

BBVA

Research

The forest, a lever for sustainable development in Colombia*

J. Julián Cubero, Nara González, Rafael Ortiz, Diego Pérez, Alejandro Reyes, Juana Téllez

October 2024

* We appreciate the space for discussion with the teams of Asobancaria, Asocarbono, Verra, Allcot, Conservation International and the different areas of BBVA Colombia, Spain and Mexico.

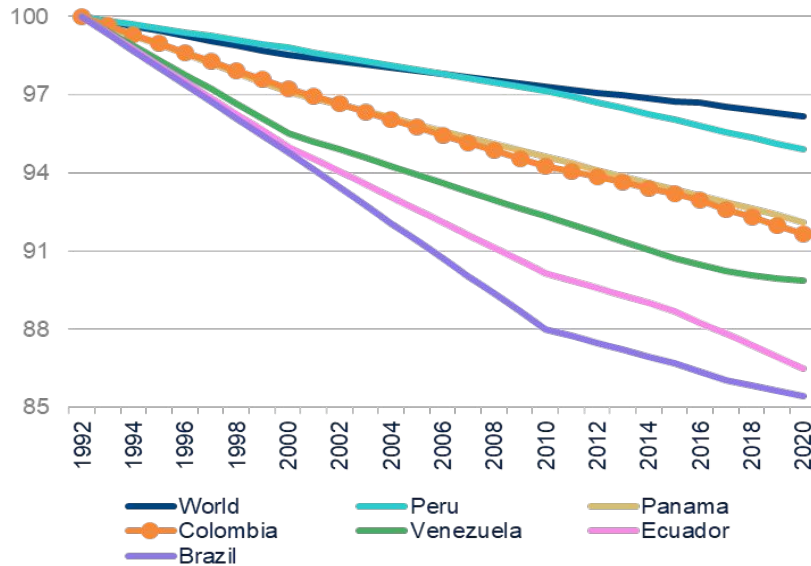
01

Unsustainable deforestation

Forest area has decreased by 9% in Colombia since 1990, averaged over its geographic area.

FOREST AREA

(% OF TERRITORY, INDEX 1992 = 100)

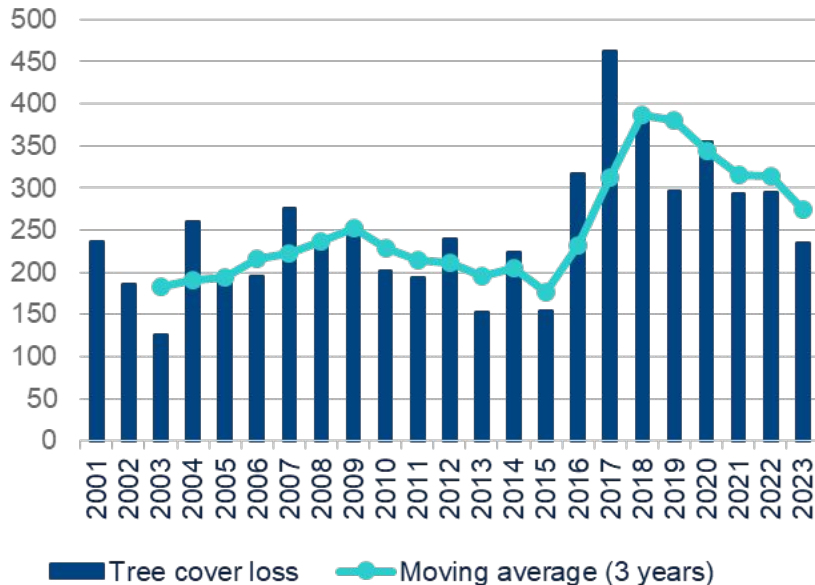


- The **forest** area occupies 53% of the Colombian territory, **9% less than in 1990**.
- The decline in forest area is **common in the region**, ranging from **5% in Peru** to about **15% in Ecuador and Brazil**.
- For Colombia since 1990, **this represents a total area of 6.0 million hectares**, very close to the size of the department of Antioquia or a little more than a country the size of Croatia.

