with the predominant activity carried out therein. These classifications include housing, industrial, commercial, and agricultural, among others.
d. **False tradition:** False tradition is a type of irregular ownership that does not allow the owner the full exercise of his right, since the vitiated acquisition continues vitiated in the new owner and the different acts that the second owner performs do not sanitize the irregularity (UPRA, 2014).
e. **Family Agricultural Unit (UAF in Spanish):** Article 38 of Law 160 of 1994 defined the UAF as: "the basic agricultural, livestock, aquaculture or forestry production enterprise whose extension, in accordance with the agro-ecological conditions of the area and with the appropriate technology, allows the family to remunerate its work and to have a capitalizable surplus that contributes to the formation of its patrimony. The UAF will normally require only the labor of the owner and his family to be exploited, without prejudice to the use of foreign labor, if the nature of the exploitation so requires. In order to determine the subsidy value that may be granted, the size of the Family Farming Unit shall be established at the farm level". According to this definition, the UAF is the minimum unit of rural land necessary for efficient agricultural and livestock exploitation.
f. **Fiscal assets:** According to numeral 6.1 of Ruling 21699 of 2012, issued by the Council of State; "*Fiscal assets are those that belong to subjects of public law of any nature or order that, in general, are intended for the performance of public functions or public services, such as land, buildings, farms, farms, equipment, fixtures, shares, income and budget assets, etc, i.e., attached to the development of its mission and used for its activities, or may constitute a patrimonial reserve for purposes of common utility. They*

*are the property of the Republic, but their use does not generally belong to the inhabitants, so that the State owns and manages them in a similar way as private individuals do with their own property. They may be subdivided into fiscal property proper and adjudicable fiscal property or vacant property*".

g. **Greenhouse gases (GHG):** Gases integral to the atmosphere, of natural and anthropogenic origin, that absorb and emit radiation at certain wavelengths of the infrared radiation spectrum emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect (IPCC, 2018).
h. **Informality index:** Index that allows estimating, identifying and delimiting areas with possible presence of informality in land tenure at the property level, which serves as a technical input in the planning process of social and productive management of rural property in the country. (UPRA 2019, Informality Index).
i. **Land tenure:** Relationship, defined in legal or customary form, between people, in terms of individuals or groups, with respect to land relations - policies of dominion over land and resources, whether for economic use or to sustain political powers (UPRA 2014, conceptual bases processes of regularization of rural property and access to land).
j. **Mere tenancy:** It is called mere tenancy that which is exercised over a thing, not as owner, but in place of or on behalf of the owner. The pledgee, the sequestrator, the usufructuary, the user, the one who has the right of habitation, are mere holders of the thing pledged, seized or whose usufruct, use or habitation belongs to them.
k. **National Agricultural Census:** According to FAO's World Agricultural Census program, the Census is a large-scale statistical operation in which data on the structure of a country's agriculture are collected, processed and disseminated. Census data refer to farm size, land tenure and land use, crop area, number of head of livestock, among others. The most recent version of the Census corresponds to the year 2014.
l. **National Agricultural Survey:** Statistical sampling operation that aims to estimate land use, area, production and yield of the main transitory and permanent crops, dispersed fruit trees, pasture and forest area, milk production and livestock inventory in 32 departments of the Colombian territory. (Retrieved on September 14, https://www.dane.gov.co/index.php/estadisticas-por-tema/agropecuario/encuesta-nacional-agropecuaria-ena)
m. **Orinoquia:** For the purposes of this project and document, the Orinoco is a region of Colombia that is composed of the Meta, Vichada, Arauca and Casanare departments.

n. **Property Ownership:** Corresponds to the full right or dominion over the land, demonstrable by means of a legal instrument of verification valid in the national legal system.
o. **Public Instruments registration:** The registration of real property is a public service provided by the State by officials called Registrars of Public Instruments, in the manner established in the Registry Statute and for the purposes and with the effects established by law. The basic objectives of the registry are: a) To serve as a means of tradition of ownership of real estate and other real rights constituted therein in accordance with Article 756 of the Civil Code; b) To publicize public instruments that transfer, transmit, move, encumber, limit, declare, affect, modify or extinguish real rights over real estate; and c) To provide evidentiary merit to all public instruments subject to registration.
p. **Vacant property:** It is a public property of the nation catalogued within the category of adjudicable fiscal property, since the nation keeps it to adjudicate it to those who meet all the requirements established by law. (Constitutional Court, Decision No. C-595/95).

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## Annex 4: Current Version of the Benefit Sharing Plan for the ISFL ER Program

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# CONTENT

# 1. INTRODUCTION

Annex 4 of the ERPD contains the essential aspects of the Benefit Sharing Plan, such as definition of the different categories of potential beneficiaries, eligibility criteria, types and scale of benefits, criteria, processes and timing for the distribution of benefits and guidelines to monitor the implementation of the BDP.

For further information on what is presented in this annex, please refer to the current PDB version, and by December 2023 the final document of the Benefit Sharing Plan, which is under development and will be finalized when the model agreements with the executing and implementing entities can be defined after the ERPA is signed.

# 2. BENEFICIARIES

The Orinoco has an area of 249.717 $km^2$ with a population of 1.615.166 inhabitants, where 49,3% are women (796.486) and 50,7% are men (818.680). The indigenous population census, inhabiting 100 reservations, amounts to 53.137 people, which represents 3,3% of the total population. The largest extension of these reserves is mainly located in the Vichada department and particularly in the municipality of Cumaribo. Additionally, there are 21.464 indigenous people residing in non-ethnic territories, some are victims of forced displacement due to the social and armed conflict, others have left as a result of insufficient and depleted land in the collective territories, and others because of threats due to deforestation, the agricultural frontier expansion, land occupation, and non-legal economic or criminal interests. On the other hand, the Afro-Colombian population censused in 2018 corresponded to 25,197 people and represents 1.6% of the total (DANE, 2018). To date, only one collective territory titled in the name of organized Afro-Colombian communities is registered, in the Arauca department, with an area of 61 ha.

The beneficiaries of the BioCarbon ERP (PRE Biocarbono in Spanish) will be all those individuals, groups and entities that receive a payment for results according to their contributions to the fulfillment of the emission reduction objectives and goals.

The beneficiaries are structured in two categories, the institutional level and the population level. The first category includes government entities that are executing and co-executing and implement direct and indirect measures to reduce emissions, at the national, regional and territorial levels (departments and municipalities). There is also the academia, i) universities and research centers that provide the technical and practical foundations for low-carbon agricultural production systems and for sustainable forest management processes, conservation and restoration of strategic ecosystems, and ii) the National Learning Service (SENA in Spanish) and other training centers.

The institutional category also includes beneficiaries such as implementing entities that may be public or private entities, at the national, regional or local level, with whom technical and/or administrative efforts will be joined for the structuring and execution of projects that will implement the GHG reduction measures and actions defined in the Biocarbon ERP, such as the

Corporation for the sustainable development of the special management area La Macarena - CORMACARENA, CORPORINOQUIA, National Natural Parks (PNN in Spanish), Rural Development Agency (ADR in Spanish), National Land Agency (ANT in Spanish), Colombian Agricultural Institute (ICA in Spanish), Colombian Agricultural Research Corporation (Agrosavia in Spanish), Alexander von Humboldt Institute, governors and mayors of the territory, ethnic groups (associations of indigenous reservations and other ethnic organizations), producer organizations, NGOs, private sector, among others.

The second category -population- includes individuals and local communities organized as beneficiaries of activities aimed at strengthening capacities and competencies or as final beneficiaries that have modified their practices towards the protection of forests and strategic ecosystems and low carbon production. The monitoring, reporting and verification system -MRV- has to find evidence that they have achieved a reduction in emissions.

It has been estimated that the total number of direct and indirect beneficiaries will be 78.246, distributed as follows:

- 32.118 people who participate in organizations engaged in income-generating activities related to forestry and/or agricultural activities and who receive benefits from the Biocarbon ERP. Of these beneficiaries, 50% are women.
- 46.128 people living in communities adjacent to forests with monetary/non-monetary benefits from the forest.

Table 168 presents the role or responsibility of each type of beneficiary and a justification why the BioCarbon ERP requires their participation.

Table 168. Responsibilities of the beneficiaries for the benefits distribution

| Category | Beneficiary Type | Entity/Group | Responsibility | Justification |
|---|---|---|---|---|
| Institutional | National public entities in the agricultural and livestock sector | Agriculture and Rural Development Ministry | It is the Biocarbon ERP executor, organizes the operation and the distribution of benefits. | The highest executive government entity for the agriculture and rural development sector. |
| | | Rural Development Agency | Co-financing of integrated agricultural and rural development projects. | Partner in the implementation of measures and local capacity building. |
| | | National Land Agency | Land authority and executor of the rural property social management policy. | Property formalization measure implementer |
| | | Agrosavia | Science, technology and innovation corporation that contributes to changes to improve | Partner in the implementation of local capacities measures and strengthening |

| Category | Beneficiary Type | Entity/Group | Responsibility | Justification |
|---|---|---|---|---|
| | | | agricultural productivity and competitiveness. | |
| | | UPRA | Guides planning policy in land management for agricultural and livestock uses | Responsible for MRV in the agricultural sector |
| Institutional | National public entities in the environmental sector | Environment and Sustainable Development Ministry | Co-executor of the BioCarbon ERP, leads mitigation actions for REDD+ activities. | The highest executive government entity for the environment and sustainable development sector. |
| Institutional | | IDEAM | Generation of scientific knowledge by MRV for land use and land use change activities | Supports the national government in monitoring natural resources and the environment, develops information systems, analysis and studies on causes and effects of GHG and forest monitoring |
| Institutional | | National Natural Parks (PNN in Spanish) | Supports the ERP measures implementation in areas under its jurisdiction. | Administers and manages national natural parks, regulates the use of conservation areas. |
| Institutional | Regional public entity | Cormacarena | In charge of implementing ERP measures | Environmental authority in the Meta department, manages natural resources and the environment. |
| Institutional | | Corporinoquía | In charge of implementing ERP measures | Environmental authority and administrator of natural resources in Arauca, Casanare and Vichada. |
| Institutional | Territorial public entity | Arauca, Casanare, Meta and Vichada govermments | Supports and co-finances the measures Implementation | Highest executive governmental authority at the departmental level. Formulates and manages projects for the agricultural, rural development and environmental sectors. |
| Institutional | Local public entity | Municipal mayors | Manages and supports the measures Implementation | The highest executive governmental authority at the municipal level. |

| Category | Beneficiary Type | Entity/Group | Responsibility | Justification |
|---|---|---|---|---|
| | | | | Promotes and executes programs related to agricultural production, rural development and use of renewable natural resources. |
| Institutional | Research entities | Universities and Research Centers | Advance or complement research prioritized by the ERP. | Specific development needs have been identified for the Orinoco region in science, technology, research and knowledge transfer. |
| Institutional | Training Entities | SENA, Training Centers and other similar entities | To certify and develop courses to strengthen labor competencies in the agricultural sector and renewable natural resources management. | Specific training needs have been identified in the areas of low carbon production, sustainable forest, land, planning and governance management. |
| Institutional | Ethnic Actors | Safeguards Associations and other ethnic organizations | Conservation and protection Forest | The area under collective legal entities is significant in the Orinoco region, with forest conservation, threats and deforestation risks. |
| Institutional | Forest management actors | Associations and organizations developing REDD+ initiatives | Organize and take action against deforestation, forest degradation, promote sustainable forest management and forest conservation | Presence in the region, learning experiences. |
| | Actors in the management of agricultural and commercial forestry chains | Guilds as Fedearroz, Fedecacao, Fedepalma, Fedegan, Fedemaderas<br><br>Public-private partnerships to strengthen production chains | Co-financing, organizing and supporting the ERP measures implementation | Experience in the region and recognition of their work.<br>Contribution of lessons learned. |

| Category | Beneficiary Type | Entity/Group | Responsibility | Justification |
|---|---|---|---|---|
| | | Social organizations to strengthen food security.<br><br>Local livestock farmers' committees.<br><br>Producers' associations in the agricultural and forestry sector. | | |
| Institutional | Beneficiaries for the strengthening of labor skills and competencies | Technical and professional project formulators and managers | In charge of actions and activities development in the ERP measures implementation. | The ERP measures implementation requires the specific projects formulation for their financing, calls for proposals for their viability, monitoring and follow-up. |
| Population | | Rural Extensionists. Individuals, Technologists, Technicians and Professionals registered in ADR - SNIA. | In charge of actions and activities development in the implementation of ERP measures. | The ERP measures implementation requires technical assistance and rural extension to achieve changes in the producers and local communities' practices. |
| Population | | Individuals, Technical Technologists and Professionals at the local level trained for labor competencies | Local support for the actions and activities development in the of ERP measures implementation. | The groups of workers linked to the ERP should have an appropriate level of knowledge and act as multipliers to develop quality actions and activities. |
| Population | Final beneficiaries | Ethnic communities and indigenous families | In charge of actions and activities in the ERP measures implementation that directly impact on emissions reductions | Vulnerable group linked to the ERP's safeguards and embrace the ERP's objectives. |
| | | Communities organized in NADs, | In charge of actions and activities in the ERP measures | Vulnerable group linked to the ERP's safeguards |

| Category | Beneficiary Type | Entity/Group | Responsibility | Justification |
|---|---|---|---|---|
| | | restoration or conservation areas | implementation that directly affect emission reductions and removals. | and embrace the ERP's objectives. |
| | | Owners, possessors and occupants in NADs, restoration or conservation areas | In charge of actions and activities in the ERP measures implementation that directly affect emission reductions and removals. | Actors that have an impact on the ERP intervention areas. |
| | | Organized communities of agricultural producers seeking to lead low-carbon production actions and activities. | In charge of actions and activities in the ERP measures implementation. | Their work has an impact on the decisions made by producers, guiding, advising and accompanying them. |
| | | Agricultural and forestry producers | In charge of actions and activities in the ERP measures implementation that directly affect emission reductions and removals. | Actors influencing the ERP intervention areas |

# 3. TYPES OF BENEFITS

This section describes the carbon benefits that are subject to payment by results and the non-carbon benefits that have been preliminarily prioritized.

## 3.1. BENEFITS ASSOCIATED TO CARBON

The GHG emissions reduction will generate payments by results, which we call "carbon benefits", these can be given through: i) direct allocation for participation of the entity in BioCarbon ERP, working in the coordination and implementation of measures to achieve the the BioCarbon ERP objectives and ii) according to the performance in the direct emissions reduction by the final beneficiaries or coordination for the implementation of direct measures in the implementing partners (Table 169).

- **Non-monetary benefits**
    - Non-monetary benefits of direct payment

        - Payment of fees for specialized staff
        - Payment of training course fees
        - Consumables, tools, equipment, infrastructure
    - Non-monetary benefits from indirect payment.
        - Support and technical assistance to officials of government agencies and other entities
        - Job training and education
        - Rural extension
- **Monetary benefits**
    - Institutional monetary benefits
    - Incentives and other monetary benefits to participants

Table 169. Monetary and non-monetary benefits distribution according to beneficiary type

| Monetary benefits | Non-monetary benefits |
|---|---|
| **Executing and co-executing entities** | |
| Implementing entities will not receive monetary transfers. | Public institutions will benefit through fees paid directly by the trustee to dedicated staff for consultancies and capacity building activities.<br><br>Some institutions will receive non-monetary benefits indirectly from ERP partners and associated entities. This includes technical assistance, capacity building and rural extension services. |
| **Research and capacity building centers. Universities and Labor Training Institutions** | |
| Cash transfer to co-finance climate change mitigation projects and initiatives. They will be delivered through calls for proposals with selection criteria related to the type of research or job training course to be developed. | When there is no specific capacity required in the selected institutions, the ERP can hire and directly pay the required researchers or instructors. |
| **Organizaciones étnicas, autoridades y comunidades** | |
| | They will receive technical support in the project formulation process from the associated indigenous reserves. |
| They may receive monetary support through their authorities, depending on the decisions of the community, citizens and their social organization form. | The communities will receive benefits in the form of inputs, tools and equipment to implement projects and life plans of the ethnic communities. The trustee will purchase the goods and deliver them directly to the communities with low financial management capacity. |
| **Local communities organized within NAD, producers organized communities.** | |
| Non-ethnic local communities will not receive cash transfers | The communities will receive benefits in the form of inputs, seeds and seedlings. The trustee will purchase the goods and deliver them directly to the communities with low financial management capacity. |

| Implementing entities | |
|---|---|
| They will receive monetary benefits according to the reduction potential achieved by the measures implemented through projects. | They can also receive training courses and conferences |
| **Final beneficiaries: Individual producers** | |
| Individual private proponents will receive incentives and other monetary benefits directly from the trustee. | Non-monetary benefits will be delivered indirectly to individuals through implementing entities or implementing partners in the form of technical assistance, capacity building and other rural extension services. |
| | Depending on the production chain or the type of measures developed by the projects in which they participate, they may receive inputs such as seeds or seedlings, tools, etc. |

### 3.2. NON-CARBON BENEFITS

The BioCarbon ERP through the implementation of its measures will inherently provide environmental, socioeconomic and governance benefits beyond reducing emissions or carbon sequestration, the mitigation of environmental, social and cultural risks, which influence the improvement of local life, build effective governance structures and improve the conservation of ecosystem services. Non-carbon benefits do not receive payment by results, although they are tracked and monitored by the BioCarbon ERP. Details of non-carbon benefits can be found in ERPD subchapter 3.3.

## 4. ELIGIBILITY CRITERIA AND PROCESSES FOR THE BENEFITS DISTRIBUTION

Those who wish to participate in the BioCarbon ERP and receive payments by results must comply with: i) the eligibility criteria to be a potential beneficiary as an implementing entity or individual beneficiary; ii) execute a project through which a package of GHG reduction measures is implemented in accordance with the activity and productive vocation of the producers group and the specific intervention area; and iii) comply with the benefit distribution criteria.

### 4.1. ELIGIBILITY REQUIREMENTS

In order for a potential beneficiary, whether implementing entity or individual beneficiary, to receive monetary or non-monetary benefits, it must comply with the eligibility criteria in Table 170.

Table 170. Eligibility criteria

| Beneficiary Type | Eligibility Criteria |
| --- | --- |
| Implementing entities | 1. Be legally constituted in accordance with the competent entity to issue its existence and legal representation, with a minimum period of 2 years conformation (capacity criterion).<br>2. Demonstrate associative experience through the execution of projects with public or private entities, in the productive chains prioritized by the Biocarbon ERP and in the Orinoquia region (suitability criterion).<br>3. Demonstrate administrative and financial capacity for the management of public resources, cooperation, others.<br>4. Express its intention to sign an agreement with the program and sub-agreements with the producers, in which the participation in the program and the scheme conditions of benefits and use of reduced emissions distribution are established.<br>5. Enable tracking and monitoring of mitigation activities/commitments and the use of agreed benefits and provide information related to the implementation of measures |
| Individual participants | 1. The individual beneficiaries (holders and alternates) must be of legal age and must be registered in the BioCarbon ERP beneficiary database.<br>2. Demonstrate tenure relationship with a property to develop the mitigation measure in the prioritized areas (ownership, possession, mere possession or occupation).<br>3. The property must be located in the areas targeted by the Program, according to the corresponding productive chain.<br>4. The properties and the measures carried out for GHG reduction must be compatible with the corresponding land use in the POT, PBOT or EOT and the environmental zoning established by the corresponding Environmental Authority.<br>5. Allow follow-up and monitoring of mitigation activities/commitments and the use of the agreed benefits and provide information related to the the implementation of measures.<br>6. Commit to conserve existing forest areas on the registered property by signing Zero Deforestation or conservation agreements.<br>7. Contribute co-financing resources, either their own or through an ally or entity. |

## 4.2. IMPLEMENTATION OF GEI REDUCTION MEASURES

Potential beneficiaries that comply with the eligibility criteria must implement projects that include a package of GHG reduction measures in accordance with the activity and productive vocation of the producers group and the specific intervention area. For these purposes, the following will be considered:

a. The project must be submitted by an implementing entity.

b. The project must be registered in the BioCarbon ERP Project bank (qualifying criterion).
c. If there is forest area on the beneficiaries' properties, they must sign conservation agreements for those areas (enabling criteria).
d. Comply with the criteria of the specific funding source to which the project will be submitted.
e. The location of the intervention areas with the project must be within the areas targeted by the BioCarbon ERP according to the productive or conservation activity[214].
f. The project must include the database of potential beneficiaries and their families, and a written statement to contribute with counterpart resources for the GHG measures implementation.
g. There must be coherence between the activities proposed by the project and the GHG reduction measures defined by the BioCarbon ERP.

## 4.3. BENEFIT SHARING CRITERIA

A payment percentage for results corresponds to gross payments, defined as the expenses that PRE Biocarbon incurs for its operation. Operating costs are as follows:

- The work team that integrates the BioCarbon ERP Implementation Unit (IUERP in Spanish).
- The work team and the IT requirements for monitoring, reporting and verification (MRV).
- The technical and financial operator cost, which is a specialized entity authorized for the financial resource management.
- External audit on the quality and accuracy of financial, administrative and technical reports.
- A percentage, defined by the BioCarbon Steering Committee, constitutes the Risk Fund, which is a reserve (sub-account) made each payment period of the BioCarbon ISFL to cover eventualities of final beneficiaries affected by events (natural or operational) not foreseen but that may lead to emission reductions.

After deducting gross payments, there are net payments defined as monetary and non-monetary benefits that will be distributed: i) directly to environmental sector entities, agricultural sector entities, territorial entities, academia and research institutes and ethnic groups; ii) by performance to beneficiaries that implement GHG emission reduction activities.

To define the criteria for the net payment's distribution, workshops were held with experts' groups from the executing and co-executing entities (Table 171). This proposal is preliminary and will be consulted with representative potential beneficiaries groups once ERPA implementation begins, in order to have a final version of the criteria.

[214] There is a geo-referenced focalization of the area's intervention of the Biocarbon ERP, according to the identification of legal restrictions in force due to their environmental, cultural or conservation importance.

Table 171. Criteria for monetary and non-monetary benefits distribution according to type of beneficiary

| Beneficiary Type | Distribution criteria |
|---|---|
| **Direct provision** | |
| Environmental sector entities | Operating and Investment Plan (POAI in Spanish) presentation for approval by the benefit-sharing committee. |
| Agricultural sector entities | Operating and Investment Plan (POAI in Spanish) presentation for approval by the benefit-sharing committee. |
| Territorial entities | Operating and Investment Plan (POAI in Spanish) presentation for approval by the benefit-sharing committee. |
| Academia - research entities | Calls for proposals with selection criteria related to the type of research or job training course to be developed. |
| Ethnic communities | Compliance with zero deforestation and conservation agreements |
| **Performance distribution** | |
| Beneficiaries involved in **avoided deforestation** activities | a. % of emissions reduced relative to baseline (performance) - NREF benefit sharing.<br>b. Prioritized areas for biodiversity conservation according to instruments established by Regional Autonomous Corporations (CARs in Spanish), Natural Parks, Humboldt Institute.<br>c. Prioritized population |
| Beneficiaries participating in **Restoration** activities | a. % of emissions reduced relative to baseline (performance) - NREF benefit sharing.<br>b. Areas prioritized for restoration according to the National Restoration Plan.<br>c. Prioritized population |
| Beneficiaries involved in **livestock** activities | a. Landscape management tools (ha tool/ha total)<br>b. Emission intensity reduction (tnCO2/kg meat or lts)<br>c. Prioritized population<br>d. Food security (multi-chain) |
| Beneficiaries participating in **forestry plantation** activities | a. Plantations hectareas<br>b. Prioritized population Food security (multichain) |
| Beneficiaries participating in **palm** activities | a. Crops with low carbon practices (ha) - Low Carbon Model<br>b. Priority population Food security (multi-chain) |
| Beneficiaries participating in **Cacao** activities | a. Crops with low carbon practices (ha) - Low Carbon Model<br>b. Priority population Food security (multi-chain) |
| Beneficiaries participating in **Rice** activities | a. Crops with low carbon practices (ha) - Low Carbon Model<br>b. Priority population Food security (multi-chain) |

## 4.4. PROCEDURE FOR BENEFITS DISTRIBUTION

The benefits distribution among the multiple participants of the BioCarbon ERP has the following steps:

a) The gross benefits have an operating value per year, based on information, consultations and evaluations in the working group on human resources requirements, remuneration levels, operating expenses, platforms start-up, information systems and databases, and values for the specialized services provision according to available market surveys and for operations similar to Biocarbon ERP.

b) The net benefits are distributed in percentages based on i) a direct allocation corresponding to the financial effort to be made by the executing entities in years 3 to 6 of the implementation of the ERP, ii) a direct allocation for the indigenous communities, preliminarily according to the participation of the territory area to be integrated into the ERP; iii) a performance-based allocation for the implementing entities based on the results obtained in the different production chains and environmental intervention areas and iv) a performance-based allocation for the final beneficiaries based on the results in the reduction of emissions.

A preliminary distribution of the payment percentages for results was made, according to the costs associated with the implementation of each mitigation measure and operating expenses. These percentages will be consulted among the participants during the second half of 2023, as part of the Agreements definition.

Likewise, the Profit Sharing Committee may, from time to time, modify these percentages, according the following criteria:

a) In direct institutional allocations, depending on the progress obtained in a biannual performance evaluation and results obtained, there may be needs for strengthening, research, training, etc.
b) The direct allocation for indigenous communities will change at the end of the participatory process and once the projects are formulated and decisions on funding sources are made.
c) The allocation by performance has preliminary percentages that are a ceiling, i.e., maximum distributable among the groups of measures so as to encourage the participation of the prioritized productive chains and promote desirable changes in the NADs and other strategic ecosystems and are defined according to their participation in the mitigation potential, with a proxy that is the emission generation according to the baseline (GHG inventory AFOLU sector). These percentages may change according to the mitigation results generated by the MRV.
d) In the latter c), the distribution of benefits between the implementing entities and the final beneficiaries must be agreed during the definition of the Agreements. BioCarbono's initial proposal takes into consideration the results of the territorial benefit-sharing workshops, held

during 2022, where participants indicated their preferences for each group of measures between receiving a monetary or non-monetary benefit. In the latter case, the payment recipient for results is the implementing partner, who is in charge of making acquisitions, service orders, as necessary. The preferences can be the application of resources for re-investment in the generation of emission reductions, in the realization of collective investments for social development or improvement of livelihoods or if there is a percentage for free use.

e) Based on the biannual result evaluation of the measures and volumes emission reductions evidenced, the Benefit Sharing Committee may modify the percentages in the perspective of adjusting the benefits to what is expected for the fulfillment of goals.

Table 172 consolidates the proposed distribution of monetary and non-monetary benefits according to the type of BioCarbon ERP beneficiary.

In terms of timing, ERPA implementation is expected to begin in early 2024, in order to carry out the Agreement processes, complete the participatory consultations with the indigenous communities, and have the final PDB version. Given that for the MRV a baseline has been constructed, a prospective mitigation model with and without ERP and methodologies have been agreed upon, there will be a delay between the year where ERP implementation is to be initiated (2024) and the start of payment for results. Therefore, it is expected that these payments will contribute to partially co-finance the implementation of the ERP measures (gap closure) and finance operating costs from 2026 onwards.

### 4.5. MONITORING

The IUERP is responsible for the implementation of information systems and databases that account for the registration of beneficiaries, GIS, project bank, eligibility of participants, distribution of benefits and social and environmental management monitoring and measures implementation. At the territorial level, support is provided to the implementing entities to develop operational and financial planning tools and to follow up on the execution of actions and activities.

Likewise, it generates quarterly progress reports on the implementation of the measures with a traffic light style evaluation (green, yellow and red for alerts) on the defined goals (management, product and results indicators that will be defined in the Technical Operations Manual), as a relationship between what was programmed and what was executed and annotations on the modifications, preventive or corrective measures taken to ensure compliance. In the same way, the report will consider the Biocarbon ERP execution according to the territorial work areas, to show alerts about risks that affect or may affect the work dynamics in the interventions and the measures adopted for their prevention, minimization, attention or control. Also, there is an assessment report on the performance of implementing partners, associations, organizations and communities in terms of participants who have withdrawn or have a low level, cases in which a change or cancellation is warranted.

The IUERP presents to the Benefit Sharing Committee the conditions established in the Agreements and Sub-Agreements and the monitoring report evidencing compliance with them. Additionally, the MRV results on emissions reductions, the areas that are effectively accounted for and receive payment for results. The distribution percentages, monetary and non-monetary benefits and the definition of the use that each type of beneficiary has made for those who are eligible to receive payment for results are reviewed and adjusted.

The Beneficiary Committees are organized according to the grouping of projects and make decisions on the type of benefits to be received. Likewise, the Benefit Sharing Committee establishes the procedures for information capture, compilation and reporting on the use of payment by results, which is followed up and reported by the Beneficiary Committees. This is complemented by verifications carried out by the IUERP through a sample selection.

Table 172. Consolidated Biocarbon ERP benefit sharing

| Benefit type | | Assignment | | Beneficiary type | | Sector/Level | | Measurement group | % of group | % of total | Poten |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Operating costs | 16% | IUERP | | | | | | | 64,6% | 10,0% | IUERP |
| | | Other Operational | | | | | | Fiducia | 18,0% | 2,8% | To be |
| | | | | | | | | External Audit | 9,7% | 1,5% | To be |
| | | | | | | | | Risk Fund | 0,9% | 0,1% | Not a |
| | | | | | | | | Integral Information System | 5,8% | 0,9% | To be |
| | | MRV | | | | | | | 1,0% | 0,2% | IDEAM |
| | | Total operating and administrative costs | | | | | | | **100,0%** | **15,5%** | |
| Net income | 84% | Direct Assignment | 35% | Government and academia | 55% | Agriculture and Rural Development Sector | 35,0% | Planning and Governance | | **5,7%** | Agricu Spani Natio Spani Rural (ADR Agros |
| | | | | | | Environment and Sustainable Development Sector | 35,0% | Planning and Governance | | **5,7%** | Enviro Devel in Spa Corpo Corm |
| | | | | | | Local authorities | 15,0% | Planning and Governance | | 2,4% | Gover Office propo |
| | | | | | | Research and Training | 15,0% | | | 2,4% | Unive accor |
| | | | | | | Total Government and Academia | **100,0%** | | | **16,3%** | |
| | | | | Ethnic communities | 45,0% | | | | | 13,3% | Indige organ |
| | | | | Total Direct | **100%** | | | | | **29,6%** | |
| | | Performance assignment | 65% | Executors | 63% | Agriculture and rural development sector | 58% | Rice | 5% | 1,1% | Fedea assoc |
| | | | | | | | | Cocoa | 6% | 1,1% | Fedec assoc |
| | | | | | | | | Palm | 8% | 1,7% | Fedep cente |
| | | | | | | | | Cashew nuts | 4% | 1,3% | Cashe Assoc |
| | | | | | | | | Multichain | 6% | 0,8% | Assoc |
| | | | | | | | | Forest Plantations | 14% | 2,7% | NGOs |

| Benefit type | | Assignment | | Beneficiary type | | Sector/Level | | Measurement group | % of group | % of total | Poten |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Rubber Plantations | 2% | 0,4% | NGOs |
| | | | | | | | | Livestock | 55% | 11,1% | Fedeg |
| | | | | | | | | Total Agriculture and Rural Development | **100%** | **20,2%** | |
| | | | | | | Environment and Sustainable Development Sector | 42% | Restoration and Conservation | 28% | 4,0% | REDD Corm |
| | | | | | | | | Reducing Deforestation | 72% | 10,5% | REDD Corm |
| | | | | | | | | Total Environment and Sustainable Development | **100%** | **14,5%** | |
| | | | | | | Total executors | **100%** | | | 34,8% | |
| | | | | Participants | 37% | | 34% | Rice | 6% | 0,4% | UPAS |
| | | | | | | | | Cocoa | 4% | 0,3% | UPAS |
| | | | | | | | | Palm | 11% | 0,8% | UPAS |
| | | | | | | | | Cashews | 6% | 0,4% | UPAS |
| | | | | | | | | Multichain | 3% | 0,2% | UPAS |
| | | | | | | | | Forest Plantations | 15% | 1,1% | UPAS |
| | | | | | | | | Rubber Plantations | 2% | 0,1% | UPAS |
| | | | | | | | | Livestock | 52% | 3,6% | UPAS |
| | | | | | | | | Total Agriculture and Rural Development | **100%** | **6,9%** | |
| | | | | | | Environment and Sustainable Development Sector | 66% | Restoration and Conservation | 26% | 3,4% | Prope prote |
| | | | | | | | | Reducing Deforestation | 74% | 9,8% | Prope areas |
| | | | | | | | | Total Environment and Sustainable Development | **100%** | **13,2%** | |
| | | | | | | Total participants | **100%** | | | **20,1%** | |
| | | | | Total Performance | **100%** | | | | | **54,9%** | |

| Benefit type | | Assignment | | Beneficiary type | | Sector/Level | | Measurement group | % of group | % of total | Poten |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Net income | **100%** | | | | | | | **84,5%** | |
| Gross benefits | 100% | | | | | | | | | **100,0%** | |

## Annex 5: Design Process for Benefit Sharing Arrangements for the ISFL ER Program

## INTRODUCTION

Annex V of the ERPD contains the essential evidence that describes and demonstrates the Design process for the Benefit Sharing Agreements for the ISFL ER program, including how the process incorporates the input from relevant stakeholders and the supporting documentation which evidences the work done, Including the participation of indigenous communities.

For further information, please refer to the current version of the following documents *Benefit Sharing Plan and Methodology for the socialization and construction of the PDB with the indigenous communities of the Orinoco region*.

The final documents will be ready in December 2023, as there is a work plan for the second half of 2023Once the ERPA is signed, the benefit sharing agreements with the executing agencies and implementing partners can be started, signed, discussed; The latter in turn sign Sub-Agreements with the final beneficiaries.

The stakeholder consultation process has followed the steps presented in the figure below:


Source: Biocarbon Program, 2023.

## MEETINGS WITH RELEVANT ACTORS IN THE TERRITORY

In 2020, the project Biocarbon Orinoquía carried out work related to the mapping of key institutional actors in the territory, their categorization, analysis of their position in relation to the PRE, level of interest and influence, their interactions and the nature of their possible participation in the ERP. A total of 943 entities were identified, according to the categories presented in the table below:

| Parties | Number |
|---|---|
| National Government Entities | 25 |
| International Cooperation Entities | 22 |
| Autonomous Regional and Sustainable Development Corporations | 2 |
| Territorial Entities | 64 |
| Finacial and business support entitites | 6 |
| Universities, research centers and technical assistance | 26 |
| Ethnic groups | 127 |
| Social Organizations | 149 |
| NGO | 23 |
| GHG Greenhouse Gas Mitigation Initiatives | 49 |
| Hydrocarbons | 69 |
| Unions and Private Companies and Producers Associations | 381 |
| **Total** | **943** |

The first institutional meetings were held in virtually as a process of socialization, information sharing and dissemination of the next methodological participation steps. A space was also provided for questions and comments, which were recorded in the PRE costing Excel sheet of the structured financial model which is updated as the dynamics, sizing and scaling of the PRE change. Each of the meetings has a list of attendees and a recording of the meeting. Participants previously received an invitation, and their selection was based on their attendance at previous Biocarbon events, such as the Causes, Agents and Measures workshops, held in 2021. The number of participants is presented in the following table:

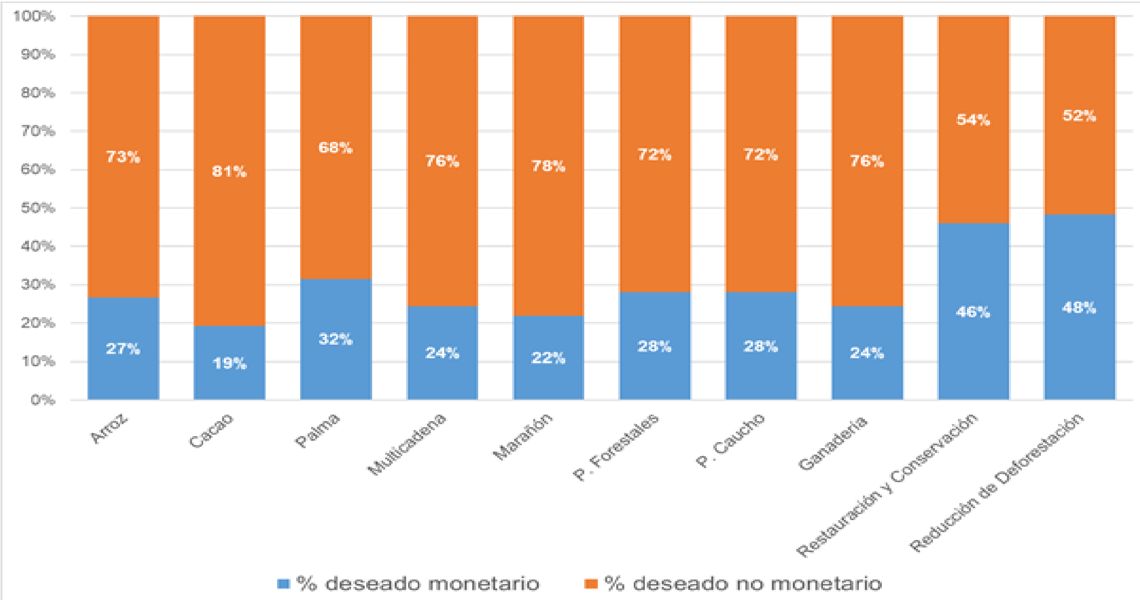
| Virtual Meetings according to Measurement groups | Participants |
|---|---|
| Group 1 – Productive chains | 35 |
| Group 2 – Sustainable forest management and restoration | 18 |
| Group 3 – Sustainable Livestock | 40 |

| | |
|---|---|
| Group 4 – Deforestation | 24 |
| Group 5 – Planning and Governance | 30 |
| **Total Participants** | **147** |

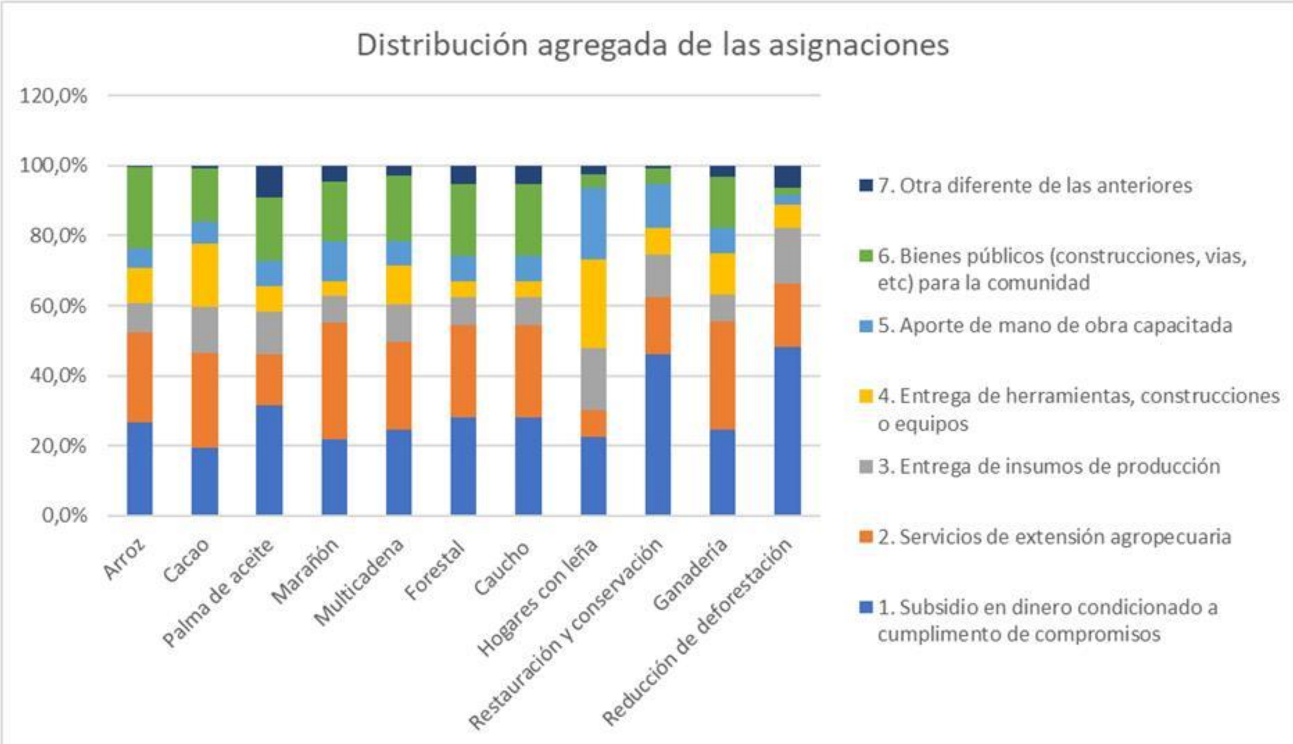
During 2022, the Orinoquía Benefit Distribution Workshops were convened according to the 4 departments, in Puerto Carreño, Villavicencio, Yopal and Arauca and a work protocol (Delphos methodology) was designed, and in this way, it will facilitate to identify the preferences of the participants in the possible award of monetary and non-monetary benefits, inquiring according to the 10 groups of productive chains and REDD+ in which the measures to be implemented for the direct reduction of emissions are organized.

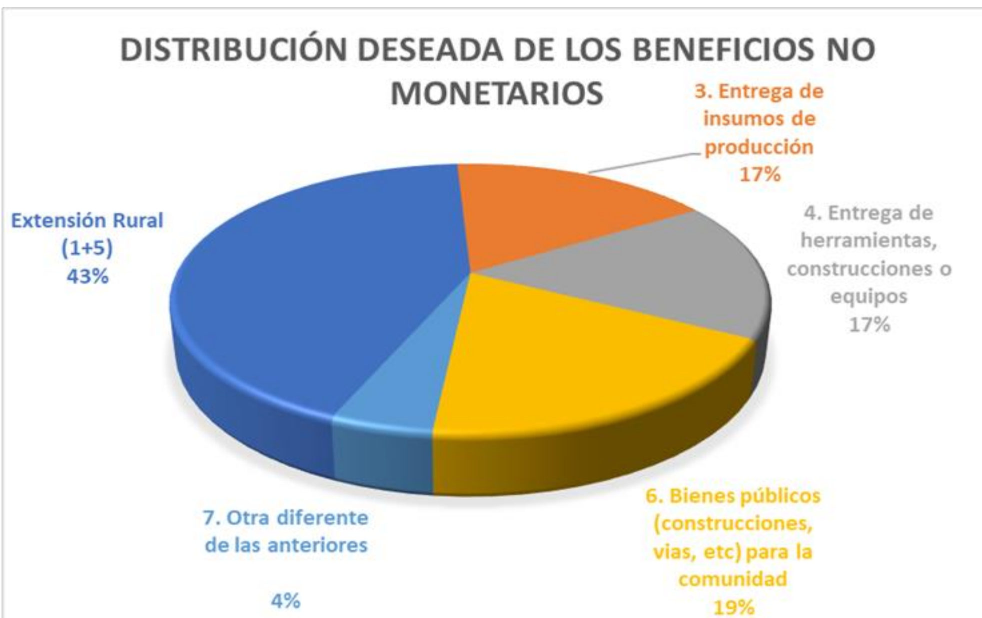
Source: Econometrics Consultants.
Pilot workshop held in Puerto Carreño, May 12, 2022.

The Puerto Carreño workshop was the first and acted as a pilot. The questionnaires for the participants, the compilation and processing of the responses can be found in the PDB Workshop Report. The results, which consolidate the answers given in the 4 workshops, on the distribution between monetary and non-monetary benefits are presented in the following figure:




There is also the desired distribution, as shown in the following figures:


Distribución agregada de las asignaciones
120,0%
100,0%
80,0%
60,0%
40,0%
20,0%
0,0%
Arroz
Cacao
Palma de aceite
Marañón
Multicadena
Forestal
Caucho
Hogares con leña
Restauración y conservación
Ganadería
Reducción de deforestación
7. Otra diferente de las anteriores
6. Bienes públicos (construcciones, vias, etc) para la comunidad
5. Aporte de mano de obra capacitada
4. Entrega de herramientas, construcciones o equipos
3. Entrega de insumos de producción
2. Servicios de extensión agropecuaria
1. Subsidio en dinero condicionado a cumplimento de compromisos


DISTRIBUCIÓN DESEADA DE LOS BENEFICIOS NO MONETARIOS
3. Entrega de insumos de producción 17%
4. Entrega de herramientas, construcciones o equipos 17%
Extensión Rural (1+5) 43%
7. Otra diferente de las anteriores 4%
6. Bienes públicos (construcciones, vias, etc) para la comunidad 19%

## MEETINGS WITH INDIGENOUS COMMUNITIES IN THE TERRITORY

The meetings were preceded by the information gathering on indigenous resguardos (reserves), the census of the indigenous population and other ethnic groups and the place of residence of these families. A directory was compiled with the contact information of the representatives of the "Indigenous council". The participation of the legal representatives of the organizations and associations, a preliminary list provided by the Ministry of the Interior, which was complemented and updated through an inquiry made to some of those attending a previous event convened in Bogotá by representatives of ONIC and Major Government. Each Cabildo representative was contacted to validate the ethnic group to which they belong, coordinate the date, place of the meeting in which their participation is requested and transportation from their place of residence to the meeting venue. The invitations were then sent by Biocarbon.

The legal representatives of the organizations and associations were summoned to the meeting held in Bogota on February 27, 2023 and it was the first one. The contact and communication protocols preferred by the communities were followed in order to build and maintain productive relationships. Here we inquired about the working questions for the following meetings, the methodological steps and the work plan.

Based on the mapping and location of the participants, representatives of the cabildos organized the groups to coordinate logistics. According to the number of people, some representatives will be able to attend with a second member of the cabildo, in order to meet security needs for traveling with a companion. In total, 12 meetings are scheduled and their realization takes several months, mainly because the times are agreed with the participants. The table below shows the organization of the meetings.

| Department | Municipalities/Places to Visit |
|---|---|
| CASANARE | Caño mochuelo (hato corozal and paz de Ariporo). 10 ethnic groups and 14 communities. Evelio Rubio could provide coordination support.<br>Chaparral Barronegro (Sácama and Támara) uwa ethnic group Evelio Rubio supports coordination.<br>Orocue: 8 Indigenous resguardos(reserves) - Sáliba. Could support in coordination Victoriano Joropa. |
| ARAUCA | Arauca- Cravo north- Arauquita: Sikuani (5 reservations and 3 reservations of Arauquita). |

| | |
|---|---|
| | Saravena (includes indigenous resguardos (reserves) of Tame and Fortul) |
| VICHADA | Puerto Carreño: 8 indigenous resguardos (reserves)- coordinated by Eduardo García and Eliseo.<br>Santa Rosalía: The meeting would convene primavera (3 indigenous resguardos (reserves)) and Santa Rosalía (2 indigenoys resguardos (reserves). Coordinated by Arley Joropa.<br>Cumaribo: PALAMEKU- Major government (4 indigenous resguardos (reserves)) Palameku + 10 major government) Walter and Fabio / ACATISEMA- Selva Matavén (17 indigenous resguardos (reserves))- Eduardo García / Rio Guaviare. |
| META | Puerto López Puerto Gaitán: UNUMA's Indigenous resguardo (reserves). Supported by Vicente Aguilar<br>Puerto López: Supports Ramón Manchai<br>Uribe: Uribe and Macarena reservations. Supports Miguel Dagua<br>Mesetas: Mapiripán Lejanías Uribe and Macarena, Mesetas, Villavicencio, Puerto Concordia reservation. Supported by José Fidel Lipia |

To date, 4 meetings have been held, with the number of participants shown in the table below:

| Place | Community Participants |
|---|---|
| Puerto Carreño | 17 |
| Puerto Gaitán | 29 |
| Santa Rosalía | 10 |
| Orocué | 21 |
| Total | 77 |

The most important aspects expressed by the participants during these workshops are:

a) The ERP should be implemented in indigenous territories with the development of actions and activities that are in constant dialogue with the communities and in full respect for their uses and customs. They offer the accompaniment of the indigenous guard to enter their territory and will provide translators for effective communication with their families.

b) To need establishing a dialogue of knowledge and continuous support throughout the life project.
c) To define a planning process for productive projects, as a required step to foresee their satisfactory implementation.

Regarding the Participation Agreements, the participants mentioned their interest in receiving economic resources and technical assistance. In the Orocué workshop, the participants added their knowledge of studies, guidelines and protocols. They can commit to provide the land and unskilled labor, but they would also need training, participate in all activities to which they are invited, and agree to follow up and monitor the implementation of the ERP.

With payment by results, a collective investment in the improvement of road communication routes (Puerto Carreño) and effective commercialization channels (Puerto Gaitán) could be considered. It should also be noted that the workshops provided detailed information on the characterization of the territories; the indigenous resguardos (reserves) maintain minimum levels of food security and do not have any productive projects under development; the exception to the above is the Wacoyo reservations, which is implementing a rice project.

They express interest in sustainable livestock activities, including pasture improvement (Santa Rosalía), rice production (Puerto Gaitán) and reforestation (Puerto Gaitán and Santa Rosalía).

The next step is to define the productive project which they will participate in the PRE, in accordance with the life plan of each reservation, in order to receive assistance and support in its formulation.

## Annex 6: GHG inventory of all AFOLU categories, subcategories, gases and pools in the Program Area

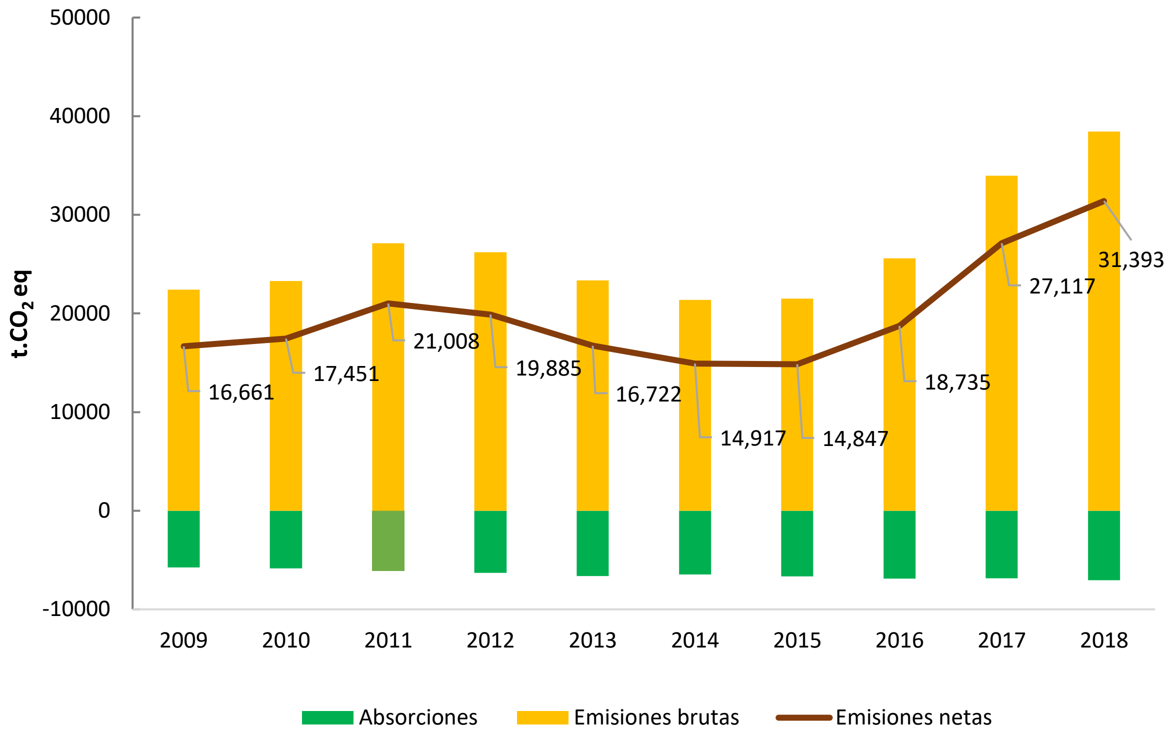



Figure 131. Inventory of GHG emissions in the Orinoquia for the AFOLU sector (2009-2018).

The information for the construction of the GHG emissions inventory in the Orinoquia (Figure 131) can be seen in

Table ***173***, which shows the contribution of emissions by IPCC subcategory from 2009 to 2018. The file in Excel format can be consulted at: 4_1_2_Orinoquia_GHGIN_2009_2018.xlsx or at 4_1_2_Inventario_Resumen_Historico.xlsx.

Table 173. Orinoquia Regional Inventory 2009-2018.