Deforestation in Colombia has averaged 250,000 hectares per year in the last 23 years

LOSS OF TREE COVER (*)

(2001-2023, THOUSANDS OF HECTARES PER YEAR)



(*) "Loss" denotes the removal or mortality of tree cover and can be due to a variety of factors, including mechanical harvesting, fire, disease, or storm damage. So "loss" does not equate to deforestation.¹

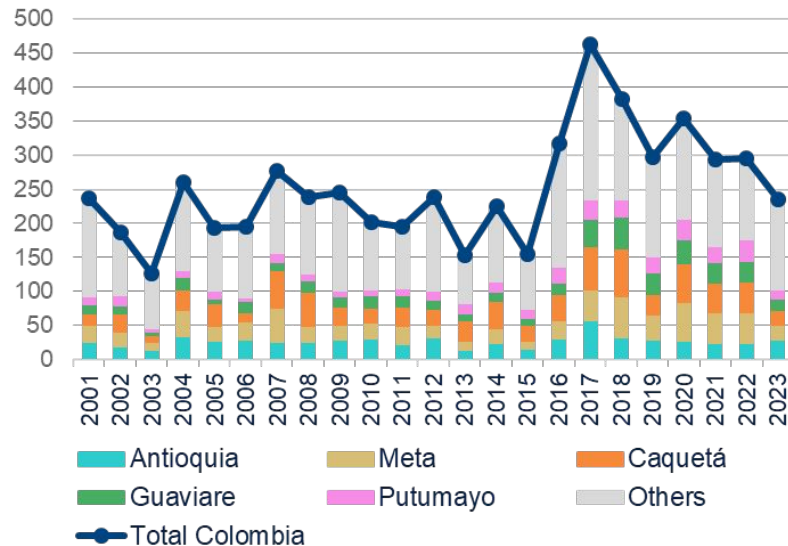
Source: BBVA Research based on Hansen/UMD/Google/USGS/NASA.

- **Deforestation in Colombia** in the last 23 years averaged **250 thousand hectares per year**.
- Since **2016** there has been a **strong spike in the deforested area**, linked on the one hand to improvements in the measurement of tree area, common to other countries, but there may also be an impact of the peace agreement between the Colombian government and the FARC-EP.
- **Recent downward trend**, although levels in 2023 remain comparatively elevated.

50% of the loss of forest area is concentrated in five departments: Caquetá, Antioquia, Meta, Guaviare, and Putumayo

LOSS OF TREE COVER (*) DEPARTMENTS WITH THE HIGHEST FOREST LOSSES

(2001-2023, THOUSANDS OF HECTARES PER YEAR)

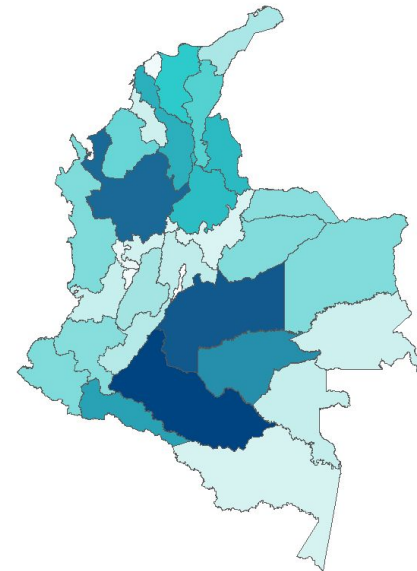


(*) "Loss" denotes the removal or mortality of tree cover and can be due to a variety of factors, including mechanical harvesting, fire, disease, or storm damage. So "loss" does not equate to deforestation.¹

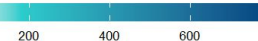
Source: BBVA Research, based on Hansen/UMD/Google/USGS/NASA.