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2009 | TOTAL ORINOQUIA | -5.688,59 | 12.397,54 | 8.940,55 | 1.070,45 | -5.747,35 | 22.408,55 | 16.661,20 |
| ORINOQUIA | 2009 | 3 - Agriculture, Forestry, and Other Land Uses | -5.688,59 | 12.397,54 | 8.940,55 | 1.070,45 | -5.747,35 | 22.408,55 | 16.661,20 |
| ORINOQUIA | 2009 | 3A - Livestock | 0,00 | 0,00 | 7.413,77 | 24,49 | 0,00 | 7.438,26 | 7.438,26 |
| ORINOQUIA | 2009 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.299,30 | 0,00 | 0,00 | 7.299,30 | 7.299,30 |
| ORINOQUIA | 2009 | 3A2 - Manure management | 0,00 | 0,00 | 114,47 | 24,49 | 0,00 | 138,96 | 138,96 |
| ORINOQUIA | 2009 | 3B - Land | -5.675,33 | 12.361,29 | 0,00 | NA | -5.734,08 | 12.361,29 | 6.627,21 |
| ORINOQUIA | 2009 | 3B1 - Forest land | -5.440,84 | 4.892,07 | 0,00 | 0,00 | -5.499,60 | 4.892,07 | -607,53 |
| ORINOQUIA | 2009 | 3B2 - Cropland | -234,48 | 172,05 | 0,00 | 0,00 | -234,48 | 172,05 | -62,43 |
| ORINOQUIA | 2009 | 3B3 - Grassland | 0,00 | 6.956,76 | 0,00 | 0,00 | 0,00 | 6.956,76 | 6.956,76 |
| ORINOQUIA | 2009 | 3B4 - Wetlands | 0,00 | 277,21 | 0,00 | 0,00 | 0,00 | 2.77,21 | 277,21 |
| ORINOQUIA | 2009 | 3B5 - Settlements | 0,00 | 3,25 | 0,00 | 0,00 | 0,00 | 3,25 | 3,25 |
| ORINOQUIA | 2009 | 3B6 - Other land | 0,00 | 59,96 | 0,00 | 0,00 | 0,00 | 59,96 | 59,96 |
| ORINOQUIA | 2009 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -13,26 | 36,25 | 1.526,78 | 1045,96 | -13,26 | 2.608,99 | 2.595,73 |
| ORINOQUIA | 2009 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 0,07 | 0,05 | 0,00 | 0,12 | 0,12 |
| ORINOQUIA | 2009 | 3C2 - Liming | NA | 24,29 | NA | NA | 0,00 | 24,29 | 24,29 |
| ORINOQUIA | 2009 | 3C3 - Urea application | NA | 11,95 | NA | NA | 0,00 | 11,95 | 11,95 |
| ORINOQUIA | 2009 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 588,82 | 0,00 | 588,82 | 588,82 |
| ORINOQUIA | 2009 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 446,52 | 0,00 | 446,52 | 446,52 |
| ORINOQUIA | 2009 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 10,57 | 0,00 | 10,57 | 10,57 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2009 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.526,71 | 0,00 | 0,00 | 1.526,71 | 1.526,71 |
| ORINOQUIA | 2009 | 3D1 - Products from harvested wood | -13,26 | IE | NA | NA | -13,26 | 0,00 | -13,26 |
| ORINOQUIA | 2010 | TOTAL ORINOQUIA | -5.773,87 | 13.217,18 | 8.978,46 | 1.099,97 | -5.844,36 | 23.295,61 | 17.451,26 |
| ORINOQUIA | 2010 | 3 - Agriculture, Forestry, and Other Land Uses | -5.773,87 | 13.217,18 | 8.978,46 | 1.099,97 | -5.844,36 | 23.295,61 | 17.451,26 |
| ORINOQUIA | 2010 | 3A - Livestock | 0,00 | 0,00 | 7.614,43 | 24,12 | 0,00 | 7.638,55 | 7.638,55 |
| ORINOQUIA | 2010 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.500,04 | 0,00 | 0,00 | 7.500,04 | 7.500,04 |
| ORINOQUIA | 2010 | 3A2 - Manure management | 0,00 | 0,00 | 114,39 | 24,12 | 0,00 | 138,51 | 138,51 |
| ORINOQUIA | 2010 | 3B - Land | -5.760,43 | 13.186,64 | 0,00 | NA | -5.830,91 | 13.186,64 | 7.355,73 |
| ORINOQUIA | 2010 | 3B1 - Forest land | -5.501,79 | 4.889,10 | 0,00 | 0,00 | -5.572,27 | 4.889,10 | -683,17 |
| ORINOQUIA | 2010 | 3B2 - Cropland | -258,64 | 213,78 | 0,00 | 0,00 | -258,64 | 213,78 | -44,86 |
| ORINOQUIA | 2010 | 3B3 - Grassland | 0,00 | 7.736,84 | 0,00 | 0,00 | 0,00 | 7.736,84 | 7.736,84 |
| ORINOQUIA | 2010 | 3B4 - Wetlands | 0,00 | 282,10 | 0,00 | 0,00 | 0,00 | 282,10 | 282,10 |
| ORINOQUIA | 2010 | 3B5 - Settlements | 0,00 | 3,25 | 0,00 | 0,00 | 0,00 | 3,25 | 3,25 |
| ORINOQUIA | 2010 | 3B6 - Other land | 0,00 | 61,57 | 0,00 | 0,00 | 0,00 | 61,57 | 61,57 |
| ORINOQUIA | 2010 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -13,44 | 30,54 | 1.364,03 | 1.075,86 | -13,44 | 2.470,43 | 2.456,98 |
| ORINOQUIA | 2010 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 15,22 | 11,63 | 0,00 | 26,85 | 26,85 |
| ORINOQUIA | 2010 | 3C2 - Liming | NA | 21,30 | NA | NA | 0,00 | 21,30 | 21,30 |
| ORINOQUIA | 2010 | 3C3 - Urea application | NA | 9,23 | NA | NA | 0,00 | 9,23 | 9,23 |
| ORINOQUIA | 2010 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 597,99 | 0,00 | 597,99 | 597,99 |
| ORINOQUIA | 2010 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 455,95 | 0,00 | 455,95 | 455,95 |
| ORINOQUIA | 2010 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 10,29 | 0,00 | 10,29 | 10,29 |
| ORINOQUIA | 2010 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.348,82 | 0,00 | 0,00 | 1.348,82 | 1.348,82 |
| ORINOQUIA | 2010 | 3D1 - Products from harvested wood | -13,44 | IE | NA | NA | -13,44 | 0,00 | -13,44 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2011 | TOTAL ORINOQUIA | -6.020,74 | 16.858,15 | 9.116,68 | 1.131,14 | -6.098,08 | 27.105,98 | 21.007,90 |
| ORINOQUIA | 2011 | 3 - Agriculture, Forestry, and Other Land Uses | -6.020,74 | 16.858,15 | 9.116,68 | 1.131,14 | -6.098,08 | 27.105,98 | 21.007,90 |
| ORINOQUIA | 2011 | 3A - Livestock | 0,00 | 0,00 | 7.580,47 | 24,11 | 0,00 | 7.604,59 | 7.604,59 |
| ORINOQUIA | 2011 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.466,20 | 0,00 | 0,00 | 7.466,20 | 7.466,20 |
| ORINOQUIA | 2011 | 3A2 - Manure management | 0,00 | 0,00 | 1.14,27 | 24,11 | 0,00 | 138,39 | 138,39 |
| ORINOQUIA | 2011 | 3B - Land | -6.007,77 | 16.822,52 | 0,00 | NA | -6.085,11 | 16.822,52 | 10.737,41 |
| ORINOQUIA | 2011 | 3B1 - Forest land | -5.657,41 | 4.616,09 | 0,00 | 0,00 | -5.734,75 | 4.616,09 | -1.118,66 |
| ORINOQUIA | 2011 | 3B2 - Cropland | -350,36 | 378,92 | 0,00 | 0,00 | -350,36 | 378,92 | 28,56 |
| ORINOQUIA | 2011 | 3B3 - Grassland | 0,00 | 1.1358,19 | 0,00 | 0,00 | 0,00 | 11.358,19 | 11.358,19 |
| ORINOQUIA | 2011 | 3B4 - Wetlands | 0,00 | 433,55 | 0,00 | 0,00 | 0,00 | 433,55 | 433,55 |
| ORINOQUIA | 2011 | 3B5 - Settlements | 0,00 | 3,25 | 0,00 | 0,00 | 0,00 | 3,25 | 3,25 |
| ORINOQUIA | 2011 | 3B6 - Other land | 0,00 | 32,52 | 0,00 | 0,00 | 0,00 | 32,52 | 32,52 |
| ORINOQUIA | 2011 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -12,97 | 35,63 | 1.536,21 | 1.107,03 | -12,97 | 2.678,87 | 2.665,90 |
| ORINOQUIA | 2011 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 19,78 | 15,83 | 0,00 | 35,61 | 35,61 |
| ORINOQUIA | 2011 | 3C2 - Liming | NA | 24,64 | NA | NA | 0,00 | 24,64 | 24,64 |
| ORINOQUIA | 2011 | 3C3 - Urea application | NA | 10,99 | NA | NA | 0,00 | 10,99 | 10,99 |
| ORINOQUIA | 2011 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 618,44 | 0,00 | 618,44 | 618,44 |
| ORINOQUIA | 2011 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 462,43 | 0,00 | 462,43 | 462,43 |
| ORINOQUIA | 2011 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 10,32 | 0,00 | 10,32 | 10,32 |
| ORINOQUIA | 2011 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.516,43 | 0,00 | 0,00 | 1.516,43 | 1.516,43 |
| ORINOQUIA | 2011 | 3D1 - Products from harvested wood | -12,97 | IE | NA | NA | -12,97 | 0,00 | -12,97 |
| ORINOQUIA | 2012 | TOTAL ORINOQUIA | -6.227,06 | 16.364,34 | 8.728,38 | 1.104,03 | -6.311,27 | 26.196,75 | 19.885,48 |
| ORINOQUIA | 2012 | 3 - Agriculture, Forestry, and Other Land Uses | -6.227,06 | 16.364,34 | 8.728,38 | 1.104,03 | -6.311,27 | 26.196,75 | 19.885,48 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_ Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_CO$_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2012 | 3A - Livestock | 0,00 | 0,00 | 7.463,62 | 25,19 | 0,00 | 7.488,81 | 7.488,81 |
| ORINOQUIA | 2012 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.346,60 | 0,00 | 0,00 | 7.346,60 | 7.346,60 |
| ORINOQUIA | 2012 | 3A2 - Manure management | 0,00 | 0,00 | 117,02 | 25,19 | 0,00 | 142,22 | 142,22 |
| ORINOQUIA | 2012 | 3B - Land | -6.215,16 | 16.330,71 | 0,00 | NA | -6299,36 | 16.330,71 | 10.031,34 |
| ORINOQUIA | 2012 | 3B1 - Forest land | -5.778,35 | 4.603,86 | 0,00 | 0,00 | -5.862,56 | 4.603,86 | -1.258,70 |
| ORINOQUIA | 2012 | 3B2 - Cropland | -436,80 | 343,74 | 0,00 | 0,00 | -436,80 | 343,74 | -93,07 |
| ORINOQUIA | 2012 | 3B3 - Grassland | 0,00 | 10.906,16 | 0,00 | 0,00 | 0,00 | 10.906,16 | 10.906,16 |
| ORINOQUIA | 2012 | 3B4 - Wetlands | 0,00 | 440,68 | 0,00 | 0,00 | 0,00 | 440,68 | 440,68 |
| ORINOQUIA | 2012 | 3B5 - Settlements | 0,00 | 3,25 | 0,00 | 0,00 | 0,00 | 3,25 | 3,25 |
| ORINOQUIA | 2012 | 3B6 - Other land | 0,00 | 33,03 | 0,00 | 0,00 | 0,00 | 33,03 | 33,03 |
| ORINOQUIA | 2012 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -11,91 | 33,63 | 1.264,76 | 1.078,84 | -11,91 | 2.377,23 | 2.365,32 |
| ORINOQUIA | 2012 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 1,03 | 0,36 | 0,00 | 1,39 | 1,39 |
| ORINOQUIA | 2012 | 3C2 - Liming | NA | 21,39 | NA | NA | 0,00 | 21,39 | 21,39 |
| ORINOQUIA | 2012 | 3C3 - Urea application | NA | 12,24 | NA | NA | 0,00 | 12,24 | 12,24 |
| ORINOQUIA | 2012 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 611,89 | 0,00 | 611,89 | 611,89 |
| ORINOQUIA | 2012 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 455,48 | 0,00 | 455,48 | 455,48 |
| ORINOQUIA | 2012 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 11,11 | 0,00 | 11,11 | 11,11 |
| ORINOQUIA | 2012 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.263,73 | 0,00 | 0,00 | 1.263,73 | 1263,73 |
| ORINOQUIA | 2012 | 3D1 - Products from harvested wood | -11,91 | IE | NA | NA | -11,91 | 0,00 | -11,91 |
| ORINOQUIA | 2013 | TOTAL ORINOQUIA | -6.542,65 | 13.588,76 | 8.651,38 | 1.108,51 | -6.627,12 | 23.348,65 | 16.721,52 |
| ORINOQUIA | 2013 | 3 - Agriculture, Forestry, and Other Land Uses | -6.542,65 | 13.588,76 | 8.651,38 | 1.108,51 | -6.627,12 | 23.348,65 | 16.721,52 |
| ORINOQUIA | 2013 | 3A - Livestock | 0,00 | 0,00 | 7.367,25 | 24,39 | 0,00 | 7.391,63 | 7.391,63 |
| ORINOQUIA | 2013 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.253,91 | 0,00 | 0,00 | 7.253,91 | 7.253,91 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2013 | 3A2 - Manure management | 0,00 | 0,00 | 113,34 | 24,39 | 0,00 | 137,72 | 137,72 |
| ORINOQUIA | 2013 | 3B - Land | -6.527,94 | 13.555,99 | 0,00 | NA | -6.612,41 | 13.555,99 | 6.943,58 |
| ORINOQUIA | 2013 | 3B1 - Forest land | -6.043,39 | 4643,19 | 0,00 | 0,00 | -6.127,86 | 4.643,19 | -1484,68 |
| ORINOQUIA | 2013 | 3B2 - Cropland | -484,55 | 627,30 | 0,00 | 0,00 | -484,55 | 627,30 | 142,75 |
| ORINOQUIA | 2013 | 3B3 - Grassland | 0,00 | 8.118,50 | 0,00 | 0,00 | 0,00 | 8.118,50 | 8.118,50 |
| ORINOQUIA | 2013 | 3B4 - Wetlands | 0,00 | 101,27 | 0,00 | 0,00 | 0,00 | 101,27 | 101,27 |
| ORINOQUIA | 2013 | 3B5 - Settlements | 0,00 | 33,14 | 0,00 | 0,00 | 0,00 | 33,14 | 33,14 |
| ORINOQUIA | 2013 | 3B6 - Other land | 0,00 | 32,60 | 0,00 | 0,00 | 0,00 | 32,60 | 32,60 |
| ORINOQUIA | 2013 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -14,71 | 32,76 | 1.284,14 | 1.084,12 | -14,71 | 2.401,02 | 2.386,31 |
| ORINOQUIA | 2013 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 6,73 | 5,16 | 0,00 | 11,89 | 11,89 |
| ORINOQUIA | 2013 | 3C2 - Liming | NA | 22,53 | NA | NA | 0,00 | 22,53 | 22,53 |
| ORINOQUIA | 2013 | 3C3 - Urea application | NA | 10,24 | NA | NA | 0,00 | 10,24 | 10,24 |
| ORINOQUIA | 2013 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 617,00 | 0,00 | 617,00 | 617,00 |
| ORINOQUIA | 2013 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 451,20 | 0,00 | 451,20 | 451,20 |
| ORINOQUIA | 2013 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 10,76 | 0,00 | 10,76 | 10,76 |
| ORINOQUIA | 2013 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.277,40 | 0,00 | 0,00 | 1.277,40 | 1.277,40 |
| ORINOQUIA | 2013 | 3D1 - Products from harvested wood | -14,71 | IE | NA | NA | -14,71 | 0,00 | -14,71 |
| ORINOQUIA | 2014 | TOTAL ORINOQUIA | -6.377,97 | 11.834,11 | 8.451,21 | 1.094,65 | -6.462,73 | 21.379,97 | 14.917,24 |
| ORINOQUIA | 2014 | 3 - Agriculture, Forestry, and Other Land Uses | -6.377,97 | 11.834,11 | 8.451,21 | 1.094,65 | -6.462,73 | 21.379,97 | 14.917,24 |
| ORINOQUIA | 2014 | 3A - Livestock | 0,00 | 0,00 | 7.399,88 | 26,01 | 0,00 | 7.425,89 | 7.425,89 |
| ORINOQUIA | 2014 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.281,36 | 0,00 | 0,00 | 7.281,36 | 7.281,36 |
| ORINOQUIA | 2014 | 3A2 - Manure management | 0,00 | 0,00 | 118,52 | 26,01 | 0,00 | 144,53 | 144,53 |
| ORINOQUIA | 2014 | 3B - Land | -6.359,06 | 11.809,05 | 0,00 | NA | -6.443,82 | 11.809,05 | 5.365,22 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2014 | 3B1 - Forest land | -5.813,44 | 4.606,55 | 0,00 | 0,00 | -5.898,20 | 4.606,55 | -1.291,65 |
| ORINOQUIA | 2014 | 3B2 - Cropland | -545,62 | 675,36 | 0,00 | 0,00 | -545,62 | 675,36 | 129,74 |
| ORINOQUIA | 2014 | 3B3 - Grassland | 0,00 | 6.409,03 | 0,00 | 0,00 | 0,00 | 6.409,03 | 6.409,03 |
| ORINOQUIA | 2014 | 3B4 - Wetlands | 0,00 | 83,98 | 0,00 | 0,00 | 0,00 | 83,98 | 83,98 |
| ORINOQUIA | 2014 | 3B5 - Settlements | 0,00 | 4,19 | 0,00 | 0,00 | 0,00 | 4,19 | 4,19 |
| ORINOQUIA | 2014 | 3B6 - Other land | 0,00 | 29,94 | 0,00 | 0,00 | 0,00 | 29,94 | 29,94 |
| ORINOQUIA | 2014 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -18,91 | 25,07 | 1.051,33 | 1.068,64 | -18,91 | 2.145,03 | 2.126,12 |
| ORINOQUIA | 2014 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 18,58 | 8,03 | 0,00 | 26,61 | 26,61 |
| ORINOQUIA | 2014 | 3C2 - Liming | NA | 18,13 | NA | NA | 0,00 | 18,13 | 18,13 |
| ORINOQUIA | 2014 | 3C3 - Urea application | NA | 6,94 | NA | NA | 0,00 | 6,94 | 6,94 |
| ORINOQUIA | 2014 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 600,06 | 0,00 | 600,06 | 600,06 |
| ORINOQUIA | 2014 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 448,77 | 0,00 | 448,77 | 448,77 |
| ORINOQUIA | 2014 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 11,78 | 0,00 | 11,78 | 11,78 |
| ORINOQUIA | 2014 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.032,74 | 0,00 | 0,00 | 1.032,74 | 1.032,74 |
| ORINOQUIA | 2014 | 3D1 - Products from harvested wood | -18,91 | IE | NA | NA | -18,91 | 0,00 | -18,91 |
| ORINOQUIA | 2015 | TOTAL ORINOQUIA | -6.578,40 | 11.518,82 | 8.837,85 | 1.154,01 | -6.663,18 | 21.510,67 | 14.847,49 |
| ORINOQUIA | 2015 | 3 - Agriculture, Forestry, and Other Land Uses | -6.578,40 | 11.518,82 | 8.837,85 | 1.154,01 | -6.663,18 | 21.510,67 | 14.847,49 |
| ORINOQUIA | 2015 | 3A - Livestock | 0,00 | 0,00 | 7.418,24 | 28,44 | 0,00 | 7.446,68 | 7.446,68 |
| ORINOQUIA | 2015 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.290,37 | 0,00 | 0,00 | 7.290,37 | 7.290,37 |
| ORINOQUIA | 2015 | 3A2 - Manure management | 0,00 | 0,00 | 127,87 | 28,44 | 0,00 | 156,31 | 156,31 |
| ORINOQUIA | 2015 | 3B - Land | -6.565,40 | 11.481,33 | 0,00 | NA | -6.650,19 | 11.481,33 | 4.831,15 |
| ORINOQUIA | 2015 | 3B1 - Forest land | -5.970,11 | 3.456,97 | 0,00 | 0,00 | -6.054,89 | 3.456,97 | -2.597,93 |
| ORINOQUIA | 2015 | 3B2 - Cropland | -595,29 | 678,18 | 0,00 | 0,00 | -595,29 | 678,18 | 82,89 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2015 | 3B3 - Grassland | 0,00 | 7.208,44 | 0,00 | 0,00 | 0,00 | 7.208,44 | 7.208,44 |
| ORINOQUIA | 2015 | 3B4 - Wetlands | 0,00 | 104,30 | 0,00 | 0,00 | 0,00 | 104,30 | 104,30 |
| ORINOQUIA | 2015 | 3B5 - Settlements | 0,00 | 4,19 | 0,00 | 0,00 | 0,00 | 4,19 | 4,19 |
| ORINOQUIA | 2015 | 3B6 - Other land | 0,00 | 29,25 | 0,00 | 0,00 | 0,00 | 29,25 | 29,25 |
| ORINOQUIA | 2015 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -13,00 | 37,49 | 1.419,60 | 1.125,57 | -13,00 | 2.582,66 | 2.569,66 |
| ORINOQUIA | 2015 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 2,41 | 1,01 | 0,00 | 3,43 | 3,43 |
| ORINOQUIA | 2015 | 3C2 - Liming | NA | 24,85 | NA | NA | 0,00 | 24,85 | 24,85 |
| ORINOQUIA | 2015 | 3C3 - Urea application | NA | 12,63 | NA | NA | 0,00 | 12,63 | 12,63 |
| ORINOQUIA | 2015 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 644,20 | 0,00 | 644,20 | 644,20 |
| ORINOQUIA | 2015 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 466,86 | 0,00 | 466,86 | 466,86 |
| ORINOQUIA | 2015 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 13,50 | 0,00 | 13,50 | 13,50 |
| ORINOQUIA | 2015 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.417,19 | 0,00 | 0,00 | 1417,19 | 1417,19 |
| ORINOQUIA | 2015 | 3D1 - Products from harvested wood | -13,00 | IE | NA | NA | -13,00 | 0,00 | -13,00 |
| ORINOQUIA | 2016 | TOTAL ORINOQUIA | -6.786,62 | 15.076,63 | 9.323,33 | 1.206,47 | -6.871,44 | 25.606,43 | 1.8734,99 |
| ORINOQUIA | 2016 | 3 - Agriculture, Forestry, and Other Land Uses | -6.786,62 | 15.076,63 | 9.323,33 | 1.206,47 | -6.871,44 | 25.606,43 | 1.8734,99 |
| ORINOQUIA | 2016 | 3A - Livestock | 0,00 | 0,00 | 7.660,27 | 28,20 | 0,00 | 7.688,47 | 7.688,47 |
| ORINOQUIA | 2016 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.530,48 | 0,00 | 0,00 | 7.530,48 | 7.530,48 |
| ORINOQUIA | 2016 | 3A2 - Manure management | 0,00 | 0,00 | 129,78 | 28,20 | 0,00 | 157,98 | 157,98 |
| ORINOQUIA | 2016 | 3B - Land | -6.775,83 | 15.031,46 | 0,00 | NA | -6.860,64 | 15.031,46 | 8.170,82 |
| ORINOQUIA | 2016 | 3B1 - Forest land | -6.148,72 | 3.996,17 | 0,00 | 0,00 | -6.233,53 | 3.996,17 | -2237,36 |
| ORINOQUIA | 2016 | 3B2 - Cropland | -627,11 | 499,94 | 0,00 | 0,00 | -627,11 | 499,94 | -127,17 |
| ORINOQUIA | 2016 | 3B3 - Grassland | 0,00 | 10.000,82 | 0,00 | 0,00 | 0,00 | 10.000,82 | 10.000,82 |
| ORINOQUIA | 2016 | 3B4 - Wetlands | 0,00 | 177,67 | 0,00 | 0,00 | 0,00 | 177,67 | 177,67 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2016 | 3B5 - Settlements | 0,00 | 64,88 | 0,00 | 0,00 | 0,00 | 64,88 | 64,88 |
| ORINOQUIA | 2016 | 3B6 - Other land | 0,00 | 291,98 | 0,00 | 0,00 | 0,00 | 291,98 | 291,98 |
| ORINOQUIA | 2016 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -10,79 | 45,16 | 1.663,07 | 1.178,27 | -10,79 | 2886,50 | 2875,70 |
| ORINOQUIA | 2016 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 2,61 | 0,64 | 0,00 | 3,25 | 3,25 |
| ORINOQUIA | 2016 | 3C2 - Liming | NA | 31,42 | NA | NA | 0,00 | 31,42 | 31,42 |
| ORINOQUIA | 2016 | 3C3 - Urea application | NA | 13,74 | NA | NA | 0,00 | 13,74 | 13,74 |
| ORINOQUIA | 2016 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 679,92 | 0,00 | 679,92 | 679,92 |
| ORINOQUIA | 2016 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 484,14 | 0,00 | 484,14 | 484,14 |
| ORINOQUIA | 2016 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 13,57 | 0,00 | 13,57 | 13,57 |
| ORINOQUIA | 2016 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.660,45 | 0,00 | 0,00 | 1.660,45 | 1.660,45 |
| ORINOQUIA | 2016 | 3D1 - Products from harvested wood | -10,79 | IE | NA | NA | -10,79 | 0,00 | -10,79 |
| ORINOQUIA | 2017 | TOTAL ORINOQUIA | -6.769,17 | 23.145,21 | 9.597,35 | 1.228,67 | -6.853,99 | 33.971,23 | 27.117,24 |
| ORINOQUIA | 2017 | 3 - Agriculture, Forestry, and Other Land Uses | -6.769,17 | 23.145,21 | 9.597,35 | 1.228,67 | -6.853,99 | 33.971,23 | 27.117,24 |
| ORINOQUIA | 2017 | 3A - Livestock | 0,00 | 0,00 | 7.822,61 | 30,57 | 0,00 | 7.853,18 | 7.853,18 |
| ORINOQUIA | 2017 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 7.684,68 | 0,00 | 0,00 | 7.684,68 | 7.684,68 |
| ORINOQUIA | 2017 | 3A2 - Manure management | 0,00 | 0,00 | 137,93 | 30,57 | 0,00 | 168,50 | 168,50 |
| ORINOQUIA | 2017 | 3B - Land | -6.760,78 | 23.097,76 | 0,00 | NA | -6.845,59 | 23.097,76 | 16.252,16 |
| ORINOQUIA | 2017 | 3B1 - Forest land | -6.131,55 | 6.416,77 | 0,00 | 0,00 | -6.216,37 | 6.416,77 | 200,40 |
| ORINOQUIA | 2017 | 3B2 - Cropland | -629,22 | 465,81 | 0,00 | 0,00 | -629,22 | 465,81 | -163,42 |
| ORINOQUIA | 2017 | 3B3 - Grassland | 0,00 | 15.791,28 | 0,00 | 0,00 | 0,00 | 15.791,28 | 15.791,28 |
| ORINOQUIA | 2017 | 3B4 - Wetlands | 0,00 | 164,19 | 0,00 | 0,00 | 0,00 | 164,19 | 164,19 |
| ORINOQUIA | 2017 | 3B5 - Settlements | 0,00 | 73,80 | 0,00 | 0,00 | 0,00 | 73,80 | 73,80 |
| ORINOQUIA | 2017 | 3B6 - Other land | 0,00 | 185,91 | 0,00 | 0,00 | 0,00 | 185,91 | 185,91 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2017 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -8,40 | 47,45 | 1.774,74 | 1.198,10 | -8,40 | 3.020,29 | 3.011,90 |
| ORINOQUIA | 2017 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 2,28 | 0,56 | 0,00 | 2,83 | 2,83 |
| ORINOQUIA | 2017 | 3C2 - Liming | NA | 33,82 | NA | NA | 0,00 | 33,82 | 33,82 |
| ORINOQUIA | 2017 | 3C3 - Urea application | NA | 13,63 | NA | NA | 0,00 | 13,63 | 13,63 |
| ORINOQUIA | 2017 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 688,13 | 0,00 | 688,13 | 688,13 |
| ORINOQUIA | 2017 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 494,51 | 0,00 | 494,51 | 494,51 |
| ORINOQUIA | 2017 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 14,90 | 0,00 | 14,90 | 14,90 |
| ORINOQUIA | 2017 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.772,47 | 0,00 | 0,00 | 1.772,47 | 1.772,47 |
| ORINOQUIA | 2017 | 3D1 - Products from harvested wood | -8,40 | IE | NA | NA | -8,40 | 0,00 | -8,40 |
| ORINOQUIA | 2018 | TOTAL ORINOQUIA | -6.967,08 | 27.244,10 | 9.892,12 | 1.310,04 | -7.052,89 | 38.446,26 | 31.393,37 |
| ORINOQUIA | 2018 | 3 - Agriculture, Forestry, and Other Land Uses | -6.967,08 | 27.244,10 | 9.892,12 | 1.310,04 | -7.052,89 | 38.446,26 | 31.393,37 |
| ORINOQUIA | 2018 | 3A - Livestock | 0,00 | 0,00 | 8.474,88 | 33,10 | 0,00 | 8.507,98 | 8.507,98 |
| ORINOQUIA | 2018 | 3A1 - Enteric fermentation | 0,00 | 0,00 | 8.322,77 | 0,00 | 0,00 | 8.322,77 | 8.322,77 |
| ORINOQUIA | 2018 | 3A2 - Manure management | 0,00 | 0,00 | 152,11 | 33,10 | 0,00 | 185,21 | 185,21 |
| ORINOQUIA | 2018 | 3B - Land | -6.946,43 | 27.204,88 | 0,00 | NA | -7.032,24 | 27.204,88 | 20.172,64 |
| ORINOQUIA | 2018 | 3B1 - Forest land | -6.314,76 | 9.502,05 | 0,00 | 0,00 | -6.400,57 | 9.502,05 | 3.101,48 |
| ORINOQUIA | 2018 | 3B2 - Cropland | -631,66 | 592,02 | 0,00 | 0,00 | -631,66 | 592,02 | -39,64 |
| ORINOQUIA | 2018 | 3B3 - Grassland | 0,00 | 16.704,32 | 0,00 | 0,00 | 0,00 | 16.704,32 | 16.704,32 |
| ORINOQUIA | 2018 | 3B4 - Wetlands | 0,00 | 261,52 | 0,00 | 0,00 | 0,00 | 261,52 | 261,52 |
| ORINOQUIA | 2018 | 3B5 - Settlements | 0,00 | 8,24 | 0,00 | 0,00 | 0,00 | 8,24 | 8,24 |
| ORINOQUIA | 2018 | 3B6 - Other land | 0,00 | 136,72 | 0,00 | 0,00 | 0,00 | 136,72 | 136,72 |
| ORINOQUIA | 2018 | 3C - Aggregate sources and non-$CO_2$ land-based emissions | -20,65 | 39,22 | 1.417,24 | 1.276,94 | -20,65 | 2.733,40 | 2.712,75 |
| ORINOQUIA | 2018 | 3C1 - Emissions from biomass burning | 0,00 | 0,00 | 1,94 | 0,48 | 0,00 | 2,41 | 2,41 |

| Department | Year | Source and sump categories | Abs_$CO_2$_Gg | Emi_$CO_2$_Gg | Emi_$CH_4$_Gg | Emi_$N_2O$_Gg | Abs_$CO_2$_$CO_2$_eq | Total _Emissions _$CO_2$_eq | Net _Emissions _CO2_eq |
|---|---|---|---|---|---|---|---|---|---|
| ORINOQUIA | 2018 | 3C2 – Liming | NA | 27,46 | NA | NA | 0,00 | 27,46 | 27,46 |
| ORINOQUIA | 2018 | 3C3 - Urea application | NA | 11,76 | NA | NA | 0,00 | 11,76 | 11,76 |
| ORINOQUIA | 2018 | 3C4 - Direct $N_2O$ emissions from managed soils | 0,00 | 0,00 | 0,00 | 730,41 | 0,00 | 730,41 | 730,41 |
| ORINOQUIA | 2018 | 3C5 - Indirect emissions of $N_2O$ from managed soils | 0,00 | 0,00 | 0,00 | 529,64 | 0,00 | 529,64 | 529,64 |
| ORINOQUIA | 2018 | 3C6 - Indirect $N_2O$ emissions from manure management | 0,00 | 0,00 | 0,00 | 16,41 | 0,00 | 16,41 | 16,41 |
| ORINOQUIA | 2018 | 3C7 - Rice cultivation | 0,00 | 0,00 | 1.415,30 | 0,00 | 0,00 | 1.415,30 | 1.415,30 |
| ORINOQUIA | 2018 | 3D1 - Products from harvested wood | -20,65 | IE | NA | NA | -20,65 | 0,00 | -20,65 |

# Annex 7: Review of the available data and methods for the subcategories from the initial selection against the quality and baseline setting requirements for ISFL Accounting

- **Forest converted to other forest land**
- **Forest converted to cropland (Deforestation)**
- **Forest converted to grassland (Deforestation)**
- **Forest converted to wetlands (Deforestation)**
- **Forest converted to settlements (Deforestation)**
- **Forest converted to other land (Deforestation)**

**Activity data parameters (Available historical time series and information sources)**

The activity data for the categories related to deforestation are established from satellite image analysis carried out by the Forest and Carbon Monitoring System (SMByC), for the historical series 2001-2018, whose information is presented in biennial periods for the years 2000-2012 and on an annual basis for the years 2023-2018.

The method used to determine land use changes related to changes from natural forest areas to other land uses is deforestation typification, which consists of stratified random sampling in areas of decreasing natural forest area, where an interpreter identifies the following change coverages:

- **Forest converted to other forest land:** Change to shrub land - other woody vegetation (OWV) and Forest Plantations.
- **Forest converted to cropland:** Change to crops and oil palm plantations.
- **Forest converted to grassland:** Change to pasture.
- **Forest converted to wetlands:** Change to water bodies and marsh vegetation.
- **Forest becoming settlements:** Change to urban space.
- **Forest converted to other land:** Change to bare soil.

| Parameter | Information Source | | Comments |
|---|---|---|---|
| | Period | Data source | |
| Area of change from forest to other forest land | 2009-2018 | SMByC | Available at biome level |

| | | | |
|---|---|---|---|
| Area of change of forest converted to crops | 2009-2018 | SMByC | Available at biome level |
| Area of forest change from forest to grassland | 2009-2018 | SMByC | Available at biome level |
| Area of forest change from forest to wetland | 2009-2018 | SMByC | Available at biome level |
| Area of forest change from forest to settlements | 2009-2018 | SMByC | Available at biome level |
| Area of change from Forest to other land | 2009-2018 | SMByC | Available at biome level |

| Parameter | Information Source | | Comments |
|---|---|---|---|
| | Period | Data source | |
| Deforestation typification | 2009-2018 | SMByC | Available at biome level |

The activity data used for the estimates in the subcategories related to deforestation can be consulted at the following links: 03-DA_SMBYC tif.zip y 11-DA_Tipificacion_deforestación.zip

**Emission factor parameters (information sources)**

Aboveground biomass and soil carbon content factors are obtained from the National Forest Inventory at the biome level. The carbon content factor for dead organic matter is a default from the 2006 IPCC Guidelines.

Carbon losses in the soil pool are estimated as the annual carbon loss over a 20-year period according to the IPCC default assumption.

| Emission factor | Information source | | Value |
|---|---|---|---|
| | Period | Data source | |
| Carbon content in biomass | - | IDEAM (IFN) | **Amazon:** BA (t.m.s/ha) 257,9. **Orinoquia:** BA (t.m.s/ha) 153,6. **Andes:** BA (t.m.s/ha) 85,6 |
| Carbon content in DOM | - | IPCC (2006); Vol 4. Chapter 2. Table 2.2 | Default value of natural forest: 2.1 t.C $ha^{-1}$ |
| Carbon content in soils | - | IDEAM (IFN) | **Amazon:** COS (t.C/ha) 73,76. **Orinoquia:** COS (t.C/ha) 64,51. **Andes:** COS (t.C/ha) 124,65. |
| Flu*Fmg*Fi Forest | - | Default factor imputation for the country (IPCC 2006) | **Amazon:** 1,00. **Orinoquia:** 1,00. **Andes:** 1,00. |
| Flu*Fmg*Fi Crops | - | Default factor imputation for the country (IPCC 2006) | **Amazon:** 0,56. **Orinoquia:** 0,49. **Andes:** 0,64. |
| Flu*Fmg*Fi Grassland | - | Default factor imputation for the country (IPCC 2006) | **Amazon:** 0,46. **Orinoquia:** 0,60. **Andes:** 0,67. |
| Flu*Fmg*Fi Wetlands | - | Default factor imputation for the country (IPCC 2006) | **Amazon:** 0,34. **Orinoquia:** 0,37. **Andes:** 0,76. |

The emission factors used in the emission estimates in the subcategories related to deforestation can be found in Table 14-3 and Table 14-4 on pages 999 and 1000 of the document "Informe del inventario nacional de gases efecto invernadero 1990-2018 y carbono negro 2010-2018 de Colombia"

| | |
|---|---|
| **Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions.** | Biome-level, spatially explicit, use category conversion information is available. |
| **Methodological level (equations)** | Tier 2<br><br>**Equation 2.15: Annual change in biomass carbon stock in land converted to another land-use category (Tier 2)**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$\Delta\ C_B\ =\ \Delta C_G + \Delta Conversión - \Delta C_L$<br>Where:<br><br>$\Delta\ C_B$ = Annual change in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta\ C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta\ C_L$ = Annual decrease in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br><br>**Equation 2.16: Initial change in biomass carbon stock in land converted to another category**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$\Delta Conversión = \Sigma\left(\left(B_{después} - B_{antes}\right) * \Delta\ A_{otras}\right) * CF$ |

| | |
|---|---|
| | Where:<br><br>$Bdespués =$ Existence of biomass in soil type i after conversion. $ton\ dm. ha^{-1}$.<br>$Bantes =$ Existence of biomass in soil type i before conversion. $ton\ dm. ha^{-1}$.<br>$A_{otras} =$ Area of land use i converted to another land use category. $ha. yr^{-1}$.<br>$CF$ = Carbon fraction of dry matter. $ton\ C\ .(ton\ dm)^{-1}$.<br><br>**Equation 2.9*: Annual increase in biomass carbon stocks. In land remaining in the same land use category.**<br>(IPCC - 2006. volume 4. chapter 2)<br><br>$$\Delta\ C_G\ =\ \Sigma(A * Gtotal * CF)$$<br>Where:<br><br>$\Delta\ C_G\ =$ Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$A =$ Area of land remaining in the same category. $ha$.<br>$G_{total}\ =$ Average annual biomass growth. $ton\ dm. ha^{-1}yr^{-1}$.<br>$CF =$ Carbon fraction of dry matter. $ton\ C\ .(ton\ dm)^{-1}$.<br><br>**Equation 2.10*: Average Annual Biomass Increments (Tier 1)**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$$G_{total}\ =\ \Sigma\left(G_w * (1 + R)\right)$$<br><br>Where: |

$G_{total}$ = Average annual biomass growth. $ton\ dm. ha^{-1}. yr^{-1}$.
$G_w$ = Average annual growth of aboveground biomass. $ton\ dm. ha^{-1}. yr^{-1}$.
$R$ = Relationship between below-ground biomass and above-ground biomass.
$Ton\ _{bg}dm\ (Ton\ _{ag}\ dm)^{-1}$.

**Equation 2.18: Annual change in carbon stocks of dead wood or litter (gain-loss method)**

(IPCC - 2006, Volume 4, Chapter 2)

$$\Delta C_{DOM} = A * \left((DOM_{in} - DOM_{out}) * CF\right)$$

Where:

$\Delta C_{DOM}$ = Annual change in carbon stocks in dead wood/leaf litter pools. $ton\ C\ yr^{-1}$.
$A$ = Area of land under management. $ha$
$DOM_{in}$ = Average annual biomass transfer to the dead wood/leaf litter pool due to annual processes and disturbances. $ton\ dm. ha^{-1}. yr^{-1}$.
$DOMout$ = Average annual carbon loss due to decomposition and disturbance from dead wood or litter deposits. $ton\ dm. ha^{-1}. yr^{-1}$.
$CF$ = Carbon fraction of dry matter. $ton\ C\ . (ton\ dm)^{-1}$.

| | |
|---|---|
| | **Equation 2.25: Annual change of organic carbon stocks in mineral soils**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$\Delta C_{Minerales} = \left(\left(SOC_0 - SOC_{(0-T)}\right)/D\right)$<br>Where:<br><br>$SOC_0$ = Existence of organic carbon in soils in the last year of a period in the inventory. $ton\ C$.<br>$SOC_{0-T}$ = Existence of organic carbon in soils at the beginning of a period in the inventory. $ton\ C$.<br>$D$ = Amount of time in a given period.<br><br>$SOC = \Sigma\,(SOC_{REF} * F_{LU} * F_{MG} * F_I * A)$<br><br>Where:<br><br>$F_{LU}$= Stock change factor for land-use systems.<br>$F_{MG}$= Stock change factor for management schemes.<br>$F_{LU}$= Stock change factor for organic matter input.<br><br>* Equations used to calculate natural forest growth < to 20 years. |
| **Consitent representation of lands** | Yes, because these categories have information on change of use and have spatially explicit information. |

<table>
<tr><th colspan="2">Land converted to forest (Regeneration)</th></tr>
<tr><td>Activity data parameters (Available historical time series and information sources)</td><td>Regeneration activity data are based on satellite image analysis performed by the SMByC, for the 2001-2018 historical series, whose information is presented in biennial periods for the years 2000-2012 and annually for the years 2023-2018.<br><br><table><tr><th rowspan="2">Parameter</th><th colspan="2">Information source</th><th rowspan="2">Comments</th></tr><tr><th>Period</th><th>Data source</th></tr><tr><td>Area of change from other uses to forest land</td><td>2009-2018</td><td>SMByC</td><td>Available at biome level</td></tr></table><br>The activity data used for the estimates in subcategory 3B1b can be consulted at the following link: 03-DA_SMBYC tif.zip</td></tr>
<tr><td>Emission factor parameters (information sources)</td><td>Aboveground biomass and soil carbon content factors are obtained from the National Forest Inventory at the biome level. The dead organic matter carbon content factor is a default from the 2006 IPCC Guidelines.<br><br>In this category the previous use of the conversion of the areas to natural forest is not known and therefore removals are estimated as the annual carbon accumulation over a 20-year period according to the IPCC default assumption, until the carbon content of the natural forest is reached at the biome level. This same approach is used for carbon accumulation in soil and dead organic matter pools.<br><br><table><tr><th rowspan="2">Emission factor</th><th colspan="2">Information source</th><th rowspan="2">Value</th></tr><tr><th>Period</th><th>Period</th></tr><tr><td>Carbon content in biomass</td><td>-</td><td>IDEAM (IFN)</td><td>Amazon: BA (t.m.s/ha) 257,9.</td></tr></table></td></tr>
</table>

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<tr>
<td></td>
<td>
<table>
<tr><td></td><td></td><td></td><td>Orinoquia: BA (t.m.s/ha) 153,6.<br>Andes: BA (t.m.s/ha) 85,6</td></tr>
<tr><td>Carbon content in DOM</td><td>-</td><td>IPCC (2006); Vol 4. Chapter 2. Table 2.2</td><td>Default value of natural forest: 2.1 t.C $ha^{-1}$</td></tr>
<tr><td>Carbon content in soils</td><td>-</td><td>IDEAM (IFN)</td><td>Amazon: COS (t.C/ha) 73,76.<br>Orinoquia: COS (t.C/ha) 64,51.<br>Andes: COS (t.C/ha) 124,65.</td></tr>
<tr><td>Flu*Fmg*Fi Forest</td><td>-</td><td>Default factor imputation for the country (IPCC 2006)</td><td>Amazon: 1,00.<br>Orinoquia: 1,00.<br>Andes: 1,00.</td></tr>
</table>
<br>
The emission factors used in the emission estimates in the subcategories related to deforestation can be found in Table 14-3 and Table 14-4 on pages 999 and 1000 of the document: “Informe del inventario nacional de gases efecto invernadero 1990-2018 y carbono negro 2010-2018 de Colombia”
</td>
</tr>
<tr>
<td>Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions</td>
<td>Biome-level, spatially explicit, use category conversion information is available</td>
</tr>
<tr>
<td>Methodological level (equations)</td>
<td>Tier 2<br><br>Equation 2.15: Annual Change in Biomass Carbon Stocks in Land Converted to Another Land-Use Category (Tier 2)</td>
</tr>
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| | |
|---|---|
| | (IPCC - 2006. Volume 4. Chapter 2)<br><br>$$\Delta\, C_B \;=\; \Delta C_G + \Delta Conversión - \Delta C_L$$<br>Where:<br><br>$\Delta\, C_B$ $=$ Annual change in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta\, C_G$ $=$ Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta\, C_L$ $=$ Annual decrease in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br><br>**Equation 2.16: Initial change in biomass carbon stock in land converted to another category.**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$$\Delta C_{conversión} = \Sigma\left(\left(B_{después} - B_{antes}\right) * \Delta\, A_{otras}\right) * CF$$<br>Where:<br><br>$B_{despues=}$ Existence of biomass in soil type i after conversion. $ton\ dm.\, ha^{-1}$.<br>$B_{antes=}$ Existence of biomass in soil type i before conversion. $ton\ dm.\, ha^{-1}$.<br>$\Delta A_{otras}$ = Area of land use i converted to another land use category. $ha.\, yr^{-1}$.<br><br>$CF$ = Carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$.<br><br>**Equation 2.9*: Annual increase in biomass carbon stocks. In land remaining in the same land-use category.**<br>IPCC - 2006. volume 4. chapter 2) |

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|---|---|
| | $$\Delta\, C_G \;=\; \Sigma(A * Gtotal * CF)$$ Where: <br><br> $\Delta\, C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$. <br> $A$ = area of land remaining in the same category. $ha$. <br> $G_{total}$ = Average annual biomass growth. $ton\ dm. ha^{-1}. yr^{-1}$. <br> $CF$ = Carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$. <br><br> **Equation 2.10*: Average annual biomass increments (Level 1)** <br> (IPCC - 2006. volume 4. chapter 2) <br><br> $$G_{total} \;=\; \Sigma\left(G_w * (1+R)\right)$$ <br> Where: <br><br> $G_{total}$ = Average annual biomass growth. $ton\ dm. ha^{-1}. yr^{-1}$. <br> $G_w$ = Average annual growth of aboveground biomass. $ton\ dm. ha^{-1}. yr^{-1}$. <br> $R$ = Relationship between below-ground biomass and above-ground biomass. <br> $Ton\ _{bg}dm\ (Ton\ _{ag}\ dm)^{-1}$. <br><br> **Equation 2.18: Annual change in carbon stocks of dead wood or litter (gain-loss method)** <br> (IPCC - 2006, Volume 4, Chapter 2) <br> $$\Delta C_{DOM} = \; A * \left((DOM_{in} - DOM_{out}) * CF\right)$$ |

| | |
|---|---|
| | Where:<br><br>$\Delta C_{DOM}$= annual change in carbon stock change in dead wood/leaf litter stocks. $ton\ C\ yr^{-1}$.<br>$A$ = Area of land under management. $ha$<br>$DOM_{in}$ = Average annual biomass transfer to the dead wood/leaf litter deposit due to annual processes and disturbances. $ton\ dm. ha^{-1}. yr^{-1}$.<br>$DOMout$ = Average annual carbon loss due to decomposition and disturbance from dead wood or litter deposits. $ton\ dm. ha^{-1}. yr^{-1}$.<br>$CF$ = Carbon fraction of dry matter. $ton\ C\ .(ton\ dm)^{-1}$.<br><br>**Equation 2.25: Annual change of organic carbon stock in mineral soils**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$\Delta C_{Minerales} = \left((SOC_0\ - SOC_{(0-T)})/D\right)$<br><br>Where:<br><br>$SOC_0$ = Existence of organic carbon in soils in the last year of a period in the inventory. $ton\ C$.<br>$SOC_{0-T}$ = Existence of organic carbon in soils at the beginning of a period in the inventory. $ton\ C$.<br>$D$ = Amount of time in a given period.<br><br>$SOC = \Sigma\ (SOC_{REF} * F_{LU} * F_{MG} * F_I * A)$<br><br>Where: |

| | |
|---|---|
| | $F_{LU}$= Stock change factor for land-use systems.<br>$F_{MG}$= Stock change factor for management schemes.<br>$F_{LU}$= Stock change factor for organic matter input.<br><br>* Equations used to calculate natural forest growth < to 20 years. |
| **Consistent representation of lands** | No, this category does not have information on change of use, although it does have spatially explicit information. |

<table>
<tr><th colspan="2">Forest remaining forest</th></tr>
<tr><td>Activity data parameters (Available historical time series and information sources)</td><td>The activity data used to estimate emissions from firewood consumption corresponds to the rural population that consumes firewood, which is obtained from the percentage of the population that consumes firewood established in the PERS and the rural population of the 4 departments of the region from the DANE population census.
<table>
<tr><th rowspan="2">Parameter</th><th colspan="2">Information source</th><th rowspan="2">Comments</th></tr>
<tr><th>Period</th><th>Data source</th></tr>
<tr><td>Rural population DANE</td><td>2009-2018</td><td>Population Census 2018 DANE</td><td>Available by department</td></tr>
<tr><td>% population consuming firewood</td><td>-</td><td>DANE Quality of Life Survey 2018</td><td>Available nationwide</td></tr>
</table>
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| | In the following links you can consult the supporting information of the activity data for the estimations of emissions from firewood consumption:<br>01-DA_ECV_2018_leña.xlsx Table 10 and Table 11<br>01-DA_leña_1985-1992.xlsx<br>01-DA_Leña_1993-2004.xlsx<br>01-DA_Leña_2005-2017.xlsx<br>01-DA_Leña_2018-2050.xlsx |
| **Emission factor parameters (information sources)** | The following aspects are taken into account to obtain the firewood consumption factor:<br><br>The carbon content of the biomass removed as firewood does not include belowground biomass, the percentage of moisture in firewood is 19% and the population consuming firewood decreases as the substitution is made by other energy sources, for which a back projection is made until the population consuming firewood is 100% with the annual % adjustment of the population consuming firewood. |

| Emission factor | Information source | | Value |
|---|---|---|---|
| | Period | Data source | |
| Firewood consumption kg/inhabitant/year | - | PERS (UPME) | **Ton/inhab/yr:** 1,40 |
| R | - | IPCC, 2006 | 0,29 |
| Carbon fraction of dry matter (FC) | - | IPCC, 2006 | 0,47 |
| % Annual adjustment of the percentage of population consuming firewood | | UPME | 1,8 |

The emission factors for the estimation of emissions from firewood consumption were taken from the characterization sheet of the NDC sectoral measure "Replacement of traditional wood stoves with

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| | efficient stoves - increase in ambition", which was agreed with the different sectoral stakeholders and can be consulted at the following link: 01-FE_Leña.xlsm |
| **Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions** | Information at the departmental level, spatially referenced from statistics, there is no information on conversion of use categories. |
| **Methodological level (equations)** | Tier 2<br><br>**Equation 2.7: Annual change in biomass carbon stock in land remaining in a particular land-use category (gain-loss method)**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$\Delta C_B = \Delta C_G - \Delta C_L$<br>Where:<br><br>$\Delta C_B$ = Annual change in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta C_L = Annual\ decrease\ in\ biomass\ carbon\ stocks.\ ton\ C\ yr^{-1}$.<br><br>**Equation 2.9: Annual increase in biomass carbon stocks. In land remaining in the same land-use category.**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$\Delta C_G = \Sigma(A * G_{total} * CF)$ |

| | |
|---|---|
| | Where:<br><br>$\Delta\, C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$A$ = Area of land remaining in the same category. $ha$.<br>$G_{total}$ = Average annual biomass growth. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$CF$ = Carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$.<br><br>**Equation 2.10: Average Annual Biomass Increments (Tier1)**<br>(IPCC - 2006. volume 4. chapter 2)<br><br>$$G_{total} = \Sigma\left(G_w * (1+R)\right)$$<br>Where:<br><br>$G_{total}$ = Average annual biomass growth. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$G_w$ = Average annual growth of aboveground biomass. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$R$ = Relationship between below − ground biomass and above − ground biomass. $Ton\ _{bg}dm\ (Ton\ _{ag}\ dm)^{-1}$.<br><br>**Equation 2.11: Annual reduction in biomass carbon stocks. In land remaining in the same land-use category (Stock-difference methods).**<br>(IPCC - 2006. volume 4. chapter 2)<br><br>$$\Delta C_L = L_{remoción-bosques} + L_{madera-combustible} + L_{perturbación}$$<br>Where:<br><br>$\Delta C_L$ = Annual decrease in biomass carbon stocks. $ton\ C\ yr^{-1}$. |

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| | $L_{remoción-bosques}$ = Annual carbon loss due to timber harvests *. $ton\ C\ yr^{-1}$.<br>$L_{madera-combustible}$ = Annual carbon loss due to firewood-fuel removals. $ton\ C\ yr^{-1}$.<br>$L_{perturbación}$= Annual carbon loss due to disturbances *. $ton\ C\ yr^{-1}$.<br><br>**Equation 2.12: Annual biomass carbon loss due to forest removals.**<br>(IPCC - 2006. volume 4. chapter 2)<br><br>$$L_{remoción-bosques} = \{H * BCEF_R * (1 + R) * CF\}$$<br><br>Where:<br><br>$L_{remoción-bosques}$ = Annual carbon loss due to timber harvests *. $ton\ C\ yr^{-1}$.<br>$H$= Annual timber harvest. $m^3\ yr^{-1}$.<br>$BCEF_R$= Biomass conversion factor for conversion of VENABLE volume removals to total biomass removals (including bark). $ton\ _{biomas\ removida}\ (m^3{}_{removida})^{-1}$.<br>$R$ = Relationship between below-ground biomass and above-ground biomass. $ton\ _{bg}dm\ (ton\ _{ag}\ dm)^{-1}$.<br>$CF$ = Carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$.<br><br>**Equation 2.13: Annual biomass carbon loss from fuelwood removals.**<br>(IPCC - 2006. volume 4. chapter 2)<br><br>$$L_{madera-combustible} = \left[\{FG_{arbol} * BCEF_R(1 + R)\} + FG_{part} * D\right] * CF$$<br><br>Where: |

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| | $L_{madera-combustible}$ = Annual carbon loss due to firewood-fuel removals. $ton\ C\ yr^{-1}$.<br>$BCEF_R$= Biomass conversion factor for conversion of VENABLE volume removals to total biomass removals (including bark).). $ton\ _{biomas\ removida}\ (m^3{}_{removida})^{-1}$.<br>$R$ = Relationship between below-ground biomass and above-ground biomass.<br>$ton\ _{bg}dm\ (ton\ _{ag}\ dm)^{-1}$.<br>$FG_{part}$= Annual volume of firewood removal as parts of trees **. $m^3\ yr^{-1}$.<br>D= Wood density. Ton $m^{-3}$<br>CF= Carbon fraction of dry matter. Ton C (Ton dm)$^{-1}$<br>**Equation 2.14: Annual biomass carbon losses due to disturbance.**<br>(IPCC - 2006. volume 4. chapter 2)<br>$$L_{perturbación} = \{A_{perturbación} * B_W * (1 + R) + CF * fd\}$$<br>Where:<br>$L_{perturbación}$ = Annual carbon loss due to disturbances. $ton\ C\ yr^{-1}$.<br>$B_w$= Average aboveground biomass in affected areas. $ton\ dm.ha^{-1}$.<br>$R$ = Relationship between below-ground biomass and above-ground biomass.<br>$ton\ _{bg}dm\ (ton\ _{ag}\ dm)^{-1}$.<br>$CF$ = Carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$.<br>$df$. = Fraction of biomass lost due to disturbances<br>**Equation 2.16: Initial change in biomass carbon stock in land converted to other land categories.** |

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| | *Alternate equation used to quantify natural forest losses that are not converted to other use categories.* (IPCC - 2006. volume 4. chapter 2)<br><br>$$\Delta C_{conversión} = \Sigma\left(\left(B_{después} - B_{antes}\right) * \Delta\, A_{otras}\right) * CF$$<br><br>Where:<br><br>$B_{despues}$= Existence of biomass in soil type i after conversion. $ton\ dm.ha^{-1}$.<br>$B_{antes}$= Existence of biomass in soil type i before conversion. $ton\ dm.ha^{-1}$.<br>$\Delta A_{otras}$ = Area of land use i converted to another category of use. $ha.yr^{-1}$.<br>$CF$ = Carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$.<br><br>**Equation 2.26: Annual carbon loss in drained organic soils ($CO_2$)**<br>(IPCC - 2006. volume 4. chapter 2)<br><br>$$L_{orgánicos} = \Sigma(A * EF)$$<br><br>Where:<br><br>$A$ = Surface area of drained organic soils by climate type. $ha$.<br>$EF$ = Emission factor by climate type. $ton\ C\ ha^{-1}.yr^{-1}$. |
| **Consistent representation of lands** | No, because this category does not have information on change of use, nor does it have spatially explicit information. |

<table>
<tr><th colspan="2">Dynamic in OWV</th></tr>
<tr><td>Activity data parameters (Available historical time series and information sources)</td><td>
The activity data for the subcategory Dynamic in OWV are established from satellite image analysis carried out by the SMByC, for the historical series 2001-2018, whose information is presented in biennial periods for the years 2000-2012 and annually for the years 2023-2018.
The activity data have a particular adjustment of the area for the biennial periods (2000-2002, 2002-2004, 2004-2006, 2006-2008, 2008-2010, 2010-2012), where in the initial year of the biennial period the sum of stable area plus half of the area of increase, plus half of the area of decrease in coverage is made. For the final year of the period, the sum of the stable area plus the area of increase minus the area of decrease in coverage is made; for the other periods 2013-2018, the calculation is made directly by adding the stable and increase areas.
In addition, an adjustment of the area is made taking into account the deforestation caused by this cover, subtracting from the area of increase the identified area of change from natural forest to OVL by typing, this was done to avoid double counting.
<table>
<tr><th rowspan="2">Parameter</th><th colspan="2">Information Source</th><th rowspan="2">Comments</th></tr>
<tr><th>Period</th><th>Data source</th></tr>
<tr><td>OWL stable areas</td><td>2009-2018</td><td>SMByC</td><td>Available at biome and department level</td></tr>
<tr><td>OWL increase area</td><td>2009-2018</td><td>SMByC</td><td>Available at biome and department level</td></tr>
<tr><td>OWL decrease area</td><td>2009-2018</td><td>SMByC</td><td>Available at biome and department level</td></tr>
</table>
The activity data for the estimation of emissions/removals due to the Dynamic of other woody vegetation, can be consulted at the following link: 03-DA_SMBYC tif.zip
</td></tr>
</table>

<table>
<tr>
<td>Emission factor parameters (information sources)</td>
<td>
<table>
<tr><th rowspan="2">Emission factor</th><th colspan="2">Information Source</th><th rowspan="2">Value</th></tr>
<tr><th>Period</th><th>Data Source</th></tr>
<tr><td>Carbon content in biomass</td><td>-</td><td>Yepes et al, 2011</td><td>BT (t.m.s/ha): 65,075</td></tr>
</table>
The biomass content factor used in the estimation of emissions/removals from OWV Dynamic can be consulted on page 10 of the document “Estimación de las emisiones de dióxido de carbono generadas por deforestación durante el periodo 2005-2010” available at the following link: 03-FE_Estudio_Yepes_2011.pdf
</td>
</tr>
<tr>
<td>Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions.</td>
<td>Department and biome level information, spatially explicit.</td>
</tr>
<tr>
<td>Methodological level (equations)</td>
<td>
Equation 2.7: Annual change in biomass carbon stock in land remaining in a particular land-use category (gain-loss method)
(IPCC - 2006. volume 4. chapter 2)
$$\Delta C_B = \Delta C_G - \Delta C_L$$
Where:
$\Delta C_B$ = Annual change in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>
$\Delta C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.
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| | $\Delta\, C_L \;\; =$ Annual decrease in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br><br>**Equation 2.9: Annual increase in biomass carbon stocks. In land remaining in the same land-use category.**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$$\Delta\, C_G \;\; = \; \Sigma(A * G_{total} * CF)$$<br>Where:<br><br>$\Delta\, C_G \;\; =$ Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$A$ = Area of land remaining in the same category. $ha$.<br>$G_{total} \;\; = \text{Average annual biomass growth}.\ ton\ dm.ha^{-1}.yr^{-1}$.<br>$CF\, =$ Carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$.<br><br>**Equation 2.10: Average Annual Biomass Increments (Tier 1)**<br>(IPCC - 2006. volume 4. chapter 2)<br><br>$$G_{total} \; = \; \Sigma\big(G_w \; * (1+R)\big)$$<br>Where:<br><br>$G_{total} \;\; =$ Average annual biomass growth. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$G_w \;\; =$ Average annual growth of aboveground biomass. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$R\, =$ Relationship between below-ground biomass and above-ground biomass.<br>$Ton\ _{bg}dm\ (Ton\ _{ag}\ dm)^{-1}$. |

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| **Consistent representation of lands** | No, because this category does not have information on change of use, although it does have spatially explicit information. |

<table>
<tr><th colspan="2">Dynamic in forest plantations</th></tr>
<tr><td>Activity data parameters (Available historical time series and information sources)</td><td>
The activity data for the categories related to forest plantation dynamic is established based on the analysis of satellite images by the SMByC, for the historical series 2001-2018, whose information is presented in biennial periods for the years 2000-2012 and annually for the years 2023-2018.
The activity data have a particular adjustment of the area for the biennial periods (2000-2002, 2002-2004, 2004-2006, 2006-2008, 2008-2010, 2010-2012), where in the initial year of the biennial period the sum of stable area, plus half of the increase area, plus half of the decrease area of this coverage is made, for the final year of the period the sum of stable area, plus the increase area, minus the decrease area of this coverage is made, for the other periods 2013-2018 the calculation is made directly by adding the stable and increase areas.
In addition, an adjustment of the area is made taking into account the deforestation caused by this cover, subtracting the area of increase, the identified area of change from natural forest to forest plantations by typification, this was done to avoid double counting.
The changes in carbon content in the DOM and Soil pools remain stable for this category.
<table>
<tr><th rowspan="2">Parameter</th><th colspan="2">Information Source</th><th rowspan="2">Comments</th></tr>
<tr><th>Period</th><th>Data Source</th></tr>
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<table>
<tr><td>Stable areas of forest plantations</td><td>2009-2018</td><td>SMByC</td><td>Available at biome and department level</td></tr>
<tr><td>Area of increase of forest plantations</td><td>2009-2018</td><td>SMByC</td><td>Available at biome and department level</td></tr>
<tr><td>Area of forest plantation decline</td><td>2009-2018</td><td>SMByC</td><td>Available at biome and department level</td></tr>
</table>
The activity data for the estimation of emissions/removals by the Dynamic in forest plantations can be consulted at the following link: 03-DA_SMBYC tif.zip
</td>
</tr>
<tr>
<td>Emission factor parameters (information sources)</td>
<td>
The factors used to estimate the gains or losses of carbon content in a planted area are obtained from the consolidation of biomass factors for commercial forest plantations in the Orinoquia, carried out by the University of Tolima, which include data on density, average annual increment (IMA), biomass expansion factor (FEB), aboveground biomass to belowground biomass ratio (R), harvesting shift and the carbon fraction per species identified for the Orinoquia region (a total of 12 species).
Additionally, there is spatially referenced information on consolidated plantation areas for the forestry bulletin issued by the Agriculture and Rural Development Ministry (MADR) for 2021, which compiles information from ICA (Colombian Agricultural Institute), MADR, FINAGRO (Agricultural Sector Financing Fund), FNC (National Federation of Coffee Growers) and FEDECACAO (National Federation of Cocoa Growers), for the 1990-2018 series. This information has data on planted areas which is disaggregated by species (a total of 51 additional species to the 12 in the study of the U. Tolima study, identified for the Orinoquia). For these 51 species an assignment of factors was made taking into account the genus and type of growth with the information available at regional or country level.
Based on this spatially referenced information, estimates were made of annual carbon gains due to the growth of the plantations until reaching the year of their shift and of annual carbon losses associated with the harvests that would occur in the year of fulfillment of the theoretical shift of the planted species. These
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<tr><td></td><td>calculations were made for the Third Biennial Update Report (BUR3) of Colombia, and were used as the basis for an exercise to assign factors to areas with spatially explicit information.<br><br>This assignment of factors was made on the basis of information from the calculation of emissions and removals generated for the spatially referenced database of plantation records, determining the t C ha/year of increase (removals) and decrease (emissions) of areas for each year by department, divided by the area reported in the same year by department. This allows obtaining a differentiated emission factor by year and department, according to the emissions and removals reported for the areas and species registered in the Orinoquia and that can be imputed to the spatially explicit area.<br><br><table><tr><th rowspan="2">Emission factor</th><th colspan="2">Information Source</th><th rowspan="2">Value</th></tr><tr><th>Period</th><th>Data Source</th></tr><tr><td>Carbon content in biomass</td><td>2009-2018</td><td>Study University of Tolima</td><td>See spreadsheets</td></tr></table><br>The factors of carbon content in the biomass were estimated from the information generated by the study of the University of Tolima in the framework of the Orinoco Biocarbon Project. In the following links you can see the supports of the factors used in the spreadsheets:<br>04-FE_Plantaciones.xlsx<br>04-FE_Estudio_UTolima.pdf<br>04-BD_FE_UTolima.xlsx</td></tr>
<tr><td>Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions.</td><td>Department and biome level information, spatially explicit.</td></tr>
</table>

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| **Methodological level (equations)** | **Equation 2.7: Annual change in biomass carbon stock In land remaining in a particular land-use category (gain-loss method)**<br>(IPCC - 2006. volume 4. chapter 2)<br>$$\Delta C_B = \Delta C_G - \Delta C_L$$<br>Where:<br>$\Delta C_B$ = Annual change in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta C_L$ = Annual decrease in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br><br>**Equation 2.9: Annual increase in biomass carbon stocks. In land remaining in the same land-use category.**<br>(IPCC - 2006. volume 4. chapter 2)<br>$$\Delta C_G = \Sigma(A * G_{total} * CF)$$<br>Where:<br>$\Delta C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$A$ = Area of land remaining in the same category. $ha$.<br>$G_{total}$ = Average annual biomass growth. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$CF$ = Carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$.<br><br>**Equation 2.10: Average annual biomass increments Tier 1)**<br>(IPCC - 2006. volume 4. chapter 2) |

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| | $$G_{total} = \Sigma\left(G_w * (1+R)\right)$$ Where:<br><br>$G_{total}$ = Average annual biomass growth. $ton\ dm. ha^{-1}. yr^{-1}$.<br>$G_w$ = Average annual growth of aboveground biomass. $ton\ dm. ha^{-1}. yr^{-1}$.<br>$R$ = Relationship between below-ground biomass and above-ground biomass.<br>$Ton\ _{bg}dm\ (Ton\ _{ag}\ dm)^{-1}$. |
| **Method consistent representation of Lands Approach 3** | No, this category does not have information on change of use, although it does have spatially explicit information. |

| Cattle Enteric fermentation | |
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| **Activity data parameters (Available historical time series and information sources)** | • Livestock Inventory – FEDEGAN[215]: Activity data obtained at the municipal scale, standardized for the subcategories proposed by IPCC methodological Tier 2 (2019). Information available for the period 2001 to 2013.<br>• National Livestock Census – ICA[216]: Data consolidated annually by ICA at the municipal level, resulting from the compilation of the single vaccination register, homologated for the subcategories proposed by IPCC methodological Tier 2 (2019). Information available for the period 2014 to 2022. The information is updated annually.<br><br>The databases reported by ICA and FEDEGAN contain information on the number of animals by age groups: calves under one year old, females and males between 1 and 2 years old, females and males between 2 and 3 years old, females and males over 3 years old. The age groups were homologated with those proposed in the IPCC guidelines. (2006[217] y 2019[218]). For this purpose, the map of livestock herd orientation at the municipal scale reported by FEDEGAN[219] was used and the following criteria were applied for the homologation of the age groups with the IPCC categories:<br><br>High-producing cows: sum of females from 2 to 3 years old and those older than 3 years old in all dairy-oriented municipalities.<br>• Low-producing cows: all females older than 3 years in dual-purpose oriented municipalities. |

215 Livestock Inventory. https://www.fedegan.org.co/estadisticas/inventario-ganadero

216 National Livestock Census. https://www.ica.gov.co/áreas/pecuaria/servicios/epidemiologia-veterinaria/censos-2016/censo-2018

217 IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2006. https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

218 IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

219 FEDEGAN, Carta Fedegán 130: Primer Foro Internacional de la Leche, 2012, Page 15. https://www.fedegan.org.co/carta-fedegan-130-primer-foro-internacional-de-la-leche

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| | • Cows for meat production: all females older than 3 years in the municipalities with fattening and breeding orientation.<br>• Bulls used for reproductive purposes: 55% of males older than 3 years, in all municipalities.<br>• Category 3A1av - 3A2av Cattle Calves pre-weaning: sum of all heifers and calves under one year old.<br>• Replacement calves: all females between 1 to 3 years old in municipalities with fattening, breeding, and dual-purpose orientation. In municipalities with specialized dairy orientation, all females between 1 to 2 years old.<br>• Growing - fattening cattle: males between 1 to 3 years old plus 45% of males older than 3 years old in all municipalities. |
| **Emission factor parameters (information sources)** | The $CH_4$ emission factors for enteric fermentation of cattle were calculated under a Tier 2 methodology, using the AFOLU 1 Colombia – IDEAM[220] model. This is a complex model that allows the calculation of emission factors based on the characterization by region of the type of animals, production system, climate and diet.<br>The equations used by the **AFOLU 1 Colombia - IDEAM model** to calculate the enteric methane emission factors are as follows:<br><br>**Equations to determine the tier 2 emission factors used in the AFOLU 1 model Colombia**<br><br>**Equation 10.21: Enteric methane emission factors for a cattle category older than one year**<br>(Adapted from IPCC, 2019; volume 4, chap 10[221]) |

[220] IDEAM et al., INFORME DEL INVENTARIO NACIONAL DE GASES EFECTO INVERNADERO 1990-2018 Y CARBONO NEGRO 2010-2018 DE COLOMBIA. Tercer informe bienal de actualización de cambio climático, BUR3. Dirigido a la convención Marco de las Naciones Unidas sobre Cambio Climático, 2022. https://unfccc.int/documents/510821

[221] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 10: Emissions from livestock and manure management, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

$$EF = \frac{GE_t * \left(\frac{Y_m}{100}\right) * PE}{55{,}65}$$

Where:

EF = emission factor, kg $CH_4$ head $^{-1}$ year $^{-1}$
$GE_t$ = total gross energy consumption for each of the IPCC categories (Mj day $^{-1}$).
Ym = methane conversion factor, percentage of the gross energy of the feed converted to methane. Ymt>1 or Ymt<1 is used according to whether the bovine is older (Ymt>1) or younger than one year (Ymt<1) and this variable should be consistent with the PE value.
PE = for animals older than one year is equal to 365; for animals younger than one year is equal to 273, and that their diet is based mainly on milk for the first 3 months of life (Church[222], 1993 and their enteric fermentation is reduced.