LOSS OF TREE COVER

(THOUSANDS OF HECTARES - CUMULATIVE 2001 - 2023)



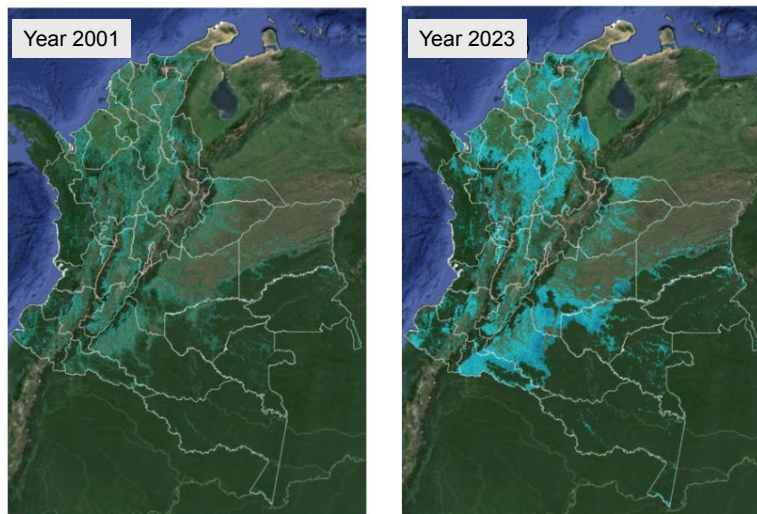
Thousand hectares



Source: BBVA Research, based on Hansen/UMD/Google/USGS/NASA.

The deforestation frontier advances from areas with better connectivity to more isolated ones, threatening virgin forests

CUMULATIVE TREE COVER LOSS (2001 AND 2023)



- At the beginning of the century, deforestation in Colombia was concentrated in areas closer to **production centers**.
- However, as the years go by, this deforestation begins to expand **to more remote areas**.
- Recently, **deforestation is now reaching the borders of rainforest** areas such as the Colombian Amazon.

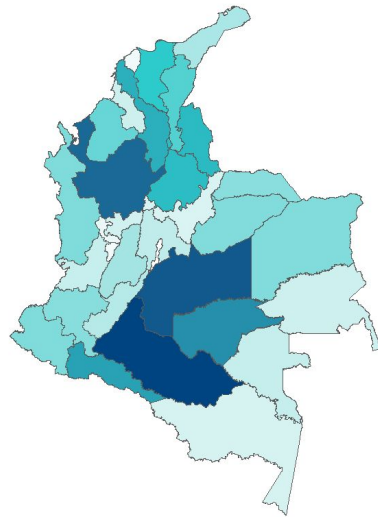
Note: "Loss" denotes the removal or mortality of tree cover and can be due to a variety of factors, including mechanical harvesting, fire, disease, or storm damage. So "loss" does not equate to deforestation.

Source: BBVA Research based on Hansen/UMD/Google/USGS/NASA.

The main causes of deforestation, which are unevenly distributed in the territory, are livestock and itinerant agriculture

LOSS OF TREE COVER

(THOUSANDS OF HECTARES - CUMULATIVE 2001 - 2023)