**Equation 10c: Enteric methane conversion factor for cattle older than one year old.**
(Adapted from Ellis *et al*[223])

$$Y_{m>1} = \left(\frac{\left(3{,}41 + 0{,}52 * (CMS) - 0{,}996 * \left(CMS * \left(\frac{FDA}{100}\right)\right) + 1{,}15 * \left(CMS * \left(\frac{FDN}{100}\right)\right)\right) * 100}{GE_t}\right)$$

Where:

[222] Church, El rumiante: fisiología digestiva y nutrición. Zaragoza: Acribia, 641. Pag. 460. 1993.
[223] Ellis *et al*, Prediction of methane production from dairy and beef cattle, 2007. https://www.sciencedirect.com/science/article/pii/S0022030207717952

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| | $Y_{m>1}$ = enteric methane conversion factor for cattle older than one year, %<br>CMS = dry matter intake, kg day$^{-1}$<br>FDA = dietary acid detergent fiber, %.<br>FDN = neutral detergent dietary fiber, %.<br>GEt = total gross energy consumption for each of the IPCC categories, Mj day $^{-1}$<br><br>**Equation 12: Determination of dry matter intake for cattle older than one year**<br>(Adapted from Pickering y Wear[224])<br><br>$$CMS = GE_t / GE_{pd}$$<br><br>Where:<br><br>CMS = dry matter intake in cattle older than one year, kg day $^{-1}$<br>$GE_t$ = total gross energy intake, Mj day $^{-1}$.<br>$GE_{pd}$ = gross energy content of the diet, MJ kg $^{-1}$.<br><br>**Equation 10c: Enteric methane conversion factor for cattle less than one year old.**<br>(Adapted from Ellis *et al*[225]) |

[224] Pickering y Wear, Detailed methodologies for agricultural greenhouse gas emission calculation, 2013. https://www.mpi.govt.nz/dmsdocument/13906-detailed-methodologies-for-agricultural-greenhouse-gas-emission-calculation
[225] Op. Cit. Ellis *et al*

$$Y_{m<1} = \left( \frac{\left(3{,}41 + 0{,}52 * (CMS_p) - 0{,}996 * \left(CMS_p * \left(\frac{FDA}{100}\right)\right) + 1{,}15 * \left(CMS_p * \left(\frac{FDN}{100}\right)\right)\right) * 100}{(CMS_p * GE_{pd})} \right)$$

Where:

$Y_{m<1}$ = enteric methane conversion factor for cattle less than one year old, %.
$CMS_p$ = potential dry matter intake for cattle less than one year old, kg day $^{-1}$.
FDA = dietary acid detergent fiber, %.
FDN = neutral detergent dietary fiber, %.
$GE_{pd}$ = gross energy content of the diet, MJ kg $^{-1}$.

**Equation 2 - Table 11: Equation for estimating dry matter intake of cattle under one year old.**
(Adapted from Fox *et al*[226])

$$CMS_p = (((Peso + (Gan * 365)) * 0{,}96)\text{^}0{,}75) * (((0{,}2435 * (NE_m/4{,}184)) - (0{,}0466 * ((NE_m/4{,}184)\text{^}2)) - 0{,}0869)/(NE_m/4{,}184)) * 1 * BI * Ajuste\ temp$$

Where:

CMSp = potential dry matter intake, kg day$^{-1}$.
Peso = average weight of the type animal according to IPCC category (kg).

[226] Fox *et al,* The Cornell Net Carbohydrate and Protein System model for evaluating herd nutrition and nutrient excretion, 2004. https://www.sciencedirect.com/science/article/abs/pii/S0377840103002979

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| | Gan = weight gain of the animal (kg).<br>NEm = net maintenance energy of the diet, Mj kg $^{-1}$<br>BI = species-specific intake adjustment, 1,08 for Bos taurus, 1,04 for crossbreds (*Bos taurus* x Bos *indicus*) and 1 for *Bos indicus* (Fox et al[227] (Equations 17, 18 and 19, Table 11)).<br>Adjustment temp = Adjustment of dry matter intake by ambient temperature.<br><br>**Equation 5: Temperature adjustment for potential dry matter consumption.**<br>(Adapted from Freer *et al*[228])<br><br>$$Ajuste\ temp = \left(1 - RCMS * (Temp - Temp_C)\right)$$<br><br>Where:<br><br>Ajuste temp = Adjustment of dry matter intake by environmental temperature.<br>RCMS = reduction in dry matter intake, 0,02 for Bos taurus, 0.015 for crossbreeds (Bos taurus x Bos indicus) and 0.01 for Bos indicus (Freer et al[229] (Parameter $C_{15}$)).<br>Temp = environmental temperature (°C), this is the temperature of the area where the animals are located, this area can be a municipality, a department or a livestock region<br>$Temp_C$ = It is the upper critical temperature (°C) of the thermal comfort range for the different animal species, 16.00 for Bos taurus, 20.00 for crossbreeds (*Bos taurus* x *Bos indicus*) and 25.00 for *Bos indicus* (Nazar Anchorena[230]). |

[227] Ibid.
[228] Freer *et al,* The GRAZPLAN animal biology model for sheep and cattle and the GrazFeed decision support tool, 2012. https://docplayer.net/22170948-The-grazplan-animal-biology-model-for-sheep-and-cattle-and-the-grazfeed-decision-support-tool-1-m-freer-a-d-moore-j-r.html
[229] Ibid.
[230] Nazar Anchorena, Adaptación del ganado vacuno a zonas cálidas, 1980. https://www.produccion-animal.com.ar/clima_y_ambientacion/18-adaptacion_a_zonas_calidas.pdf

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| | **Equation 10.16: Total gross energy consumption for cattle.**<br>(Adapted from IPCC, 2019; volume 4, chapter[231])<br>$$GE_t = \left[ \frac{\left( \frac{NE_m + NE_a + NE_l + NE_{work} + NE_p}{REM} \right) + \left( \frac{NE_g}{REG} \right)}{\frac{DE_p}{100}} \right] - GE_{milk}$$<br>Where:<br>$GE_t$ = total gross energy consumption for each of the IPCC categories, Mj day$^{-1}$<br>$NE_m$ = net energy requirement for maintenance, MJ day$^{-1}$<br>$NE_a$ = net energy requirement for physical activity, MJ day $^{-1}$<br>$NE_l$ = net energy requirement for lactation, MJ day $^{-1}$<br>$NE_{work}$ = net energy requirement for work, MJ day$^{-1}$<br>$NE_p$ = net energy requirement for gestation, MJ day$^{-1}$<br>REM = ratio of energy available in a maintenance diet to digestible energy consumed.<br>$NE_g$ = net energy requirement for weight gain, MJ day $^{-1}$<br>REG = conversion ratio between net energy for weight gain and digestible energy.<br>$DE_p$ = digestible energy of the diet expressed as % of gross energy<br>$GE_{milk}$ = gross energy intake of milk fed to the calf, MJ day $^{-1}$<br>**Equation 10.3: Net energy for maintenance.**<br>(Adapted from IPCC, 2019; volume 4, chapter10[232]) |

[231] Op. Cit. IPCC, 2019
[232] Op. Cit. IPCC, 2019

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| | $$NE_m = \left((a_1 * 4{,}184) + a_2\right) * Peso^{0{,}75}$$<br>Where:<br>$NE_m$ = net energy requirement for maintenance, MJ day$^{-1}$<br>$a_1$ = basal metabolic rate, 0.073 for *Bos taurus*, 0.069 for crossbreeds (*Bos taurus* x *Bos indicus*) and 0.064 for Bos indicus (Fox et al[233] (Page 2.3 y Table 2.1.)).<br>$a_2$ = Temperature adjustment for basal metabolic rate.<br>Weight = average weight of the type animal according to IPCC category (kg).<br>**Temperature adjustment of the basal metabolic rate.**<br>(Adapted from NRC, 1996; Page 114[234])<br>$$a_2 = (0{,}0007 * 4{,}184) * (\,Temp_C - \,Temp)$$<br>Where:<br>*$a_2$* = Temperature adjustment of the basal metabolic rate.<br>Temp = ambient temperature (°C), this is the temperature of the area where the animals are located, this area can be a municipality, a department or a livestock region.<br>$Temp_C$ = Upper critical temperature (°C) of the thermal comfort range for the different animal species, 16 for Bos taurus, 20 for crossbreeds (*Bos taurus* x *Bos indicus*) and 25 for *Bos indicus* (Nazar Anchorena[235]). |

[233] Op. Cit. Fox *et al*
[234] NRC, Nutrient Requirements of Beef Cattle, 1996, update 2000. Available at: https://nap.nationalacademies.org/catalog/9791/nutrient-requirements-of-beef-cattle-seventh-revised-edition-update-2000
[235] Op. Cit. Nazar Anchorena.

| | |
|---|---|
| | **Equation 10.4: Net energy for activity.**<br>(IPCC, 2019; volume 4, chapter 10[236])<br><br>$$NE_a = C_a * NE_m$$<br><br>Where:<br><br>$NE_a$ = net energy requirement for physical activity, MJ day$^{-1}$<br>$NE_m$ = net energy requirement for maintenance, MJ day$^{-1}$<br>$C_a$ = constant corresponding to the animal feeding system, 0 for confinement or stabling, 0.17 for intensive grazing and 0.36 for extensive grazing (IPCC, 2019 (Table 10.5)[237]).<br><br>**Equation 10.8: Net energy for lactation.**<br>(IPCC, 2019; volume 4, chapter 10[238])<br><br>$$NE_l = Milk * (1{,}47 + 0{,}40 * Grasa)$$<br><br>Where:<br><br>$NE_l$ = net energy requirement for lactation, MJ day$^{-1}$<br>Fat = fat content of milk, %.<br><br>**Equation 10.11: Net energy for work.** |

[236] Op. Cit. IPCC, 2019.
[237] Op. Cit. IPCC, 2019.
[238] Op. Cit. IPCC, 2019.

| | |
|---|---|
| | (IPCC, 2019; volume 4, chapter 10[239])<br><br>$$NE_{work} = 0.10 * NE_m * Horas$$<br>Where:<br><br>$NE_{work}$ = net energy requirement for work, MJ day $^{-1}$<br>$NE_m$ = net energy requirement for maintenance, MJ day$^{-1}$<br>Horas = Number of working hours per year.<br><br>**Equation 10.11: Net energy for gestation.**<br>(IPCC, 2019; volume 4, chap 10[240])<br><br>$$NE_p = 0{,}10 * NE_m$$<br>Where:<br><br>$NE_p$ = net energy requirement for gestation, MJ day$^{-1}$<br>$NE_m$ = net energy requirement for maintenance, MJ per day$^{-1}$<br><br>**Equation 10.14: Ratio of energy available in a maintenance diet to digestible energy consumed.**<br>(IPCC, 2019; volume 4, chapter 10[241]) |

239 Op. Cit. IPCC, 2019.
240 Op. Cit. IPCC, 2019.
241 Op. Cit. IPCC, 2019.

| | |
|---|---|
| | $$REM = \left(1{,}164 - \left(5{,}16 * 0{,}001 * DE_p\right) + \left(1{,}308 * 0{,}00001 * \left(DE_p^2\right)\right) - \left(\frac{37{,}4}{DE_p}\right)\right)$$ <br> Where: <br> REM = ratio of energy available in a maintenance diet to digestible energy consumed. <br> $DE_p$ = Digestible energy of the diet expressed as % of gross energy <br> **Equation 10.6: Net Energy for Weight Gain.** <br> (IPCC, 2019; volume 4, chapter 10[242]) <br> $$NE_g = \left(22{,}02 * \left(\left(\frac{Peso}{C * PesoA}\right)^{0{,}75}\right) * \left(Gan^{1{,}097}\right)\right)$$ <br> Where: <br> $NE_g$ = net energy requirement for weight gain, MJ day $^{-1}$ <br> Peso = average weight of the type animal according to IPCC category, kg. <br> C = sexual condition coefficient, 0,80 for females, 1,00 for castrated males and 1,20 for breeding bulls (IPCC, 2019 (Page 10.24)[243]). |

[242] Op. Cit. IPCC, 2007.
[243] Op. Cit. IPCC, 2007.

| | |
|---|---|
| | PesoA = average adult weight of the type animal according to IPCC category, kg.<br>Gan = weight gain of the animal, kg.<br><br>**Equation 10.15: Relationship between the energy available in a growing diet and the digestible energy consumed.**<br>(IPCC, 2019; Volume 4, Chapter10[244])<br><br>$$REG = \left(1{,}164 - \left(5{,}16 * 0{,}001 * DE_p\right) + \left(1{,}308 * 0{,}00001 * \left(DE_p^2\right)\right) - \left(\frac{37{,}4}{DE_p}\right)\right)$$<br><br>Where:<br><br>REG = ratio of energy available in a growing diet to digestible energy consumed.<br>$DE_p$ = Digestible energy of the diet expressed as % of gross energy.<br><br>Digestible energy of the diet expressed as % of gross energy<br>$$DE_p = \left(\frac{DE}{GE}\right) * 100$$<br><br>Where: |

[244] Op. Cit. IPCC, 2007.

| | |
|---|---|
| | $DE_p$ = Digestible energy of the diet expressed as % of gross energy.<br>DE = Digestible energy of the diet, MJ $kg^{-1}$<br>GE = Gross energy of the diet, Mj $kg^{-1}$<br><br>**Equation 4 - Table 4: Gross energy of milk fed to the calf.**<br>(Adapted from Tyrrell y Reid[245])<br><br>$$GE_{milk} = \left(\frac{Leche}{365}\right) * \left(\left(\frac{(44{,}01 * Grasa + 163.56) * 4{,}184}{0{,}4536}\right) * 0{,}001\right)$$<br><br>Where:<br><br>$GE_{milk}$ = gross energy intake of milk fed to the calf, MJ $day^{-1}$<br>Leche = total milk supplied to the calf during suckling or lactation, kg.<br>Grasa = fat content of the milk, %<br><br>**Characterization parameters of type animals, production system, climate and diet used for the calculations [246].** |

[245] Tyrrell, H. F., & Reid, J. T., Prediction of the energy value of cow's milk. Journal of Dairy Science, 1965. https://www.journalofdairyscience.org/article/S0022-0302(65)88430-2/pdf
[246] Op. Cit. IDEAM, 2022.

| Orinoquia Region | | | | | | | | | Information Source | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Period | Data Source |
| Category and Characteristics | | 3A1aii Cattle Low-producing cows | 3A1aiii Beef cattle Cows for meat production | 3A1aiv Beef Cattle Bulls used for breeding purposes | 3A1av Cattle Calves pre-weaning | 3A1avi Cattle Replacement dairy heifers | 3A1avii Growing - fattening cattle | | 1990 - 2018 | IDEAM, 2022; IPCC, 2019. |
| Animal characterization | Average Weight (kg) BW | 414,00 | 370,00 | 600,00 | 95,00 | 237,75 | 247,00 | | 1990 - 2018 | IDEAM, 2022. |
| | Adult Weight (kg) BW | 460,00 | 411,00 | 600,00 | 493,33 | 435,50 | 600,00 | | 1990 - 2018 | IDEAM, 2022. |
| | Daily milk production (kg * day1) (Daily milk consumption in calves) | 5,70 | 1,50 | | 1,50 | | | | 1990 - 2018 | IDEAM, 2022. |
| | milk production per lactation (kg) | 1.738,50 | 420,00 | | | | | | 1990 - 2018 | IDEAM, 2022. |
| | Fat content of milk (%) | 3,20 | 3,80 | | 3,20 | | | | 1990 - 2018 | IDEAM, 2022. |
| | Average weight gain (kg * day1) WG | | | | 0,20 | 0,20 | 0,30 | | 1990 - 2018 | IDEAM, 2022. |
| | Genetics | Bos taurus x Bos indicus | Bos indicus | Bos indicus | Bos indicus | Bos indicus | Bos indicus | | 1990 - 2018 | IDEAM, 2022. |
| | Working hours | - | - | - | - | - | - | | 1990 - 2018 | IDEAM, 2022. |
| | Average temperature (C°) | 27,10 | 27,1 | 27,1 | 27,1 | 27,1 | 27,10 | | 1990 - 2018 | IDEAM, 2022. |

| | Power supply system | Intensive grazing | Extensive grazing | Extensive grazing | Intensive grazing | Extensive grazing | Intensive grazing | 1990 - 2018 | IDEAM, 2022. |
|---|---|---|---|---|---|---|---|---|---|
| Diet Characterization - Pasture | Forage | Brachiaria decumbens | Guaratara-Axonopus purpusii | Guaratara - Axonopus purpusii | Guaratara-Axonopus purpusii | Guaratara-Axonopus purpusii | Brachiaria decumbens | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | Digestibility (%) | 59,5 | 54,6 | 54,6 | 54,6 | 54,6 | 59,5 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | Energy diet - NEma (MJ/kg MS) | 4,6 | 3,8 | 3,8 | 3,8 | 3,8 | 4,6 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | FDN of the diet (%) | 61,5 | 65,4 | 65,4 | 65,4 | 65,4 | 61,5 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | FDA (%) | 32,4 | 37,8 | 37,8 | 3,8 | 37,8 | 32,4 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | PC of the diet (%) | 12,8 | 8,8 | 8,8 | 8,8 | 8,8 | 12,8 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | Lignin (%) | 7,2 | 8,7 | 8,7 | 8,7 | 8,7 | 7,2 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Dietary ash (%) | 10,02 | 7,86 | 7,86 | 7,86 | 7,86 | 10,02 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | | Digestible Energy (% of Gross Energy) | 59,6107056 | 54,7029703 | 54,7029703 | 54,7029703 | 54,7029703 | 59,6107056 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | | Gross energy Grass type (Mj/kgMS) | 17,19624 | 16,90336 | 16,90336 | 16,90336 | 16,90336 | 17,19624 | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | Diet characterization - Supplement | Concentrated name | Concentrate for cows - DG 80 - PC 16 - FDN 33 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | | Digestibility (%) | 80,67 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | | Energy diet - NEma (MJ/kg MS) | 7,86592 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | | FDN of the diet (%) | 33,4 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | | FDA (%) | 19 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosav |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | ia, 2020. |
| | PC of the diet (%) | 16,14 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | Lignin (%) | 1,05 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | Dietary ash (%) | 7,22 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | Digestible energy (% of Gross Energy) | 80,6146572 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| | Gross energy (Mj/kgMS) | 17,69832 | | | | | | 1990 - 2018 | IDEAM, 2022; Agosavia, 2020. |
| Characterization coefficients | Dietary grass consumption (%) | 90 | | | | | | 1990 - 2018 | IDEAM, 2022. |
| | Dietary Supplement Consumption (%) | 10 | | | | | | 1990 - 2018 | IDEAM, 2022. |
| Conversion factor per manure | Grassland / meadows / paddocks | 95% | 100% | 100% | 100% | 100% | 100% | 1990 - 2018 | IDEAM, 2022. |
| | Feedlot - Dry lot | 5% | | | | | | 1990 - 2018 | IDEAM, 2022. |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| management system | | | | | | | | | |
| Adjustment coefficients | Basal metabolic rate (MJ) | 0,069 | 0.064 | 0.064 | 0.064 | 0.064 | 0.064 | 1990 - 2018 | Fox et al., 2004 |
| | Comfort temperature (C°) | 20 | 25 | 25 | 25 | 25 | 25 | 1990 - 2018 | Nazar Anchorena, J. B. 1980 |
| | Basal metabolic rate adjustment | 0,0007 | 0,0007 | 0,0007 | 0,0007 | 0,0007 | 0,0007 | 1990 - 2018 | NRC, 2000. |
| | Activity ratio (Ca) | 0,17 | 0,36 | 0,36 | 0,17 | 0,36 | 0,17 | 1990 - 2018 | IPCC, 2019 |
| | Physiological state coefficient (C) | 0,8 | 0,8 | 1,2 | 1 | 1 | 1 | 1990 - 2018 | IPCC, 2019 |
| | Gestation coefficient | 0,1 | 0,1 | 0 | 0 | 0 | 0 | 1990 - 2018 | IPCC, 2019 |
| | Dry matter consumption adjustment factor by species (BI) | | | | 1 | | | 1990 - 2018 | NRC, 2000. |
| | Reduced consumption due to heat stress (E) | | | | 1 | | | 1990 - 2018 | NRC, 2000. |
| | Bo | 0,19 | 0,19 | 0,19 | 0,19 | 0,19 | 0,19 | 1990 - 2018 | IPCC, 2019 |

**Summary Table with Emission Factors [247]**

| Region-Enteric methane | Cattle Low-producing cows | Cows used to produce offspring for meat | Bulls used for breeding purposes | Pre-weaned calves | Cattle Replacement dairy heifers | Growing - fattening cattle | Data source |
|---|---|---|---|---|---|---|---|

[247] OP. Cit. IDEAM, 2022.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Orinoquia Region | 70,6 | 70,7 | 80,8 | 19,2 | 58,0 | 51,1 | IDEAM, 2022 |

| | |
|---|---|
| **Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions.** | Municipal scale - Polygon of the municipal political-administrative division. |
| **Methodological level (equations)** | Tier 2 |
| **Method consistent representation of Lands Approach 3** | N/A |

| **Rice cultivation** | |
|---|---|
| **Activity data parameters (Available historical time series and information sources)** | Historical data available for the 2009 - 2018 time series. The source of information for the activity data takes as reference the harvested areas (technified and traditional irrigated and rainfed rice), compiled in the Statistical |

| | |
|---|---|
| | Yearbook of the Agricultural Sector and the Agricultural Evaluations (EVA) of AGRONET (Information and Communication Network of the Colombian Agricultural Sector), MADR[248]. |
| **Emission factor parameters (information sources)** | (see table below) |

| Category | Emission Factor | Information source | | Value |
|---|---|---|---|---|
| | | Period | Data Source | |
| Irrigated rice | Days | 2009-2018 | AGROSAVIA | 105 days |
| Irrigated rice | Scaling factor: water regime during cultivation (SFw) | 2009-2018 | IPCC (2019) C Expert consultation FEDEARROZ | 1 kg $CH_4$.ha. $d^{-1}$ |
| Irrigated rice | Scaling factor: pre-crop water regime (SFp) | 2009-2018 | IPCC (2019) Expert consultation FEDEARROZ | 1 kg $CH_4$.ha. $d^{-1}$ |
| Irrigated rice | Application of organic amendment | 2009-2018 | FEDEARROZ | 4,7 t. $ha^{-1}$ |
| Irrigated rice | Organic amendment conversion factor | 2009-2018 | IPCC (2019) Consult AGROSAVIA | 1 |
| Dry rice | Days | 2009-2018 | FEDEARROZ | 110 days |

[248] Available in the folder: Base_Agrícola_EVA_2007_2019.xlsb

| | | | | |
|---|---|---|---|---|
| Dry rice | Scaling factor: water regime during cultivation (SFw) | 2009-2018 | IPCC (2019) Expert consultation FEDEARROZ | 0,54 kg $CH_4$.ha. $d^{-1}$ |
| Dry rice | Scaling factor: pre-crop water regime (SFp) | 2009-2018 | IPCC (2019) Expert consultation FEDEARROZ | 1 kg $CH_4$.ha. $d^{-1}$ |
| Dry rice | Application of organic amendment | 1990-2018 | IPCC (2019) Consult AGROSAVIA | 4,7 t. $ha^{-1}$ |
| Dry rice | Organic amendment conversion factor | 1990-2018 | IPCC (2019) Expert consultation FEDEARROZ | 1 |

| | |
|---|---|
| **Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions.** | Activity data currently lack spatially explicit information. |
| **Methodological level (equations)** | **Tier 1 advanced**<br>**Equation 5.1 CH4 emissions from rice cultivation.**<br>(IPCC - 2006, Volume 4, Chapter 11) |

| | |
|---|---|
| | $$CH_{4\,Rice} = \sum_{i,j,k} (EF_{i,j,k} * t_{i,j,k} * 10^{-6})$$ Where: <br><br> $CH_{4\ arroz}$ = annual $CH_4$ emissions produced by rice cultivation, Gg $CH_4$ $yr^{-1}$ <br> $EF_{ijk}$ = a daily emission factor for conditions i, j, y k, kg $CH_4$ $ha^{-1}$ $day^{-1}$ <br> $t_{ijk}$ = rice cultivation period for conditions i, j, y k, days <br> $A_{ijk}$ = annual rice harvest area for conditions i, j, y k, ha $year^{-1}$ <br> i, j, y k = represent the different ecosystems, water regimes, type and quantity of organic fertilizers, and other conditions under which rice $CH_4$ emissions may vary. <br><br> **Equation 5.2 Adjusted Daily Emission Factor** <br> (IPCC - 2019, volume 4, chapter 5) <br><br> $$EF_i = EF_C * SF_w * SF_p * SF_o$$ Where: <br><br> $EF_1$= Adjusted daily emission factor for a specific harvest area. <br> $EF_c$= Base emission factor for permanently flooded land with no organic fertilizer <br> $SF_w$ = adjustment factor to compensate for differences in water regimes during the growing season (table 5.12, volume 4, chapter 5 of the IPCC 2019 Refinement). <br> $SF_p$= adjustment factor to compensate for differences in water regimes during the pre-cropping season (table 5.13, volume 4, chapter 5 of the IPCC 2019 Refinement). |

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|---|---|
| | $SF_o$= adjustment factor should vary according to the type and amount of organic fertilizer applied from equation 5.3 (table 5.14 of the IPCC 2019 Refinement).<br><br>**Equation 5.3 Adjusted Daily Emission Factor for Organic Aggregates (Updated)**<br>(IPCC - 2019, Volume 4, Chapter 5)<br><br>$$SF_o = (1 + \sum_i ROA_i * CFOA_i)^{0.59}$$<br><br>Where:<br><br>$SF_o$= adjustment factor for type and amount of organic fertilizer applied<br>$ROA_i$= rate of application of organic fertilizer i, in dry weight for straw and in fresh weight for the others, in t. $ha^{-1}$<br>CFOAi= conversion factor for organic fertilizer i (in terms of its relative effect with respect to straw applied shortly before cultivation), as indicated in Table 5.14. (Table 5.12, Volume 4, Chapter 5 of the Refinement, IPCC 2019). |
| **Method consistent representation of the earth** | N/A |

**Urine and dung deposited from grazing animals**

| | |
|---|---|
| **Activity data parameters (Available historical time series and information sources)** | • Livestock Inventory – FEDEGAN[249]: Activity data obtained at the municipal level, standardized for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2001 to 2013.<br><br>• National Livestock Census – ICA[250]: Data consolidated annually by ICA at the municipal level, resulting from the compilation of the single vaccination registry, standardized for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2014 to 2022. The information is updated annually.<br><br>The databases reported by the ICA and Fedegan contain information on the number of animals by age groups, the groups reported are: Calves and heifers under one year old, females and males between 1 and 2 years old, females and males between 2 and 3 years old, females and males over 3 years old. The age groups were homologated with those proposed in IPCC guidelines (2006[251] y 2019[252]). For this purpose, the map of herd orientation at municipal scale reported by FEDEGAN[253] was used and the following criteria were applied for the homologation of the age groups with the IPCC categories:<br><br>• High-producing cows: sum of females 2 to 3 years old and those older than 3 years old in all dairy-oriented municipalities.<br>• Low-producing cows: all females older than 3 years in dual-purpose oriented municipalities.<br>• Cows for meat production: all females older than 3 years in the municipalities with fattening and breeding orientation.<br>• Bulls used for reproductive purposes: 55% of males older than 3 years, in all municipalities.<br>• Pre-weaned calves: sum of all heifers and calves under one year old.<br>• Replacement calves: all females between 1 and 3 years old in municipalities oriented to fattening, breeding, and dual purpose. In municipalities with specialized dairy orientation, all females between 1 to 2 years old. |

[249] Livestock Inventory. https://www.fedegan.org.co/estadisticas/inventario-ganadero
[250] National Livestock Census. https://www.ica.gov.co/áreas/pecuaria/servicios/epidemiologia-veterinaria/censos-2016/censo-2018
[251] IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2006. https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
[252] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html
[253] FEDEGAN, Carta Fedegán 130: Primer Foro Internacional de la Leche, 2012, Page 15. https://www.fedegan.org.co/carta-fedegan-130-primer-foro-internacional-de-la-leche

| | |
|---|---|
| | • Growing - fattening cattle: males between 1 to 3 years old plus 45% of males older than 3 years old in all municipalities. |
| **Emission factor parameters (data sources)** | **Equation 11.1. Direct N2O emissions from urine and dung of grazing animals (Tier 1)**<br>(Adapted from IPCC, 2019; volume 4, chapter 11[254])<br>$$N_2O_{(PRP)} = (F_{PRP} * EF_3) * (44/28)$$<br>Where:<br>$N_2O_{(PRP)}$ = direct N2O emissions from urine and dung of grazing animals, kg $N_2O$ direct animal year$^{-1}$.<br>$F_{PRP}$ = annual amount of N from urine and dung deposited by grazing animals, kg N per year - annual amount of N from urine and dung deposited by grazing animals, kg N per year$^{-1}$.<br>$$F_{PRF} = \sum_T \left(N_{(T)} * Nex_{(T)}\right) * MS_{(T,PRP)}$$<br>Where:<br>$N_{(T)}$ = number of heads of livestock of species/category T in the country.<br>$Nex_{(T)}$ = average annual N excretion per head of the species/category T in the country, kg N animal$^{-1}$ year$^{-1}$ |

[254] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 11: N2O Emissions from Managed Soils, and $CO_2$ Emissions from Lime and Urea Application, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch11_Soils_N2O_CO2.pdf

$MS_{(T,PRP)}$ = fraction of total annual N excretion of each livestock species/category T that is deposited on Grassland, meadows and grasslands
$EF_3$ = emission factor for N2O emissions from N from urine and dung deposited on pasture, range and rangeland by grazing animals, kg $N_2O$-N (kg N input)$^{-1}$

**Parameters for the calculation of direct $N_2O$ emissions due to urine and dung deposited from grazing animals.**

| Orinoquia Region | | | | | | | | Information Source | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Period | Data Source |
| **Category and Characteristics Animals** | **3A1ai Cattle High-producing cows** | **3A1aii Beef Cattle Low-producing cows** | **3A1aiii Cattle Cows used to produce offspring for meat** | **3A1aiv Ganado Cattle Bulls used for breeding purposes** | **3A1av Cattle Calves pre-weaning** | **3A1avi Cattle Replacement dairy heifers** | **3A1avii Growing - fattening cattle** | **1990 - 2018** | **IDEAM, 2022; IPCC, 2019.** |
| FPRP | | 45,8471131 | 43,556145 | 68,1451 | 14,1563075 | 29,5511315 | 30,4063995 | 1990 - 2018 | IDEAM, 2022 |
| EF3 | | 0,006 | 0,006 | 0,006 | 0,006 | 0,006 | 0,006 | 1990 - 2018 | IPCC, 2019. |

| | |
|---|---|
| **Spatial level of the parameters (local, regional, national or international)** | Municipal scale - Polygon of the municipal political-administrative division. |

| | |
|---|---|
| **and whether they allow spatially explicit observations of land use categories and land use conversions.** | |
| **Methodological level (equations)** | Tier 1 |
| **Method consistent representation of Lands Approach 3** | N/A |

| **Dynamic in oil palm cultivation** | |
|---|---|
| **Activity data parameters (Available historical time series and information sources)** | The activity data for the categories related to the Dynamic of oil palm cultivation are based on satellite image analysis carried out by the SMByC, for the historical series 2001-2018, whose information is presented in biennial periods for the years 2000-2012 and annually for the years 2023-2018. |

The activity data have a particular adjustment of the area for the biennial periods (2000-2002, 2002-2004, 2004-2006, 2006-2008, 2008-2010, 2010-2012), where in the initial year of the biennial period the sum of stable area, plus half of the area of increase, plus half of the area of decrease in coverage, for the final year of the period the sum of stable area, plus the area of increase, minus the area of decrease in coverage, for the other periods 2013-2018 the calculation is made directly by adding the stable and increase areas
In addition, an adjustment of the area is made taking into account the deforestation caused by this cover, subtracting from the increase area, the identified area of change from natural forest to oil palm cultivation by typification, this was done to avoid double counting.

Changes in carbon contents in the DOM and soil pools remain stable for this category.

| Parameter | Source Information | | Comments |
|---|---|---|---|
| | Perio | Data Information | |
| stable areas of oil palm cultivation | 2009-2018 | SMByC | Available at biome and department level |
| area of increased oil palm cultivation | 2009-2018 | SMByC | Available at biome and department level |
| area of oil palm cultivation decrease | 2009-2018 | SMByC | Available at biome and department level |

The activity data used for the estimation of emissions/removals due to the Dynamic of oil palm cultivation can be consulted at the following link: 03-DA_SMBYC tif.zip

**Emission factor parameters (information sources)**

| Emission Factor | Information Source | | Value |
|---|---|---|---|
| | Period | Source Data | |

| | |
|---|---|
| | \| Carbon content in biomass \| - \| Henson et al 2012 \| **(Ton/C/Ha/year)**: 0,80 \|<br><br>The emission factor used for the estimation of emissions/removals due to the Dynamic of oil palm cultivation is taken from the study "The greenhouse gas balance of the oil palm industry in Colombia: a preliminary analysis. I. Carbon sequestration and carbon offsets" which is available at the following link: 07-FE_Palma_Henson.et.al.pdf |
| **Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions** | Departmental and biome level information, spatially explicit. |
| **Methodological level (equations)** | **Equation 2.7: Annual change in biomass carbon stock in land remaining in a particular land-use category (gain-loss method)**<br>(IPCC - 2006. volume 4. chapter)<br>$$\Delta C_B = \Delta C_G - \Delta C_L$$<br>Where:<br>$\Delta C_B$ = Annual change in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$\Delta C_L$ = Annual decrease in biomass carbon stocks. $ton\ C\ yr^{-1}$. |

| | |
|---|---|
| | **Equation 2.9: Annual increase in biomass carbon stocks. In land remaining in the same land-use category** (IPCC - 2006. volume 4. chapter 2)<br><br>$$\Delta C_G = \Sigma(A * G_{total} * CF)$$<br>Where:<br><br>$\Delta C_G$ = Annual increase in biomass carbon stocks. $ton\ C\ yr^{-1}$.<br>$A$ = area of land remaining in the same category. $ha$.<br>$G_{total}$ = Average annual biomass growth. ton dm. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$CF$ = carbon fraction of dry matter. $ton\ C\ (ton\ dm)^{-1}$.<br><br>**Equation 2.10: Average Annual Increases in Biomass (Tier 1)**<br>(IPCC - 2006. Volume 4. Chapter 2)<br><br>$$G_{total} = \Sigma\big(G_w * (1 + R)\big)$$<br>Where:<br><br>$G_{total}$ = Average annual biomass growth. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$G_w$ = Mean annual aboveground biomass growth. $ton\ dm.ha^{-1}.yr^{-1}$.<br>$R$ = Ratio of belowground biomass to aboveground biomass. $Ton\ _{bg}dm\ (Ton\ _{ag}\ dm)^{-1}$. |

| | |
|---|---|
| **Method consistent representation of Lands Approach 3** | No, because this category does not have information on change of use, although it does have spatially explicit information. |

| **Volatilization of urine and dung deposited from grazing animals** | |
|---|---|
| **Activity data parameters (Available historical time series and information sources)** | • Livestock Inventory– FEDEGAN[255]: Activity data obtained at the municipal scale, standardized for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2001 to 2013.<br>• National Livestock Census – ICA[256]: Data consolidated annually by ICA at the municipal level, resulting from the collection of the single vaccination register, homologated for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2014 to 2022. The information is updated annually.<br><br>The databases reported by ICA and FEDEGAN contain information on the number of animals by age groups, the groups reported are: Calves and heifers under one year old, females and males between 1 and 2 years old, females and males between 2 and 3 years old, females and males over 3 years old. The age groups were homologated with those proposed in IPCC guidelines (2006[257] y 2019[258]). For this purpose, the herd orientation map at municipal scale reported by FEDEGAN[259] was used and the following criteria were applied for the homologation of the age groups with the IPCC categories: |

[255] Livestock Inventory. https://www.fedegan.org.co/estadisticas/inventario-ganadero
[256] National Livestock Census. https://www.ica.gov.co/áreas/pecuaria/servicios/epidemiologia-veterinaria/censos-2016/censo-2018
[257] IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2006. https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
[258] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html
[259] FEDEGAN, Carta Fedegán 130: Primer Foro Internacional de la Leche, 2012, Page 15. https://www.fedegan.org.co/carta-fedegan-130-primer-foro-internacional-de-la-leche

| | |
|---|---|
| | • Category 3A1ai — 3A2ai Cattle High-producing cows: sum of females 2 to 3 years old and those older than 3 years old from all municipalities with dairy orientation. Low-producing cows: all females older than 3 years in dual purpose-oriented townships.<br>• Category 3A1aiii — 3A2aiii Cows used to produce offspring for meat: all females older than 3 years in municipalities with fattening and breeding orientation.<br>• Category 3A1aiv — 3A2aiv Cattle Bulls used for breeding purposes: 55% of males over 3 years old, in all municipalities.<br>• Category 3A1av - 3A2av Cattle Calves pre-weaning: sum of all heifers and calves under one year old.<br>• Category 3A1avi — 3A2avi Cattle Replacement calves: all females between 1 to 3 years old in municipalities with fattening, breeding, and dual-purpose orientation. In municipalities with specialized dairy orientation, all females between 1 to 2 years old.<br>• Category 3A1avii - 3A2avii Growing - fattening cattle: males between 1 to 3 years old plus 45% of males older than 3 years old in all municipalities. |
| **Emission factor parameters (data sources)** | **Equation 11.9. N2O produced by atmospheric deposition of volatilized N from managed soils (Tier 1)**<br>(Adapted from IPCC, 2019; volume 4, chapter 11[260])<br>$N_2O_{(ATD)} = (Frac_{GASF} * F_{PRP} * EF_4) * (44/28)$<br>Where:<br>$N_2O_{(ATD)}$ = indirect N2O emissions from Volatilization of Urine and dung from grazing animals (FPRP), kg indirect $N_2O$ animal year$^{-1}$. |

[260] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 11: $N_2O$ Emissions from Managed Soils, and $CO_2$ Emissions from Lime and Urea Application, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch11_Soils_N2O_CO2.pdf

$F_{PRP}$ = annual amount of N from urine and dung deposited by grazing animals in regions where leaching/leaching occurs. leaching/runoff occurs, kg N $year^{-1}$.

$$F_{PRF} = \sum_{T} \left(N_{(T)} * Nex_{(T)}\right) * MS_{(T,PRP)}$$

Where:

$N_{(T)}$ = number of head of livestock of species/category T in the country.
$Nex_{(T)}$ = average annual N excretion per head of the species/category T in the country, kg N $animal^{-1}$ $year^{-1}$
$MS_{(T,PRP)}$ = fraction of total annual N excretion of each T livestock species/category that is deposited in Grassland, meadows.
$Frac_{GASM}$ = fraction of organic N fertilizer materials (FON) and urine and dung N deposited by grazing animals (FPRP) that volatilizes as $NH_3$ and NOx, kg N volatilized (kg de N applied or deposited)$^{-1}$.
$EF_4$ = emission factor corresponding to $N_2O$ emissions from atmospheric deposition of N on soils and water surfaces [kg N–N2O (kg NH3–N + NOx–N volatilized)$^{-1}$]

**Parameters for the calculation of indirect $N_2O$ emissions due to Volatilization of Urine and dung deposited from grazing animals.**

| Orinoquia Region | Information Source | |
|---|---|---|
| | **Period** | **Data source** |

| **Category and Characteristics Animals** | 3A1ai Beef Cattle High-producing cows | 3A1aii Beef Cattle Low-producing cows | 3A1aiii Cattle Cows used to produce offspring for meat | 3A1aiv Cattle Bulls used for breeding purposes | 3A1av Cattle Calves pre-weaning | 3A1avi Cattle Replacement dairy heifers | 3A1avii Growing - fattening cattle | 1990 - 2018 | IDEAM, 2022; IPCC, 2019. |
|---|---|---|---|---|---|---|---|---|---|
| FPRP | | 45,8471131 | 43,556145 | 68,1451 | 14,1563075 | 29,5511315 | 30,4063995 | 1990 - 2018 | IDEAM, 2022 |
| FracGASM | | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | 0,21 | 1990 - 2018 | IPCC, 2019 |
| EF4 | | 0,014 | 0,014 | 0,014 | 0,014 | 0,014 | 0,014 | 1990 - 2018 | IPCC, 2019 |

| | |
|---|---|
| **Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions.** | Municipal scale - Polygon of the municipal political-administrative division. |

| | |
|---|---|
| **Methodological level (equations)** | Tier 1 |
| **Method consistent representation of Lands Approach 3** | N/A |

| **Leaching/runoff of deposited urine and dung from grazing animals.** | |
|---|---|
| **Activity data parameters (Available historical time series and information sources)** | • Livestock Inventory – FEDEGAN[261]: Activity data obtained at the municipal level, standardized for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2001 to 2013.<br>• National Livestock Census – ICA[262]: Data consolidated annually by ICA at the municipal level, resulting from the compilation of the single vaccination registry, standardized for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2014 to 2022. The information is updated annually.<br><br>The databases reported by the ICA and FEDEGAN contain information on the number of animals by age groups, the groups reported are: Calves and heifers under one year old, females and males between 1 and 2 years old, females and males between 2 and 3 years old, females and males over 3 years old. The age groups were homologated with those proposed in the IPCC guidelines (2006[263] y 2019[264]). For this purpose, the map of livestock herd orientation at municipal scale reported |

[261] Livestock Inventory. https://www.fedegan.org.co/estadisticas/inventario-ganadero
[262] National Livestock Census. https://www.ica.gov.co/áreas/pecuaria/servicios/epidemiologia-veterinaria/censos-2016/censo-2018
[263] IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2006. https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
[264] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

| | |
|---|---|
| | by FEDEGAN[265] was used and the following criteria were applied for the homologation of the age groups with the IPCC categories:<br><br>Category 3A1ai - 3A2ai Cattle High-producing cows: sum of females from 2 to 3 years old and those older than 3 years old from all dairy oriented municipalities.<br>● Category 3A1aii - 3A2aii Cattle Low-producing cows: all females over 3 years old in dual-purpose oriented municipalities.<br>● Category 3A1aiii - 3A2aiii Cattle Cows used to produce offspring for meat: all females over 3 years of age in municipalities with fattening and breeding orientation.<br>● Category 3A1aiv - 3A2aiv Cattle Bulls used for breeding purposes: 55% of males over 3 years old, in all municipalities.<br>● Category 3A1av - 3A2av Cattle Calves pre-weaning: sum of all heifers and calves less than one year old.<br>● Category 3A1avi — 3A2avi Cattle Replacement dairy heifers: all females between 1 and 3 years old in municipalities oriented to fattening, breeding, and dual purpose. In municipalities oriented to specialized dairy, all females between 1 to 2 years old, females between 1 and 2 years old.<br>● Category 3A1avii - 3A2avii Growing - fattening cattle: males between 1 to 3 years old plus 45% of males older than 3 years old in all municipalities. |
| **Emission factor parameters (data sources)** | **Equation 11.10. N2O emissions from leaching/runoff of n from managed soils in regions where these phenomena occur (Tier 1)**<br>(Adapted from IPCC, 2019; volume 4, chapter 11[266])<br><br>$N_2O_{(L)} = (Frac_{LEACH-(H)} * F_{PRP} * EF_5) * (44/28)$ |

[265] FEDEGAN, Carta Fedegán 130: Primer Foro Internacional de la Leche, 2012, Page 15. https://www.fedegan.org.co/carta-fedegan-130-primer-foro-internacional-de-la-leche

[266] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 11: N2O Emissions from Managed Soils, and $CO_2$ Emissions from Lime and Urea Application, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch11_Soils_N2O_CO2.pdf

Where:

$N_2O_{(L)}$ = Indirect $N_2O$ emissions from leaching and runoff of Urine and dung from grazing animals (FPRP), kg indirect $N_2O$ animal year$^{-1}$.
$F_{PRP}$ = annual amount of N from urine and dung deposited by grazing animals in regions where leaching/runoff occurs, kg N yr$^{-1}$.
$Frac_{LEACH-(H)}$ = fraction of all N added to/mineralized in managed soils in regions where leaching/runoff occurs, kg N (kg N aggregates)$^{-1}$.
$EF_5$ = 0.11 (kg N from leaching and runoff)$^{-1}$ emission factor for $N_2O$ emissions from N leaching and runoff, kg $N_2O$-N.

**Parameters for the calculation of indirect N2O emissions due to leaching/runoff of urine and dung deposited from grazing animals.**

| Orinoquia Region | Information Source | |
|---|---|---|
| | **Period** | **Data Source** |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Category and characteristics Animals** | **3A1ai Cattle High-producing cows** | **3A1aii Cattle Low-producing cows** | **3A1aiii Cattle Cows used to produce offspring for meat** | **3A1aiv Cattle Bulls used for breeding purposes** | **3A1av Cattle Calves pre-weaning** | **3A1avi Cattle Replacement dairy heifers** | **3A1avii Growing - fattening cattle** | **1990 - 2018** | **IDEAM, 2022; IPCC, 2019.** |
| | FPRP | | 45,8471131 | 43,556145 | 68,1451 | 14,1563075 | 29,5511315 | 30,4063995 | 1990 - 2018 | IDEAM, 2022 |
| | FracLEACH-(H) | | 0,24 | 0,24 | 0,24 | 0,24 | 0,24 | 0,24 | 1990 - 2018 | IPCC, 2019. |
| | EF5 | | 0,011 | 0,011 | 0,011 | 0,011 | 0,011 | 0,011 | 1990 - 2018 | IPCC, 2019. |
| **Spatial level of the parameters (local, regional, national or international) and whether they allow for spatially explicit observations of land use categories land use categories** | Municipal scale - Polygon of the municipal political-administrative division. | | | | | | | | | |

| | |
|---|---|
| **and conversions of land use** | |
| **Methodological level (equations)** | Tier 1 |
| **Method consistent representation of Lands Approach 3** | N/A |

| **Cattle manure management** | |
|---|---|
| **Activity data parameters (Available historical time series and information sources)** | • Livestock Inventory– FEDEGAN[267]: Activity data obtained at the municipal scale, standardized for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2001 to 2013.<br>• National Livestock Census– ICA[268]: Data consolidated annually by ICA at the municipal level, resulting from the compilation of the single vaccination register, homologated for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2014 to 2022. The information is updated annually.<br><br>The databases reported by the ICA and Fedegan contain information on the number of animals by age groups, the groups reported are: Calves and heifers under one year old, females and males between 1 and 2 years old, females |

[267] Livestock Inventory. https://www.fedegan.org.co/estadisticas/inventario-ganadero
[268] National Livestock Census. https://www.ica.gov.co/áreas/pecuaria/servicios/epidemiologia-veterinaria/censos-2016/censo-2018

| | |
|---|---|
| | and males between 2 and 3 years old, females and males over 3 years old. The age groups were homologated with those proposed in IPCC guidelines (2006[269] y 2019[270]). For this purpose, the map of herd orientation at municipal scale reported by FEDEGAN[271] was used and the following criteria were applied for the homologation of the age groups with the IPCC categories:<br><br>• Category 3A1ai - 3A2ai Cattle High-producing cows: sum of females from 2 to 3 years old and those older than 3 years old from all dairy oriented municipalities.<br>• Category 3A1aii - 3A2aii Cattle Low-producing cows: all females over 3 years old in dual-purpose oriented municipalities.<br>• Category 3A1aiii - 3A2aiii Cattle Cows used to produce offspring for meat: all females over 3 years of age in municipalities with fattening and breeding orientation.<br>• Category 3A1aiv - 3A2aiv Cattle Bulls used for breeding purposes: 55% of males over 3 years old, in all municipalities.<br>• Category 3A1av - 3A2av Cattle Calves pre-weaning: sum of all heifers and calves less than one year old.<br>• Category 3A1avi — 3A2avi Cattle Replacement dairy heifers: all females between 1 and 3 years old in municipalities oriented to fattening, breeding, and dual purpose. In municipalities oriented to specialized dairy, all females between 1 to 2 years old, females between 1 and 2 years old.<br>• Category 3A1avii - 3A2avii Growing - fattening cattle: males between 1 to 3 years old plus 45% of males older than 3 years old in all municipalities. |
| **Emission factor parameters (information sources)** | **Equations to determine Tier 2 emission factors used in the AFOLU 1 Colombia model.**<br><br>**Equation 10.23: Methane emission factors from manure management** |

[269] IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2006. https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
[270] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html
[271] FEDEGAN, Carta Fedegán 130: Primer Foro Internacional de la Leche, 2012, Page 15. https://www.fedegan.org.co/carta-fedegan-130-primer-foro-internacional-de-la-leche

| | |
|---|---|
| | (Adapted from IPCC, 2019; volume 4, chapter 10 [272])<br>$$EF_{(ge)} = (VS * 365) * [B_0 * 0{,}67 * \sum ((MCF\% * SGE\%)/100)]$$<br>Where:<br><br>$EF_{(ge)}$ = annual emission factor, in kg $CH_4$ head $^{-1}$ year$^{-1}$<br>VS = volatile solids excreted per day, kg animal dry matter$^{-1}$ day$^{-1}$<br>$B_0$ = maximum methane production capacity of manure produced by livestock, in $m^3$ $CH_4$ kg$^{-1}$ of excreted VS (Table 10.16 (IPCC, 2019))).<br>MCF% = methane conversion factor for each manure management system (%) (Table 10.17 (IPCC, 2019)).<br>SGE% = Percentage of manure managed using a given animal waste management system, in %.<br><br>**Equation 10.24: Volatile solids excretion rate.**<br>(Adapted from IPCC, 2019; volume 4, chapter 10[273])<br>$$VS = \left(GE_t * \left(1 - \left(\frac{Dig}{100}\right)\right) + (UE)\right) * \left(\frac{1 - \left(\frac{Ceniza}{100}\right)}{18{,}45}\right)$$<br>Where:<br><br>VS = volatile solids excreted per day, kg animal dry matter$^{-1}$ day-$^{1}$<br>$GE_t$ = total gross energy intake for each of the IPCC categories, Mj day $^{-1}$ |

[272] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 10: Emissions from livestock and manure management, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf
[273] Op. Cit. IPCC, 2019.

| | |
|---|---|
| | Dig = digestibility of diet, %<br>UE = urinary energy, Mj day $^{-1}$<br>Ceniza = ash content of the diet, %.<br><br>**Cattle UE Equation: Energy contained in urine**<br>(Ramin y Huhtanen[274])<br><br>$UE = (-2{,}71 + 0{,}028 * (10 * CP) + 0{,}589 * CMS)$<br><br>Where:<br><br>*UE* = energy contained in the urine, Mj day$^{-1}$<br>*CP* = crude protein of the diet, %<br>*CMS* = dry matter intake for each of the IPCC categories (kg day $^{-1}$)<br><br>**Equation 12: Determination of dry matter intake for cattle older than one year.**<br>(Adapted from Pickering y Wear[275]) |

[274] Ramin y Huhtanen, Development of equations for predicting methane emissions from ruminants, 2013. https://www.sciencedirect.com/science/article/pii/S0022030213000945

[275] Pickering y Wear, Detailed methodologies for agricultural greenhouse gas emission calculation, 2013. https://www.mpi.govt.nz/dmsdocument/13906-detailed-methodologies-for-agricultural-greenhouse-gas-emission-calculation

$$CMS = \frac{GE_t}{GE_{pd}}$$

Where:
CMS = dry matter intake in cattle older than one year, kg day$^{-1}$
$GE_t$ = total gross energy intake for each of the IPCC categories, Mj day$^{-1}$
$GE_{pd}$ = gross energy content of the diet, MJ kg$^{-1}$.

**Parameters for the calculation of $CH_4$ emissions due to cattle manure management**

| **Orinoquia Region** | | | | | | | Information Source | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | Period | Data Source |
| **Category and Characteristics** | 3A1aii Cattle Low-producing cows | 3A1aiii Cattle Cows used to produce offspring for meat | 3A1aiv Cattle Bulls used for breeding purposes | 3A1av Cattle Calves pre-weaning | 3A1avi Cattle Replaceme nt dairy heifers | 3A1avii Growing - fattening cattle | 1990 – 2018 | IDEAM, 2022; IPCC, 2019. |
| B0 | 0,19 | 0,19 | 0,19 | 0,19 | 0,19 | 0,19 | 1990 – 2018 | IPCC, 2019 |
| MCF% Feedlot | 0,01978888 | | | | | | 1990 – 2018 | IPCC, 2019 |
| MCF% Pasture | 0,0047 | 0,0047 | 0,0047 | 0,0047 | 0,0047 | 0,0047 | 1990 – 2018 | IPCC, 2019 |
| SGE% Feedlot | 5% | 0% | 0% | 0% | 0% | 0% | 1990 – 2018 | IDEAM, 2022. |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SGE% Pasture | 95% | 100% | 100% | 100% | 100% | 100% | 1990 – 2018 | IDEAM, 2022. |
| Get | 143,14893 | 139,154766 | 168,302075 | 40,5720055 | 102,497446 | 83,2930546 | 1990 – 2018 | IDEAM, 2022. |
| Dig | 61,653 | 54,64 | 54,64 | 54,64 | 54,64 | 59,54 | 1990 – 2018 | IDEAM, 2022. |
| ash | 9,74 | 7,86 | 7,86 | 7,86 | 7,86 | 10,02 | 1990 – 2018 | IDEAM, 2022. |
| CP | 13,161 | 8,81 | 8,81 | 8,81 | 8,81 | 12,83 | 1990 – 2018 | IDEAM, 2022. |
| Gepd | 17,246448 | 16,90336 | 16,90336 | 16,90336 | 16,90336 | 17,19624 | 1990 – 2018 | IDEAM, 2022. |

**Summary Table with Cattle Manure Management Emission Factors (kg $CH_4$ animal $^{-1}$ year$^{-1}$).**

| Region-Enteric methane | Low-producing cows | High-producing cows | Bulls used for breeding purposes | Calves pre-weaning | Replacement dairy heifers | Growing - fattening cattle | Data Source |
|---|---|---|---|---|---|---|---|
| Orinoquia Region | 0,75 | 0,74 | 0,89 | 0,21 | 0,54 | 0,40 | IDEAM, 2022. |

**Direct $N_2O$ emissions from manure management.**
**Equation 10.25: Direct $N_2O$ emissions from manure management.**
(Adapted from IPCC, 2019; volume 4, chapter 10[276])

[276] Op. Cit. IPCC, 2019.

$$N_2O_{D(ge)} = \left[\sum_{S} \left[\sum_{T,P} \left(\left(N_{(T,P)} * Nex_{(T,P)}\right) * SGE_{(T,S,P)}\right)\right] * EF_{3(S)}\right] * \left(\frac{44}{28}\right)$$

Where:

$N_2O_{D(ge)}$ = direct $N_2O$ emissions from manure management, kg $N_2O$ $yr^{-1}$
$N_{(T,P)}$ = activity data, equals the number of heads of livestock species/category T classified as production system P.
$Nex_{(T,P)}$ = average annual nitrogen excretion per head of species/category T for production system P, kg animal $N^{-1}$ $year^{-1}$
SGE = fraction of manure managed, using a given animal waste management system, in %.
$EF_{3(S)}$ = emission factor for $N_2O$ (direct) from manure management system S (IPCC, 2019 (Table 10.21)), kg $N_2O$ - N kg $N^{-1}$
S = manure management system
T = species/animal category
P = productivity level

**Equation 10.30: Nitrogen excretion rate.**
(Adapted from IPCC, 2019; volume 4, chapter10[277])

$$Nex_{(T,P)} = N_{tasa(T,P)} * \left(\frac{Peso_{(T,P)}}{1000}\right) * 365$$

[277] Op. Cit. IPCC, 2019.

Where:

$Nex_{(T,P)}$ = average annual nitrogen excretion per head of species/category T for production system P, kg animal N $^{-1}$ year$^{-1}$
$N_{tasa(T,P)}$ = nitrogen default excretion rate for category T and production level P, kg N (Table 10.19 (IPCC, 2019))
$Peso_{(T,P)}$ = peso average weight of category T, kg animal$^{-1}$
P = production level (high or low production)).

| **Orinoquia Region** | | | | | | | **Information Source** | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | **Period** | **Data Source** |
| **Category and Characteristics** | 3A1aii Cattle Low-producing cows | 3A1aiii Cattle Cows used to produce offspring for meat | 3A1aiv Cattle Bulls used for breeding purposes | 3A1av Cattle Calves pre-weaning | 3A1avi Cattle Replacement dairy heifers | 3A1avii Growing - fattening cattle | 1990 - 2018 | IDEAM, 2022; IPCC, 2019. |
| Nex(T,P) | 43,8219 | 39,1645 | 63,51 | 10,05575 | 25,29815 | 26,14495 | 1990 - 2018 | IDEAM, 2022 |
| SGE- Dry lot | 0,05 | 0 | 0 | 0 | 0 | 0 | 1990 - 2018 | IPCC, 2019 |
| SGE- Pasture | 0,95 | 1 | 1 | 1 | 1 | 1 | 1990 - 2018 | IPCC, 2019 |
| EF3(S) - Dry lot | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 0,02 | 1990 - 2018 | IPCC, 2019 |
| EF3(S) - Pasture | 0 | 0 | 0 | 0 | 0 | 0 | 1990 - 2018 | IPCC, 2019 |
| $N_{TASA}$(T,P) | 0,29 | 0,29 | 0,29 | 0,29 | 0.29 | 0.29 | 1990 - 2018 | IPCC, 2019 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Peso(T,P) | 414 | 370 | 600 | 95 | 239 | 247 | 1990 - 2018 | IDEAM, 2022 |

**Equation 10.28: Indirect $N_2O$ emissions due to n volatilization from manure management.**
(Adapted from IPCC, 2019; volume 4, chapter10)[278]

$$N_2O_{G(ge)} = (N_{volatilización-SGE} * EF_4) * \frac{44}{28}$$

Where:

$N_2O_{G(ge)}$ = indirect $N_2O$ emissions from manure management, kg $N_2O$ year $^{-1}$
$N_{volatilizacion\text{-}SGE}$ = amount of manure nitrogen lost due to volatilization of $NH_3$ and $NO_x$ per manure management system, kg N year$^{-1}$
$EF_4$ = emission factor for $N_2O$ emissions resulting from atmospheric deposition of nitrogen to the soil or water surface, kg $N_2O$-N (kg NH3-N + NOx-N volatilized)$^{-1}$; given in Chapter 11, Table 11.3 (IPCC, 2019).
factor de emission factor for N2O (direct) from manure management system S (IPCC, 2019 (volume 4, chapter 11, Table 11.3)), kg $N_2O$ – N kg N$^{-1}$

**Equation 10.26: N losses due to volatilization from manure management.**
(Adapted from IPCC, 2019; volume 4, chapter10[279])

$$N_{volatilización-SGE} = \left[\sum_{S}\left[\sum_{T,P}\left(\left(N_{(T,P)} * Nex_{(T,P)}\right) * SGE_{(T,S,P)}\right)\right] * Frac_{GasMS(T,S)}\right]$$

[278] Op. Cit. IPCC, 2019.
[279] Op. Cit. IPCC, 2019.

| | |
|---|---|
| | Where:<br><br>$N_{volatilizacion\text{-}SGE}$ = amount of manure nitrogen lost due to volatilization of $NH_3$ and $NO_x$ per manure management system, kg N year$^{-1}$<br>$N_{(T,P)}$ = activity data, equals the number of head of livestock species/category T classified as production system P.<br>$Nex_{(T,P)}$ average annual nitrogen excretion per head of species/category T for production system P, kg N animal$^{-1}$ year $^{-1}$<br>SGE = fraction of manure managed using a given animal waste management system, in %.<br>$Frac_{GasMS(T,S)}$ = fraction of nitrogen in manure managed for livestock category T that volatilizes as $NH_3$ and NOx in manure management system S ((IPCC, 2019 (Table 10.22)) |
| **Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions** | Municipal scale - Polygon of the municipal political-administrative division |
| **Methodological level (equations)** | Tier 1 |
| **Method consistent representation of Lands Approach 3** | N/A |

| Indirect Cattle Manure Management | |
|---|---|
| **Activity data parameters (Available historical time series and information sources)** | • Livestock Inventory– FEDEGAN[280]: Activity data obtained at the municipal scale, standardized for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2001 to 2013.<br>• National Livestock Census – ICA[281]: Data consolidated annually by ICA at the municipal level, resulting from the collection of the single vaccination register, homologated for the subcategories proposed by IPCC methodological level 2 (2019). Information available for the period 2014 to 2022. The information is updated annually<br><br>The databases reported by the ICA and Fedegan contain information on the number of animals by age groups, the groups reported are: Calves and heifers under one year old, females and males between 1 and 2 years old, females and males between 2 and 3 years old, females and males over 3 years old. The age groups were homologated with those proposed in IPCC guidelines (2006[282] y 2019[283]). For this purpose, the map of livestock herd orientation at municipal scale reported by FEDEGAN[284] was used and the following criteria were applied for the homologation of the age groups with the IPCC categories:<br><br>• Category 3A1ai — 3A2ai Cattle High-producing cows: sum of females 2 to 3 years old and those older than 3 years old in all dairy oriented municipalities.<br>• Low-producing cows: all females older than 3 years in dual purpose-oriented municipalities.<br>• Cows used to produce offspring for meat: all females older than 3 years in the municipalities with fattening and breeding orientation. |

[280] Livestock Inventory. https://www.fedegan.org.co/estadisticas/inventario-ganadero
[281] National Livestock Census. https://www.ica.gov.co/áreas/pecuaria/servicios/epidemiologia-veterinaria/censos-2016/censo-2018
[282] IPCC, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2006. https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
[283] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html
[284] FEDEGAN, Carta Fedegán 130: Primer Foro Internacional de la Leche, 2012, Page 15. https://www.fedegan.org.co/carta-fedegan-130-primer-foro-internacional-de-la-leche

| | |
|---|---|
| | • Bulls used for breeding purposes: 55% of males older than 3 years, in all municipalities.<br>• Calves pre-weaning: sum of all heifers and calves under one year old.<br>• Replacement dairy heifers: all females between 1 and 3 years old in municipalities oriented to fattening, breeding, and dual purpose. In municipalities with specialized dairy orientation, all females between 1 to 2 years old.<br>• Growing - fattening cattle: males between 1 to 3 years old plus 45% of males older than 3 years old in all municipalities. |
| **Emission factor parameters (information sources)** | **Indirect $N_2O$ emissions due to N volatilization from manure management.**<br><br>**Equation 10.28: Indirect $N_2O$ emissions due to N volatilization from manure management.**<br>(Adapted from IPCC, 2019; Volume 4, Chapter10[285])<br><br>$$N_2O_{G(ge)} = (N_{volatilización-SGE} * EF_4) * \frac{44}{28}$$<br><br>Where:<br><br>$N_2O_{G(ge)}$ = indirect $N_2O$ emissions from manure management, kg $N_2O$ year $^{-1}$<br>$N_{volatilizacion\text{-}SGE}$ = amount of manure nitrogen lost due to volatilization of $NH_3$ and $NO_x$ by manure management system, kg N year$^{-1}$<br>$EF_4$ = emission factor for $N_2O$ emissions resulting from atmospheric deposition of nitrogen to the soil or water surface, kg $N_2O$-N (kg $NH_3$-N + NOx-N volatilized)$^{-1}$; given in Chapter 11, Table 11.3 (IPCC, 2019). |

[285] IPCC, 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4: Agriculture, Forestry and Other Land Use, Chapter 10: Emissions from livestock and manure management, 2019. https://www.ipcc-nggip.iges.or.jp/public/2019rf/pdf/4_Volume4/19R_V4_Ch10_Livestock.pdf

| | |
|---|---|
| | emission factor for $N_2O$ (direct) from manure management system S (IPCC, 2019 (volume 4, chapter 11, Table 11.3)), kg $N_2O$ – N kg $N^{-1}$<br><br>**Equation 10.26: N losses due to volatilization from manure management.**<br>(Adapted from IPCC, 2019; volume 4, chapter10[286])<br><br>$$N_{volatilización-SGE} = \left[\sum_{S} \left[\sum_{T,P} \left(\left(N_{(T,P)} * Nex_{(T,P)}\right) * SGE_{(T,S,P)}\right)\right] * Frac_{GasMS(T,S)}\right]$$<br>Where:<br><br>$N_{volatilizacion-SGE}$ = amount of manure nitrogen lost due to volatilization of $NH_3$ and $NO_x$ per manure management system, kg N year$^{-1}$<br>$N_{(T,P)}$ = Activity data, equals the number of head of livestock species/category T classified as production system P.<br>$Nex_{(T,P)}$ = average annual nitrogen excretion per head of species/category T for production system P, kg of N animal $^{-1}$ year $^{-1}$<br>SGE = fraction of manure managed using a given animal waste management system, in %<br>$Frac_{GasMS(T,S)}$ fraction of nitrogen in the manure managed for livestock category T that volatilizes as $NH_3$ and $NO_x$ in manure management system S ((IPCC, 2019 (Table 10.22))<br><br>**Parameters for the calculation of indirect $N_2O$ emissions due to N volatilization from manure management.** |

| Orinoquia Region | Information Source | |
|---|---|---|
| | **Period** | **Data Source** |

286 Op. Cit. IPCC, 2019.

| Category and Characteristics Animals | 3A1ai Cattle High-producing cows | 3A1aii Cattle Low-producing cows | 3A1aiii Cattle Cows used to produce offspring for meat | 3A1aiv Cattle Bulls used for breeding purposes | 3A1av Cattle Calves pre-weaning | 3A1avi Cattle Replacement dairy heifers | 3A1avii Growing - fattening cattle | 1990 - 2018 | IDEAM, 2022; IPCC, 2019. |
|---|---|---|---|---|---|---|---|---|---|
| EF4 | 0,014 | 0,014 | 0,014 | 0,014 | 0,014 | 0,014 | 0,014 | 1990 - 2018 | IPCC, 2019. |
| Nex(T,P) | 0 | 43,8219 | 39,1645 | 63,51 | 10,05575 | 25,29815 | 26,14495 | 1990 - 2018 | IPCC, 2019. |
| SGE (Lote seco) | 0 | 0,05 | 0 | 0 | 0 | 0 | 0 | 1990 - 2018 | IDEAM, 2022 |
| FracGasMS(T,S) | 0 | 0,3 | 0 | 0 | 0 | 0 | 0 | 1990 - 2018 | IPCC, 2019. |

| | |
|---|---|
| **Spatial level of the parameters (local, regional, national or international) and whether they allow spatially explicit observations of land use categories and land use conversions** | Municipal scale - Polygon of the municipal political-administrative division. |
| **Methodological level (equations)** | Tier 1 |
| **Method consistent representation of Lands Approach 3** | N/A |

# Annex 8: GHG Accounting Scope and Improvement Plan (GHG-ASIP): A time-bound plan to increase the scope of accounting and improve data and methods throughout the ERPA Term

**Section A: Institutional Processes and Responsibilities**

A1. Summary of the elaboration process and agreement of this plan.

The improvement plan has been developed jointly between the BioCarbon Project Implementation Unit (PIU) and IDEAM, with the support of UPRA (Agricultural Rural Planning Unit). This plan has been developed to be implemented in the current phase (2021 to 2023) and it also contains the actions to be executed in the next phase (2024 - 2025).

Table 1. A.1 Overview of the entities that have agreed to this plan

| Entity name | Role of the entity | Name of entity representative | Position of the entity's representativ e |
|---|---|---|---|
| IDEAM | Improvement plan implementer | Elizabeth Patiño Correa<br><br>María Yuli González González | Assistant Director of Environmental Studies Area<br>Assistant Director of Ecosystem and Environmental Information Area |
| UPRA | Improvement plan implementer | Claudia Liliana Cortez López | Chief Executive Officer |
| Environment and Sustainable Development Ministry (MADS) | Provide guidance and direction | Sebastián Carranza Tovar | Director of Climate Change and Risk Management |
| Agriculture and Sustainable Development Ministry (MADR) | Provide guidance and direction | Nelson Enrique Lozano Castro | Director of Innovation, Technological Development and Health Protection |

**Section B: Summary of Analysis Supporting this Plan.**

Table 2. Summary of analysis supported by this plan

| Subcategory | Are the baseline setting requirements fulfilled? (Yes/No) | Method(s) and data requirement(s) fulfilled? (Yes/No) | Are the spatial information requirements fulfilled? (Yes/No) | Can the accounting of the ISFL methodological framework be applied? (Yes/No) |
|---|---|---|---|---|
| Forest converted to grassland (Deforestation) | Yes | Yes | Yes | Yes |
| Forest converted to other forest land | Yes | No | Yes | No |
| Forest converted to cropland (Deforestation) | Yes | Yes | Yes | Yes |
| Forest converted to wetlands (Deforestation) | Yes | Yes | Yes | Yes |
| Forest converted to other land (Deforestation) | Yes | Yes | Yes | Yes |
| Forest converted to settlements (Deforestation) | Yes | Yes | Yes | Yes |
| Land converted to forest (Regeneration) | Yes | Yes | No | No |
| Forest remaining forest | Yes | No | No | No |
| Dynamic in OWV | Yes | Yes | No | No |
| Dynamic in forest plantations | Yes | Yes | No | No |
| Cattle Enteric fermentation | Yes | Yes | N/A | Yes |
| Rice cultivation | Yes | No | N/A | No |
| Urine and dung deposited from grazing animals | Yes | No | N/A | No |
| Dynamic in oil palm cultivation | Yes | Yes | No | No |

| Subcategory | Are the baseline setting requirements fulfilled? (Yes/No) | Method(s) and data requirement(s) fulfilled? (Yes/No) | Are the spatial information requirements fulfilled? (Yes/No) | Can the accounting of the ISFL methodological framework be applied? (Yes/No) |
|---|---|---|---|---|
| Volatilization of urine and dung deposited from grazing animals | Yes | No | N/A | No |
| Leaching/runoff of deposited urine and dung from grazing animals | Yes | No | N/A | No |
| Cattle manure management | Yes | No | N/A | No |
| Indirect Cattle Manure Management | Yes | No | N/A | No |

**Section C. Agreed actions to increase the completeness of the accounting scope and improve data and methods for the next phases of the ERPA during the ERPA time frame.**

C.1 Actions to be taken to align the required subcategories with ISFL´s accounting requirements.

Table 3. Forest converted to other forest land

| Subcategory | Forest converted to other forest land | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| ● **Historical time series for baseline setting** | Yes | Historical data is available for the period (2001-2018) of area change from natural forest areas to OWV and oil palm. |
| ● **Data quality and methods** | No | Emissions associated with deforestation of natural forest and conversion to areas of OWV and forest plantations are estimated by the Tier 2 gain and loss method, using factors of carbon content in biomass and soils of natural forest obtained from the National Forest Inventory of Colombia, factors of biomass content in OWV from a compilation of secondary information for shrublands that must be improved with country-specific information, and biomass factors for plantations specific to the Orinoquia region. The estimation of changes in carbon contents in dead organic matter is done with the use of IPCC default emission factor |
| ● **Spatial representation of land for subcategories related to land use change.** | Yes | The SMByC has spatially explicit information on the change of areas from natural forest to OWV and plantations for the period 2001-2018. |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Improvement of methodological level | The emission factors used to estimate changes in carbon content from conversion to shrubland-OWV need to be improved with the most up-to-date information obtained from the implementation of the NFI and the non-forest inventory in the Orinoquia region.<br><br>The integration of the NFI information with the spatial data from the SMByC will allow adjusting the estimates of emissions from the change from natural forest to OWV | NFI, Non- Forest Inventory of the Orinoquia Region | IDEAM | 12/2023 | Biocarbon Fund |
| Improved activity data | It is necessary to differentiate the subcategory of changes from natural forest to other forest land based on the classification of deforestation into Forest converted to OWV and forest converted to forest plantation | SMByC | IDEAM | 11/2023 | Biocarbon Fund |

Table 4. Land Converted to Forest (Regeneration)

| Subcategory | Land converted to forest (Regeneration) | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| ● **Historical time series for baseline setting** | Yes | Historical data are available for the period (2000-2018) of area change from non-forest to natural forest |
| ● **Data quality and methods** | Yes | The removals by regeneration of the natural forest are estimated by the method of losses and gains of Tier 2, using factors of carbon content in biomass and soil obtained from the National Forest Inventory of Colombia and IPCC default factor for the estimation of changes in carbon content in dead organic matter |
| ● **Spatial representation of land for subcategories related to land use change** | No | The SMByC has spatial information on the change of areas from Non- Forest to Natural Forest for the period 2000-2018; however, the SMByC has not currently implemented the process to identify previous use. |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Improvement of methodological level | The SMByC is working on the identification of restored areas that become forest land, compiling information from the | Updated data from SMByC, | IDEAM, MADS, MADR | 07/2023 | GGGI-FAO |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | SNIF, an application of the MADS and the ANLA to generate a historical analysis. The protocol for this procedure will be delivered by the end of July 2023 | 180M trees application, SNIF y BD de CAR´s e IAvH[1]. | | | |
| Improved activity data | A regeneration typification analysis is required with the same thematic accuracy as the deforestation exercise, which allows to establish the proportion of land use change from other land to forest land annually. This exercise consists of a stratified sampling in which a certain number of points are evaluated and classified in a coverage, and allows the assignment of the use prior to the regeneration process | SMByC | IDEAM | 12/2023 | REM-FAO |

Table 5. Forest remaining forest

| Subcategory | Forest remaining forest | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| ● **Historical time series for baseline setting** | Yes | Historical information is available for the entire period, but it does not meet the spatial requirements requested by the ISFL methodological framework. |
| ● **Data quality and methods** | No | There is no complete analysis of natural forest degradation in the country; in the historical line of ERP emissions there are only estimates of firewood consumption for cooking in the rural population as a factor in degradation. Different methods using remote sensing and other spatial data have been applied to establish degradation analyses, but none have been validated with terrestrial data nor do they have acceptable levels of uncertainty for a reference environment.<br>The estimation data included in the timeline on fuelwood consumption do not fully account for the factors influencing degradation and are obtained from national level surveys. |
| ● **Spatial representation of land for subcategories related to land use change** | No | A stratification scheme has not been constructed to differentiate between managed and unmanaged forest lands, so far there is no spatially explicit information on degradation, which would allow monitoring of these areas. |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Baseline forest degradation | A complete analysis of natural forest degradation is required, including firewood, logging permits, fires and other factors affecting forest degradation, established with spatially explicit information and validated with the National Forest Inventory.<br><br>The estimation of degradation will be carried out through a methodology based on time series analysis of optical satellite images, in 2023 this will be conducted for the Orinoquia and Colombian Amazon regions, and in the year 2024 at the national level.<br><br>The data will be generated historically for the period between 2000 and 2018 and will be consistent with the data on | SMByC and NFI data | IDEAM | Degradation baseline December 2023 Forest harvesting September 2024 | REM-Biocarbon Fund |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | deforestation and OWV generated by the SMByC.<br><br>The construction of a field verification methodology that will serve as input for the uncertainty report of the Degradation data generated, is also proposed. This methodology will be based on the information generated by the National Forest Inventory (NFI), so its generation and implementation will be subject to the availability and level of detail of the information provided by the NFI. In case it is not possible to rely on the information generated by the NFI or the level of detail of the information provided is not adequate, the uncertainty report | | | | |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | will be built with information from remote sensors. | | | | |

Table 6. Dynamic in OWV

| Subcategory | Dynamic in OWV | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| **● Historical time series for baseline setting** | Yes | Information on increases, permanence and decreases in OWV areas is obtained from spatially explicit information from satellite image analyses performed by the SMByC, for the 2001-2018 time series. |
| **● Data quality and methods** | Yes | Emissions and removals for this category are estimated using the 2006 IPCC Guidelines Tier 2 gain and loss method, with factors obtained from a compilation of secondary information for shrubland cover, which will be enhanced with information from the NFI update and non-forest Orinoquia, based on a sample design. |
| **● Spatial representation of land for subcategories related to land use change** | No | The SMByC has spatially explicit information on increases, permanence and decrease of OWV areas, however, it does not yet identify previous and subsequent use. |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Pre and post use of OWV area increases and decreases are not known. | An analysis of OWV typification with the same thematic accuracy as the deforestation exercise is required to establish the proportion of change on an annual basis. This exercise consists of a stratified sampling in which a certain number of points are evaluated and classified in a coverage, and allows the assignment of previous and subsequent use. As a result, the OWV typification report will be obtained for the period 2000-2018. | SMByC | IDEAM | 07/2024 | REM-FAO-GEF-II-CA |
| Improvement of uncertainty analysis | Uncertainty analysis is not available for the complete series of forest and OWV area change. As a result of this improvement, the report of uncertainty and adjusted areas for the 2000 - 2018 series will be obtained. | SMByC | IDEAM | 12/2023 | Biocarbon Fund-REM-FAO-GEF-II-CA |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Improvement of emission factors | The OWV information will also be improved through the non-forest inventory for the Orinoquia region, with the collection of own data at the territorial level of carbon content in biomass, soils and dead organic matter for non-forest categories.<br><br>Additionally, with the completion of the NFI in the Orinoquia, it will be possible to refine the current carbon content factors in the three pools, for the forest and non-forest categories in general. | IDEAM y IAvH | IDEAM | 06/2024 | Biocarbon Fund-REM |

Table 7. Dynamic in forest plantations

| Subcategory | Dynamic in forest plantations | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements** | **If not met, detailed description of the deficiency(ies)** |

| Subcategory | Dynamic in forest plantations | |
|---|---|---|
| | fulfilled? (Yes/No) | |
| ● **Historical time series for baseline setting** | Yes | Information on the analysis of increases, permanence and decrease of forest plantation areas is available in a spatially explicit manner for the 2001-2018 time series, based on the SMByC analysis. |
| ● **Data quality and methods** | Yes | Emissions and removals in this category are estimated using the Tier 2 gain and loss method of the 2006 IPCC Guidelines. Information is available on biomass factors for the most representative species of the Orinoquia region, which are weighted to obtain factors at the departmental level |
| ● **Spatial representation of land for subcategories related to land use change** | No | The SMByC has spatially explicit information on increases, decreases and permanence of commercial forest plantation areas, however, it does not yet identify previous and subsequent use. |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Refinement of biomass factors by the implementation of low-carbon models in forest plantations | From a forestry plantations consultancy it is expected that low carbon practices that can provide information on emission reduction indicators for these plantations, can be identified. The expected result can provide | Consultancy Unión Temporal Forestal Orinoquia Colombia - Brazil | IDEAM | 10/2023 | Biocarbon Fund |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | information on emission reduction indicators to complement the emission factors of this coverage. | | | | |
| Identification of pre- and post-use changes for forest plantations | Another improvement contemplated for this category regarding the activity data is the identification of the use before and after the areas of increase and decrease of areas and that is consistent with the analyses of deforestation, regeneration, oil palm and OWV. As a result, the typification matrix of changes in plantation cover will be obtained. | SMByC | IDEAM | 09/2024 | GGGI-CBIT-REM |
| Improvement of activity data and imputation of emission factors | The information on forest plantations identified by the SMByC can be improved and species-specific factors can be imputed, based on the spatialization of forest plantation areas by species, with | SMByC, MADR, ICA | IDEAM | 02/2024 | CBIT-Biocarbon-Fund |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | geographic information provided by ICA and with the support of the SMByC. | | | | |

Table 8. Dynamic in oil palm cultivation

| Subcategory | Dynamic in oil palm cultivation | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| • **Historical time series for baseline setting** | Yes | Information on the analysis of increases, permanencies and decreases in palm cultivation areas is available in a spatially explicit manner for the 2001-2018 time series, based on the SMByC analysis. |

| Subcategory | Dynamic in oil palm cultivation | |
|---|---|---|
| **• Data quality and methods** | Yes | Emissions and removals in this category are estimated using the Tier 2 gain and loss method of the 2006 IPCC Guidelines. Information on biomass factors obtained from country-specific studies is available for the Orinoquia oil palm region. |
| **• Spatial representation of land for subcategories related to land use change** | No | The SMByC has spatially explicit information on increases, decreases and permanence of oil palm cultivation areas, however, it does not yet identify previous and subsequent use. |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Identification of previous and subsequent use changes in oil palm cultivation areas | The typification of changes will be carried out through a joint effort between the SMByC, the oil palm industry, CENIPALMA and UPRA, the latter two entities will provide data on planted areas that will be analyzed with the change typification methodology developed by the SMByC | CENIPALMA, UPRA, SMByC | IDEAM | 06/2024 | REM-GEF-CAII-CBIT |

C.2 Planned additional improvement to align non-required subcategories with ISFL accounting requirements.

Table 9. Rice cultivation.

| **Subcategory** | **Rice cultivation** | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| **● Historical time series for baseline setting** | Yes | |
| **● Data quality and methods** | No | The rice production chain is of great importance in the Orinoquia region and has been prioritized among the six agricultural chains in the region and in the nationally determined contribution (NDC). Currently, estimates are made under advanced Tier 1 methodology, with data suggested by the FEDEARROZ - AGROSAVIA team of experts for the adjustment of the daily emission factor for both irrigation and rainfed agriculture, according to IPCC 2019. The adjustments consider water and organic amendment scaling factors. To achieve estimates with Tier 2 methodology, it is important to estimate emission factors specific to the region. |
| **● Spatial representation of land for subcategories related to land use change** | N/A | |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Emission factors | The values of scaling factors suggested by the consultancy Low Carbon Rice in the Orinoco developed by AGROSAVIA and experts from FEDEARROZ have been used. Additionally, it is expected that in future estimates, emission factors developed by the consultancy 008-2022, in charge of Bioversity International- CIAT Alliance will be used. The object of the consultancy is to: Generate Tier 2 emission factors (IPCC 2019) for methane ($CH_4$) in irrigated and rainfed rice producing regions for the Orinoquia region, according to the technical guidelines provided by the team of the National Inventory of GHG of | 1. Field information (in situ)<br>2. Refinement of the IPCC 2019 methodology. | Alliance Bioversity & CIAT. | 11/2023 | Biocarbon Fund |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | Colombia (NGHGI) of the IDEAM | | | | |
| Activity data | Through coordinated efforts between the SMByC and UPRA, they will provide data on planted areas. | UPRA, SMByC | UPRA | 12/2023 | Biocarbon Fund |

Table 10. Urine and dung deposited from grazing animals

| Subcategory | Urine and dung deposited from grazing animals | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| ● **Historical time series for baseline setting** | Yes | It is calculated from the detailed cattle population for the historical series 2009 to 2018. |

| Subcategory | Urine and dung deposited from grazing animals | |
|---|---|---|
| • **Data quality and methods** | No | They are currently at methodological level 1 (default - IPCC, 2019). The activity data for this category is the annual amount of N from urine and dung deposited by grazing animals. The animal population is detailed for seven categories of cattle, the information is obtained from and ICA. The emission factors are by default differentiated by type of climate and is the main element limiting the upgrade to a methodological level 2. The development of a country specific emission factor requires estimating the amount of $N_2O$ emitted by N from urine and dung deposited by grazing animals on pastures, meadows and rangelands. Currently, consultancy 008-2022 is being carried out by Bioversity International- CIAT Alliance to generate Tier 2 emission factors for direct nitrous oxide from urine and dung from grazing animals for livestock. |
| • **Spatial representation of land for subcategories related to land use change** | N/A | |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Emission factors | In situ measurements will be required, to estimate emission factors corresponding to the direct $N_2O$ emissions from | Consultancy 008-2022 - "Generar factores de emisión Tier 2 (IPCC 2019) | Alliance Bioversity & CIAT. | 12/2023 | Biocarbon Fund |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | urine and dung N deposited on pastures, meadows and rangelands by grazing animals and the annual amount of urine and dung N deposited by grazing animals on pastures, meadows and rangelands, kg N $yr^{-1}$. | para óxido nitroso en pasturas para ganadería de cría y para metano ($CH_4$) para arroz riego y secano" | IDEAM is the technical supervisor of the entity performing the methodological improvement | | |
| Annual amount of N from urine and dung deposited by grazing animals. | In situ measurements will be required to estimate the annual amount of N from urine and dung deposited by grazing animals. | Consultancy 008-2022 - "Generar factores de emisión Tier 2 (IPCC 2019) para óxido nitroso en pasturas para ganadería de cría y para metano ($CH_4$) para arroz riego y secano" | Alliance Bioversity & CIAT.<br><br>IDEAM is the technical supervisor of the entity that performs the methodological improvement. | 12/2023 | Biocarbon- Fund |

Table 11. Volatilization of urine and dung deposited from grazing animals.

| **Subcategory** | **Volatilization of urine and dung deposited from grazing animals.** | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| **● Historical time series for baseline setting** | Yes | Calculated from the detailed cattle population for the historical series 2009 to 2018. |
| **● Data quality and methods** | No | It is currently at methodological level 1 (default - IPCC, 2019). The activity input for this category is the annual amount of N from urine and dung deposited by grazing animal populations. The animal population is detailed for seven categories of cattle, obtained from FEDEGAN and ICA. The emission factor is the main element limiting the ascent to a methodological level 2. The development of a country-specific emission factor requires identifying $N_2O$ emissions from the country's own atmospheric N deposition. With the support of universities and research centers, it is expected that progress will be made in the generation of information to improve the methodological level. |
| **● Spatial representation of land for subcategories related to land use change** | N/A | |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Emission factors | In situ measurements will be required to estimate emission factors corresponding to $N_2O$ emissions from atmospheric deposition of N in soils, annual amount of N from urine and dung deposited by grazing animals on pastures, meadows and rangelands and the fraction of N from urine and dung deposited by grazing animals that volatilizes as $NH_3$ and NOx | For the calculation of the emission factor, $N_2O$ emissions from atmospheric deposition of N associated with the country's environmental conditions are required.<br><br>N associated with the country's environmental conditions. | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 |
| Fraction of nitrogen in managed manure that volatilizes. | It is necessary to know the fraction of urine and dung nitrogen deposited by grazing | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, | IDEAM, Universities, research centers. | 2025 | To be defined |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | animals (FPRP) that volatilizes as $NH_3$ and NOx. | Universities, research centers. | | | |
| Nitrogen deposited by grazing animals. | It is necessary to estimate the annual amount of N from urine and dung deposited by grazing animals on pastures, meadows and rangelands. | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |

Table 12. Leaching/runoff of urine and dung deposited from grazing animals.

| Subcategory | Leaching/runoff of urine and dung deposited from grazing animals. | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |

| Subcategory | Leaching/runoff of urine and dung deposited from grazing animals. | |
|---|---|---|
| **● Historical time series for baseline setting** | Yes | Calculated from the cattle population for the historical series 2009 to 2018. |
| **● Data quality and methods** | No | It is currently at methodological level 1 (default - IPCC, 2019). The activity data for this category is the annual amount of N from urine and dung deposited by grazing animal populations. The animal population is detailed in seven categories of cattle, the information is obtained from FEDEGAN and ICA. The emission factor is the main element limiting the upgrade to methodological level 2. The development of a country-specific emission factor requires the identification of $N_2O$ emissions from leaching and runoff of urine and dung deposited by grazing animals. With the support of universities and research centers, it is expected that progress will be made in the generation of information to improve the methodological level. |
| **● Spatial representation of land for subcategories related to land use change** | N/A | N/A |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Emission factors. | For the calculation of the emission factor, $N_2O$ emissions from leaching and runoff of urine and dung deposited by grazing animals are required. | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |
| Fraction of nitrogen in managed manure that volatilizes. | The fraction of nitrogen from urine and dung deposited by grazing animals (FPRP) that is leached is required. | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Nitrogen deposited by grazing animals. | Annual amount of N required from urine and dung deposited by grazing animals on pastures, meadows and rangeland | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |

Table 13. Cattle Manure Management

| Subcategory | Cattle Manure Management | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| **● Historical time series for baseline setting** | Yes | Direct $CH_4$ and $N_2O$ emissions from cattle manure management are calculated from a detailed cattle population for the historical series 2009 to 2018. |

| Subcategory | Cattle Manure Management | |
|---|---|---|
| **• Data quality and methods** | No | Direct emissions from manure management are divided into $CH_4$ and $N_2O$ emissions. $CH_4$ emissions from manure management are currently calculated with a methodological tier 2 (IPCC, 2019).<br><br>However, direct $N_2O$ emissions are at a methodological level 1 (default - IPCC, 2019). The activity data for this category is the amount of nitrogen excreted per manure management system for the animal population. The animal population is detailed for 7 categories of cattle, the information is obtained from FEDEGAN and ICA, these entities are in charge of carrying out the cattle census of the country and are a reliable and complete source with historical data.<br><br>The emission factors are by default and are differentiated by manure management system, this is one of the limiting elements to move to a methodological level 2. The development of a country-specific emission factor requires identifying the direct $N_2O$ emissions of the different manure management systems in cattle ranching, in addition to the detailed characterization of these systems. It is also necessary to know the nitrogen excretion rate by animal category. With the support of universities and research centers, it is expected that advancements in the generation of information will allow improving the methodological level |
| **• Spatial representation of land for subcategories related to land use change** | N/A | N/A |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Emission factors | To calculate the emission factor, it is necessary to know the direct $N_2O$ emissions associated with the actual duration of storage and type of treatment of animal manure in each of the management systems in use for livestock, considering conditions such as aeration and temperature | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |
| Characterization of manure management systems. | It is necessary to know the fraction of total annual nitrogen excretion of each animal category that is in a given manure management system. | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Nitrogen excretion rates by animal category | It is necessary to know the nitrogen balance by animal category, considering the nitrogen consumption associated to the diet, the nitrogen retention associated to the production level and the nitrogen excretion. | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |

Table 14. Indirect Cattle Manure Management

| Subcategory | Indirect Cattle Manure Management | |
|---|---|---|
| **ISFL accounting requirements** | **Are the requirements fulfilled? (Yes/No)** | **If not met, detailed description of the deficiency(ies)** |
| • **Historical time series for baseline setting** | Yes | It is calculated from a detailed cattle population for the historical series 2009 to 2018 |

| Subcategory | Indirect Cattle Manure Management | |
|---|---|---|
| • **Data quality and methods** | No | Emissions are calculated with methodological Tier 1 Advanced (default - IPCC, 2019). The activity input for this category is the amount of manure nitrogen lost due to volatilization, which is calculated considering the amount of nitrogen excreted by manure management systems for the animal population. The animal population is in seven categories of cattle, obtained from FEDEGAN and ICA. The emission factors are by default differentiated by climate type, and this is one of the limiting elements to move to a methodological level 2. The development of a country-specific emission factor requires identifying N2O emissions from the country's own atmospheric N deposition. On the other hand, moving towards a methodological tier 2 also requires knowing the country-specific nitrogen fraction of managed manure that volatilizes as $NH_3$ and NOx by manure management system and nitrogen excretion rates by animal category. It is expected that with the support of universities and research centers, progress will be made in the generation of information that will allow improving the methodological level. |
| • **Spatial representation of land for subcategories related to land use change** | N/A | |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| Emission factors | For the calculation of the emission factor, $N_2O$ emissions from atmospheric deposition of N associated with the country's environmental conditions are required | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |
| Fraction of nitrogen in managed manure that volatilizes. | It is necessary to know the fraction of managed manure nitrogen that volatilizes as $NH_3$ and NOx in the different manure management systems and environmental conditions of the country. | Scientific publications, expert consultation. Fedegan, ICA, AGROSAVIA, Universities, research centers. | IDEAM, Universities, research centers. | 2025 | To be defined |
| Nitrogen excretion rates by animal category | It is necessary to know the nitrogen balance by animal category, considering the | Scientific publications, expert consultation. | IDEAM, Universities, research centers. | 2025 | To be defined |

| Identified gap | Description of what is technically needed to approach it | Possible data sources | Responsible entity | Expected completion | Financing/support sources |
|---|---|---|---|---|---|
| | nitrogen consumption associated to the diet, the nitrogen retention associated to the production level and the nitrogen excretion. | Fedegan, ICA, AGROSAVIA, Universities, research centers. | | | |

## Financial Plan

Table 18. Financial plan considering each subcategory

| Subcategory | Action | Financing requirements (per year in dollars) | Total (US$) | Financi ng | Source and type of | Financing gap (US$) |
|---|---|---|---|---|---|---|

| | | Year 1 2021 | Year 2 2022 | Year 3 2023 | Year 4 2024 | Year 5 2025 | | available (US$) | financing (grant/loan/government budget) (US$) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Deposited urine and dung from grazing animals<br><br>Volatilization of urine and dung deposited from grazing animals<br><br>Leaching/runoff of urine and dung deposited from grazing animals<br><br>Direct and indirect manure management of cattle. | Improvement of methodological level<br><br>Improvement of parameters (excretion rate) | | $ 76.500 | $ 100.000 | | | $ 176.500 | $ 176.500 | Orinoquia BioCarbon Project - Component 3. (Current Phase) | N/A |
| Land converted to forest (Regeneration) | Improvement of activity data | | | | $ 383.500 | $ 305.000 | $ 2.509.500 | $ 1.821.000 | US$ 1.821.000 Orinoquia BioCarbon | $ 498.500 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Analysis of regeneration typification | | | | | | | | Project - Component 3. (Current Phase)<br><br>US$ 190.000 PRE Orinoquia (World Bank grant, subject to approval of third phase) | |
| Forest remaining forest | Baseline forest degradation | | | $ 30.000 | | | | | | |
| Dynamic OWV | Uncertainty analysis of deforestation activity data and | | | $ 300.000 | | | | | | |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | OWV over the entire time series | | | | | | | | | | |
| | Analysis of OWV Typification | | | | | | | | | | |
| Dynamic in forest plantations | Refinement of biomass factors in forest plantations. | $ 53.000 | | | | | | | | | |
| | Identification of pre- and post-use changes for forest plantations | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Improved activity data (spatially explicit information) | | | | | | | | | |
| Dynamic in oil palm cultivation | Emission factors | | | | | | | | | |
| | Improvement of activity data | | | | | | | | | |
| Rice cultivation | Improvement of methodological level | | $ 100.000 | $ 100.000 | | | | | | |
| Forest converted to other forest land | Improvement of methodological level | $ 274.000 | $ 619.000 | $ 345.000 | | | | | | |
| **Total** | | **$ 327.000** | **$ 795.500** | **$ 875.000** | **$ 383.500** | **$ 305.000** | **$ 2.686.000** | **$ 1.997.500** | **$ 2.187.500** | **$ 498.500** |

## Annex 9: Estimation of the Emissions Baseline

The final selection of program categories was made following the ISFL requirements related to the availability of historical data, (A historical line of 10 years (2009-2018) for the Orinoquia Region) tier 2 estimates, availability of spatially explicit information and land use change analysis. According to the above, the following subcategories were selected that meet all requirements: **Forest converted to Cropland (Deforestation), Forest converted to Grassland (Deforestation), Forest converted to Wetland (Deforestation), Forest converted to Settlement (Deforestation), Forest converted to Other Land (Deforestation) and Cattle Enteric fermentation (Deforestation).**

As mentioned in section 4.2.3 of the Emission Reduction Program V.5.0 document, other categories were included that do not meet all the requirements, but are considered to be of great importance for the development of the project in the region. According to section 4.3.14 of the ISFL requirements these subcategories can be included within the interim baseline of the program as they have GHG estimates with the best available information in a 10-year reference period and there is an improvement plan in place that contemplates the refinement of data quality and methods in the short and medium term. The subcategories selected with this condition were: **Forest converted to other forest land, Dynamic in other woody vegetation (OWV), Dynamic in forest plantations, Land converted to forest (regeneration), Dynamic in oil palm cultivation and Rice cultivation.**

Figure 132 presents the baseline emissions of the Orinoquia ERP for the period 2009-2029. The historical baseline emissions estimate was developed in accordance with the 2006 IPCC Guidelines and the 2019 Refinement. The description of the activity data, emission factors, methods, approaches and assumptions used in the subcategory estimates can be found in Annex VII. The results of the historical period estimates are presented in Table 1.

Table 174. Net emissions results for historical baseline (2009-2018)

| Año | Ferment. Entérica de ganado b. | Bosque convertido a otras tierras forestales | Dinámic en otra veget leños | Dinámic plant forest | Tierras convert en bosque | Dinam en cultiv palma | Bosque que se convierte en cultivos | Bosque que se convierte en pastizal | Bosque que se convierte en humedal | Bosque que se convierte asentamiento | Bosque que se convierte en otras tierras | Cultivo de arroz | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.009 | 7.135.738 | 1.739.178 | - 2.749.120 | - 127.229 | - 147.282 | - 174.397 | 111.647 | 6.954.818 | 277.211 | 3.247 | 59.957 | 1.526.713 | 14.610.482 |
| 2.010 | 7.333.967 | 1.739.178 | - 2.775.643 | - 139.017 | - 177.613 | - 198.554 | 113.275 | 7.060.327 | 282.099 | 3.247 | 61.565 | 1.348.815 | 14.651.646 |
| 2.011 | 7.294.630 | 3.208.299 | - 4.599.540 | - 196.851 | - 192.745 | - 268.918 | 258.710 | 10.740.725 | 433.554 | 3.247 | 32.523 | 1.516.433 | 18.230.067 |
| 2.012 | 7.173.033 | 3.208.299 | - 4.658.115 | - 254.529 | - 207.877 | - 355.363 | 262.295 | 10.900.534 | 440.680 | 3.247 | 33.026 | 1.263.725 | 17.808.956 |
| 2.013 | 7.087.590 | 3.063.480 | - 4.637.631 | - 345.965 | - 208.569 | - 381.671 | 524.420 | 7.930.779 | 101.268 | 33.141 | 32.601 | 1.277.403 | 14.476.847 |
| 2.014 | 7.116.233 | 2.767.106 | - 4.043.635 | - 439.669 | - 209.139 | - 369.512 | 292.781 | 6.241.820 | 83.981 | 4.192 | 29.936 | 1.032.745 | 12.506.839 |
| 2.015 | 7.126.322 | 1.977.192 | - 4.487.026 | - 501.652 | - 209.168 | - 362.782 | 445.671 | 7.185.946 | 104.302 | 4.192 | 29.248 | 1.417.189 | 12.729.432 |
| 2.016 | 7.370.650 | 2.457.307 | - 4.374.437 | - 722.926 | - 209.227 | - 490.485 | 363.316 | 10.000.817 | 177.673 | 64.879 | 291.978 | 1.660.451 | 16.589.996 |
| 2.017 | 7.515.059 | 4.354.605 | - 3.758.238 | - 787.992 | - 209.227 | - 368.391 | 204.975 | 15.791.282 | 164.193 | 73.798 | 185.906 | 1.772.466 | 24.938.437 |
| 2.018 | 8.151.721 | 7.836.074 | - 4.148.425 | - 966.287 | - 212.496 | - 333.103 | 293.462 | 16.704.320 | 261.522 | 8.244 | 136.722 | 1.415.304 | 29.147.058 |

The 2019-2029 emissions estimate was established based on the average of the historical net emissions of the GHG inventory (2009-2018) taking information from the 4 departments of the project area Arauca, Casanare, Meta and Vichada, except for the livestock sector which was estimated with an emissions intensity approach. The combination of average values and livestock emissions intensity was used as a reference to make projections from 2019 to 2029.

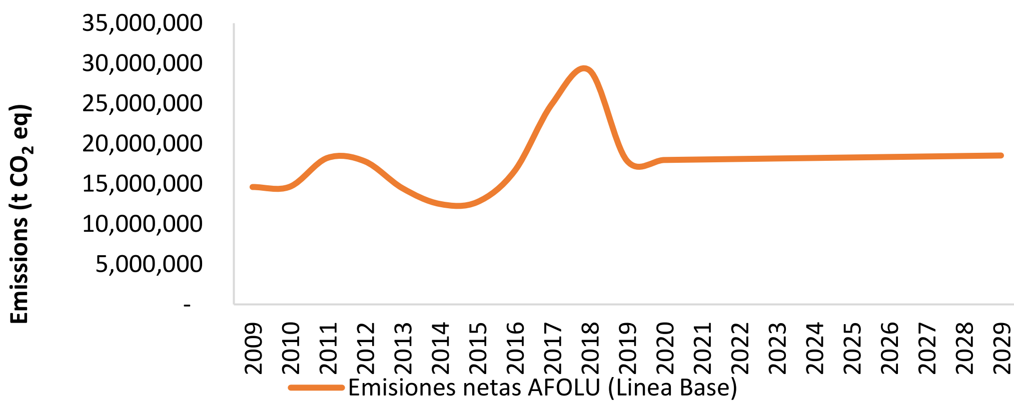


Figure 132. Emissions baseline for the Orinoquia region (2009-2029)

Livestock: emissions intensity (ratio of $CO_2$ equivalent emissions to animal protein (meat and milk) production) was calculated based on equation 1 (Eq 1), reported in section 4.2.7 of the emission reduction program requirements version 1.3[287].

[287] Available in: https://www.biocarbonfund-isfl.org/sites/default/files/2023-01/ISFL%20ER%20Program%20Requirements_V1.3_2023.pdf

Equation for the calculation of emission intensity

$$IE = \frac{Emisiones}{Producción} \qquad \text{Eq 1.}$$

Where,

IE = emissions intensity, ton $CO_2$ eq ton protein -1

Emisiones = total enteric methane emissions, ton $CO_2$ eq year -1.

Producción = total protein production, ton year -1.

The baseline emissions intensity (EI) for the period 2019 to 2029 is estimated as the average of the emissions intensity in the years 2009 to 2018[288]. Where, the calculation of the absolute emissions per year (Emissions) took the number of animals per IPCC category for the period 2009 to 2018 and multiplied by the emission factors previously calculated for NGHGI-BUR3[289] by IDEAM using an IPCC Tier 2 methodology (Bovine Enteric Fermentation $CH_4$ Emission Factors) (see Annex VII). Protein production (Production) was estimated as the sum of milk and meat protein production for each IPCC category, by the number of animals per year for the period 2009 to 2018. To calculate milk protein production, a protein content of 3,02% was considered[290]. On the other hand, in the estimation of meat protein yield, the assumptions used were carcass yield of 60%, carcass meat content of 52%, lean yield of 93% and lean meat protein content of 28,5%, as proposed by Dyer et al.[291].

Figure 133, illustrates the behavior of the emissions intensity baseline, which is stable for most of the time in the historical period, showing two extreme values corresponding to 2016 and 2018 due to factors such as methodological changes in the livestock census, reduction in livestock extraction and smuggling of livestock from Venezuela. As can be observed, these phenomena do not significantly affect the trend line that historically shows the intensity of emissions for the Orinoquia region.

[288] 4_4-4_6_ISFL_Methodology_Livestock.xlsx

[289] Available in: https://unfccc.int/documents/510821

[290] Available in: https://www.colombiaproductiva.com/ptp-capacita/publicaciones/sectoriales/publicaciones-lacteos/perfil-del-sector-lacteo-elaborado-por-proexport-2

[291] Available in: https://www.tandfonline.com/doi/abs/10.1080/10440046.2010.493376

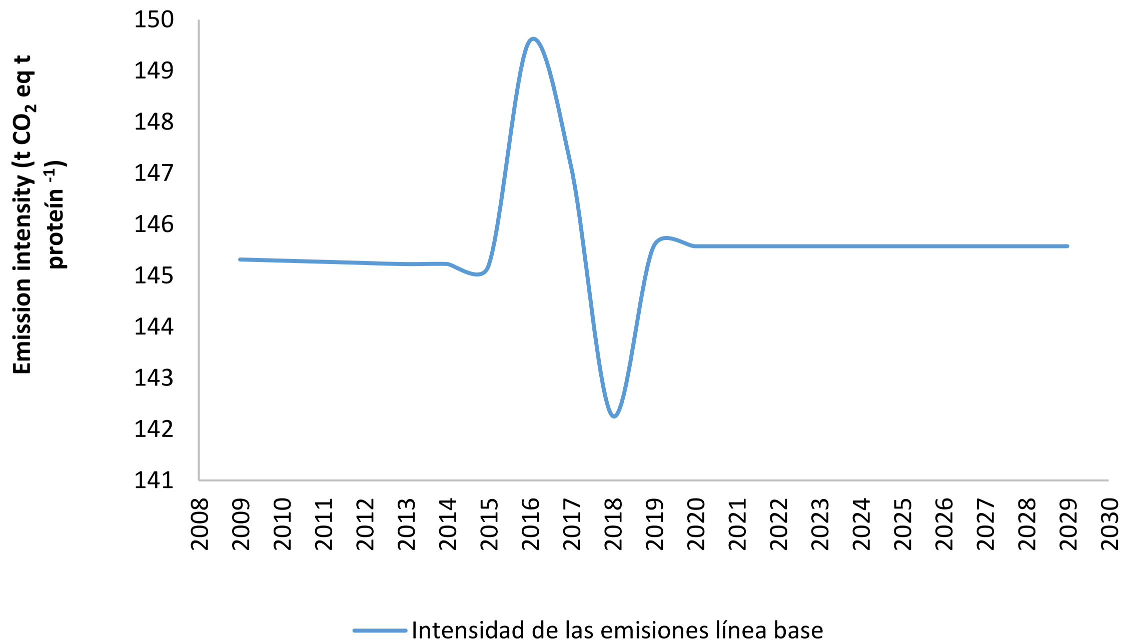


Figure 133. Livestock baseline with emissions intensity approach

Land use and land use change: the estimates for this sector include new categories with respect to the last national greenhouse gas inventory: Dynamic in OWV, Dynamic in forest plantations and Dynamic in oil palm cultivation, estimated with spatially explicit information generated by the SMByC for the historical series from 2001 to 2018, which represents an improvement in data quality compared to previous estimates of the national NGHGI, which are estimated with statistical information from official sources. This new information will allow in future phases of the ERPA, to be able to carry out monitoring in a more accurate way, taking into account that it is based on spatial information with tracking for the entire historical series and reducing the error that the spatially referenced information may contain.

The construction of historical baseline scenarios of the ERP for the sector, contemplates the GHG emissions estimates in the four departments of the Orinoquia region, period 2009-2018 for the categories Forest converted to other forest land, Forest converted to crops (Deforestation), Forest converted to grassland (Deforestation), Forest Converted to Wetland (Deforestation), Forest Converted to Settlement (Deforestation), Forest Converted to Other Land (Deforestation), Land Converted to Forest (Regeneration), Forest Remaining, Dynamic in OWV, Dynamic in Forest Plantation, Dynamic in oil Palm Cultivation. GHG estimates for the period 2019-2029 are obtained from average emissions of historical data (2009-2018).

Rice: the activity data for the 2019-2029 baseline for rice cultivation was estimated using the average of the historical share of harvested area (2009-2018) of the four departments of the Orinoquia as a reference. The source of information and values of emission factors used can be consulted in Annex VII. Table 175 shows the compilation of emissions results for the subcategories that comprise the baseline (2019-2029).

The compilation of the baseline can be found at: [4_6_Escenario_BAU&Mitigación.xlsx]

Table 175. Net emissions results for the 2019-2029 baseline

| Año | Ferment. Entérica de ganado b. | Bosque convertido a otras tierras forestales | Dinámic en otra veget leños | Dinámic plant forest | Tierras convert en bosque | Dinam en cultiv palma | Bosque que se convierte en cultivos | Bosque que se convierte en pastizal | Bosque que se convierte en humedal | Bosque que se convierte asentamiento | Bosque que se convierte en otras tierras | Cultivo de arroz | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.019 | 7.672.866 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 17.911.348 |
| 2.020 | 7.735.115 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 17.973.597 |
| 2.021 | 7.797.365 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.035.846 |
| 2.022 | 7.859.614 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.098.096 |
| 2.023 | 7.921.863 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.160.345 |
| 2.024 | 7.984.113 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.222.594 |
| 2.025 | 8.046.362 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.284.844 |
| 2.026 | 8.108.611 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.347.093 |
| 2.027 | 8.170.861 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.409.342 |
| 2.028 | 8.233.110 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.471.592 |
| 2.029 | 8.295.360 | 3.235.072 | -4.023.181 | -448.212 | -198.334 | -330.318 | 287.055 | 9.951.137 | 232.648 | 20.143 | 89.346 | 1.423.124 | 18.533.841 |

The identification and evaluation of uncertainty in the determination of the historical emissions baseline was based on the use of Monte Carlo type simulations and error propagation in each subcategory, generating variables with 10.000 simulations, for each component of the emission factor estimation models and activity data. For the subcategories in the agricultural sector, enteric fermentation of cattle obtained the lowest uncertainty (3,95 %), which is fundamental for the general estimation of uncertainty due to its contribution of emissions within the inventory. Likewise in the Land use and land use change sector, the subcategory Forest converted to other forest land registered the lowest uncertainty (9,17%), followed by Forest Converted to settlement (Deforestation) 17,88%, Forest Converted to wetland (Deforestation) 20,00%, Forest Converted to grassland (Deforestation) 24,40 % and Forest Converted to crops (Deforestation) 47,81%. Regarding the subcategories of Dynamic in OWV, Dynamic in forest plantations, Land converted to forest (Regeneration) and Dynamic in oil palm cultivation the uncertainty was estimated in the order of 20,79, 19,70, 23,42 and 77,86% respectively. Finally, the estimated uncertainty for rice cultivation was 26,0%. The uncertainty calculations can be consulted in the following folder: [4_5_3_Incertidumbre]

## Annex 10: Data and parameters to be monitored

### 1.4. Forest converted to other forest land, Forest Converted to Cropland (Deforestation), Forest Converted to Grassland (Deforestation), Forest Converted to Wetland (Deforestation), Forest Converted to Settlement (Deforestation), Forest Converted to Other Land (Deforestation), Forest Converted to Other Land (Deforestation)

| Parameters: | **Change Area of Forest converted to other forest lands**<br>**Change Area of forest converted to cropland**<br>**Change Area of forest converted to grassland**<br>**Change Area of forest converted to wetlands**<br>**Change Area of forest converted to settlements**<br>**Change Area of forest converted to other lands** |
|---|---|
| **Description:** | Deforestation is "the direct and/or induced conversion of forest cover to another type of land cover in a given period of time" (DeFries et al., 2006; GOFC-GOLD, 2009 quote by Galindo et al., 2014). |
| **Data unit:** | Hectares |
| **Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including the spatial level of the data (local, regional, national, international)** | Data source: Forest and Carbon Monitoring System – SMByC (Protocolo Procesamiento Imagenes SMByC).<br>Methods: Monitoring of the area of change from forest to other uses, using remote sensing data.<br>Spatial level: regional (includes biomes: Amazon, Andes and Orinoquia). |
| **Value fixed or monitored? If monitored, monitoring/recording frequency:** | Monitored annually |
| **Quality assurance/quality control procedures to be applied:** | The QA/QC procedures applied during data generation are presented in Protocolo Procesamiento Imagenes SMByC, in section 2.4. |

| | |
|---|---|
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and recommendations.** | The accuracy evaluation procedures applied during data generation are presented in Protocolo Procesamiento Imagenes SMByC in section 4.4. |
| **Process for managing and reducing the uncertainty associated with this parameter** | Optimize the definition of essential criteria to improve the interpretation of satellite images and enhance the accurate categorization of deforestation. |

| **Parameters:** | **Typification of deforestation** |
|---|---|
| **Description:** | Deforestation is "the direct and/or induced conversion of forest cover to another type of land cover in a given period of time" (DeFries et al., 2006; GOFC-GOLD, 2009 quoted by Galindo et al., 2014).<br>Typification: Identification of the final use of deforested areas. |
| **Data unit:** | Hectare |
| **Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international)** | Data source: Forest and Carbon Monitoring System - SMByC (Protocolo Procesamiento Imagenes SMByC).<br>Methods: Monitoring of the area of change from forest to other uses using remote sensing data.<br>Spatial level: regional (includes biomes: Amazon, Andes and Orinoquia). |
| **Value fixed or monitored? If monitored, monitoring/recording frequency:** | Monitored annually |
| **Quality assurance/quality control procedures to be applied:** | The QA/QC procedures applied during data generation are presented in Protocolo Procesamiento Imagenes SMByC in Section 2.4. |

| | |
|---|---|
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and recommendations.** | The accuracy evaluation procedures applied during data generation are presented in Protocolo_Procesamiento_Imagenes_SMByC in section 4.4. |
| **Process for managing and reducing the uncertainty associated with this parameter** | Optimize the definition of essential criteria to improve the interpretation of satellite images and enhance the accurate categorization of deforestation. |

## 1.5. Land converted to forest (Regeneration)

| Parameters: | Area of change from other uses to forest land |
|---|---|
| **Description:** | Area changing from other uses to forest |
| **Data unit:** | Hectare |
| **Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international)** | Data source: Forest and Carbon Monitoring System - SMByC.<br>Methods: Identification of area change from other uses to forest using remote sensing data.<br>Spatial level: regional (includes biomes: Amazon, Andes and Orinoquia). |
| **Value fixed or monitored? If monitored, frequency of monitoring/recording:** | Monitored annually |
| **Quality assurance/quality control procedures to be applied:** | Follow-up with annual reports |
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and guidelines.** | Error in land cover identification due to image scale and image interpretation. |
| **Process for managing and reducing the uncertainty associated with this parameter** | Improve the quality control criteria for data on area change equal to deforestation.<br><br>Adequately define the criteria necessary to improve the classification of regeneration. |

## 1.6. Forest remaining forest

| Parameters: | Area of forest remaining forest |
|---|---|
| **Description:** | Forest remaining forest |
| **Data unit:** | Hectare |
| **Data source or measurement/calculation methods and procedures to be applied (e.g.,** | Data source: Forest and Carbon Monitoring System - SMByC<br>(Protocolo_Procesamiento_Imagenes_SMByC). |

| | |
|---|---|
| **field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international)** | Methods: Monitoring of the area of change from forest to other uses.<br>Spatial level: regional (includes biomes: Amazon, Andes and Orinoquia). |
| **Value fixed or monitored? If monitored, frequency of monitoring/recording:** | Monitored annually |
| **Quality assurance/quality control procedures to be applied:** | The QA/QC procedures applied during data generation are presented in Protocolo_Procesamiento_Imagenes_SMByC in Section 2.4. |
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and guidelines.** | The accuracy evaluation procedures applied during data generation are presented in Protocolo_Procesamiento_Imagenes_SMByC in section 4.4. |
| **Process for managing and reducing the uncertainty associated with this parameter.** | Optimize the definition of essential criteria to improve the interpretation of satellite images and enhance the accurate categorization of deforestation. |

## 1.7. Dynamic in OWV

| **Parameters:** | **OWV stable areas**<br>**OWV increasing area**<br>**OWV decreasing area** |
|---|---|
| **Description:** | Stable, increasing and decreasing surfaces of OWV |
| **Data unit:** | Hectare |

| | |
|---|---|
| **Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international)** | Data source: SMByC<br>Procedures: Remote sensing data<br>Spatial level: Regional |
| **Value fixed or monitored? If monitored, frequency of monitoring/recording:** | Monitored annually |
| **Quality assurance/quality control procedures to be applied:** | Follow-up with annual reports |
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and guidelines.** | Underestimation of the area reported in the analysis with SMByC images. |
| **Process for managing and reducing the uncertainty associated with this parameter** | Joint effort between the Agriculture and Sustainable Development Ministry (MADR), ICA and SMByC, to carry out the analysis between the records reported in official databases and the plantation area identified by means of images. |

### 1.8. Dynamic in forest plantations

| Parameters: | Forest plantations stable areas<br>Forest plantations increasing area<br>Forest plantations decreasing area |
|---|---|
| Description: | Correspond to data on increases or reductions in areas with forest plantations. |
| Data unit: | Hectare |
| Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international). | Data source:<br>SMByC (using statistical and spatial information from ICA). |
| Value fixed or monitored? If monitored, frequency of monitoring/recording: | Monitored annually |
| Quality assurance/quality control procedures to be applied: | Follow-up with annual reports |
| Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and guidelines. | Underestimation of the area reported in the analysis with SMByC images. |
| Process for managing and reducing the uncertainty associated with this parameter | Joint efforts between the (MADR), ICA and SMByC, to carry out the analysis between the records reported in official databases and the plantation area identified by means of images. |

### 1.9. Rice cultivation

| Parameters: | Stable rice cultivation areas |
|---|---|

| | |
|---|---|
| **Description:** | **Stable rice-growing areas:** Refers to those regions or geographic areas where rice cultivation has remained constant and stable over time |
| **Data unit:** | Hectare |
| **Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international).** | Data source: UPRA<br>Procedures: Remote sensing data analysis<br>Spatial level: Regional |
| **Value fixed or monitored? If monitored, frequency of monitoring/recording:** | Monitored<br>Frequency 2 times a year per crop cycle. |
| **Quality assurance/quality control procedures to be applied:** | A comprehensive documentation of procedures related to Quality Assurance and Quality Control is underway and will be completed by December 2023. |
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and guidelines.** | Low performance of the supervised classification models used in the identification of rice cultivated areas. |
| **Process for managing and reducing the uncertainty associated with this parameter** | Optimize the definition of essential criteria to improve satellite image interpretation, analysis and processing and enhance accurate categorization of rice crops. |

### 1.10. Dynamic in oil palm cultivation

| Parameters: | Oil Palm cultivation stable areas<br>Oil Palm cultivation increasing area<br>Oil Palm cultivation decreasing area |
|---|---|
| **Description:** | **Stable oil palm cultivation areas:** Refers to those regions or geographic areas where oil palm regions or geographic zones where oil palm cultivation has remained constant and stable over time.<br>**Increasing of oil palm cultivation areas:** Refers to areas or regions where there has been an increase in the area under oil palm cultivation compared to previous periods.<br><br>**Area of decrease in oil palm cultivation:** Refers to areas or regions where there has been a reduction in the area under oil palm cultivation compared to previous periods. |
| **Data unit:** | Hectare |
| **Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international)** | Data source: SMByC, UPRA (with FEDEPALMA oil palm census information).<br>Methods: Remote sensing data interpretation.<br>Spatial level: Regional |
| **Value fixed or monitored? If monitored, frequency of monitoring/recording:** | Monitored annually |
| **Quality assurance/quality control procedures to be applied:** | A comprehensive documentation of procedures related to Quality Assurance and Quality Control is underway. |
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and guidelines.** | Low performance of supervised classification models used in the identification of areas under oil palm cultivation |

| | |
|---|---|
| **Process for managing and reducing the uncertainty associated with this parameter** | Optimize the definition of essential criteria to improve image interpretation, analysis and processing of satellite images and enhance the accurate categorization of oil palm crops. |

## 1.11. Urine and dung deposited from grazing animals

| **Parameters:** | **Total nitrogen excretion deposited in grassland** |
|---|---|
| **Description:** | Nitrogen from urine and dung deposited on grassland |
| **Data unit:** | Kg N animal/year |
| **Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international).** | Data source: Field measurements<br><br>Spatial level: Regional |
| **Value fixed or monitored? If monitored, frequency of monitoring/recording:** | Fixed value |
| **Quality assurance/quality control procedures to be applied:** | Standard operating procedures for field data collection of the rice and livestock consultancy and in accordance with the IPCC guidelines for the calculation of methodological level 2 will be applied. |
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and guidelines.** | Systematic errors in data collection, processing and consolidation. |

| | |
|---|---|
| **Process for managing and reducing the uncertainty associated with this parameter** | Standard operating procedures for rice and livestock consultancy field data collection will be applied to reduce systematic errors in field measurements and data processing. |

## 1.12. Emission factors

| Parameters: | Emission factors |
|---|---|
| Description: | Emission factors to be updated as a result of the implementation of activities of the National Forest Inventory and the rice and livestock consultancy. |
| Data unit: | Depends on the factor |
| Data source or measurement/calculation methods and procedures to be applied (e.g., field measurements, remotely sensed data, national data, official statistics, IPCC Guidelines, trade and scientific literature), including spatial level of data (local, regional, national, international). | • National Forest Inventory<br>• Non-forest Inventory<br>• Rice and Livestock Consulting |
| Value fixed or monitored? If monitored, frequency of monitoring/recording: | Monitored according to the update frequency of the National Forest Inventory.<br>Fixed values obtained from rice and livestock consultancy |
| Quality assurance/quality control procedures to be applied: | The quality processes are listed in the Standard Operating Procedure of the National Forest Inventory available in |

| | |
|---|---|
| | http://documentacion.ideam.gov.co/openbiblio/bvirtual/023785/Manual.pdf |
| **Identification of the sources of uncertainty for this parameter following the approaches of the most recent IPCC guidance and guidelines.** | Data collection, data processing and calculation of emission factors. |
| **Process for managing and reducing the uncertainty associated with this parameter.** | Processes to reduce uncertainty are listed in the Standard Operating Procedure for the National Forest Inventory available in http://documentacion.ideam.gov.co/openbiblio/bvirtual/023785/Manual.pdf |

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