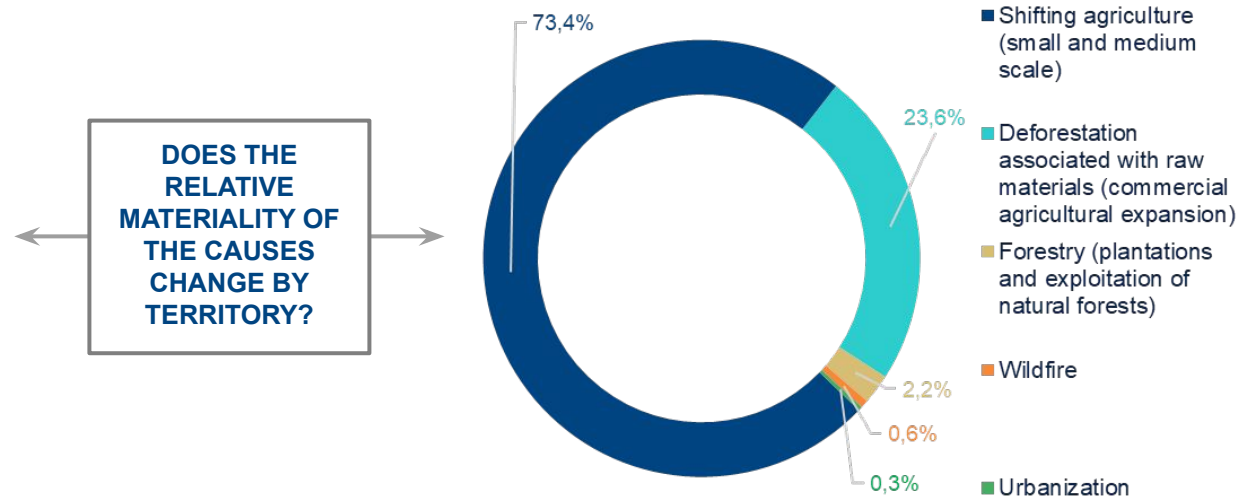
Thousand hectares



Source: BBVA Research based on Hansen/UMD/Google/USGS/NASA.

TREE COVER LOSS, BY CAUSE

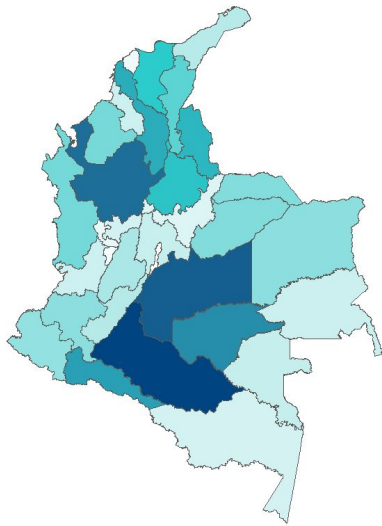
(% OF TOTAL IN PERIOD 2001-2023, COLOMBIA)



Source: Curtis et al. (2018)

The importance of the agricultural and mining sectors, and illicit crops is also unevenly distributed throughout the territory

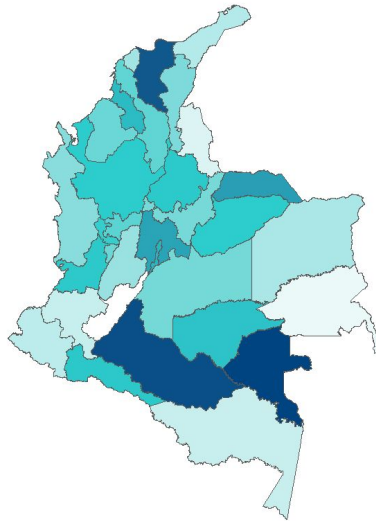
LOSS OF TREE COVER
(THOUSANDS OF HECTARES
2006-2023, CUMULATIVE)



Thousand hectares
0 200 400 600

Source: BBVA Research with Hansen/UMD/Google/USGS/NASA data

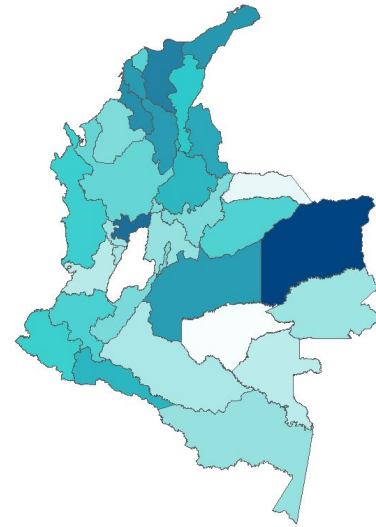
AVG. GROWTH GDP AGRICULTURAL SECTOR
(%, 2006-2023)



% 0 2 4 6

Source: BBVA Research with data from DANE

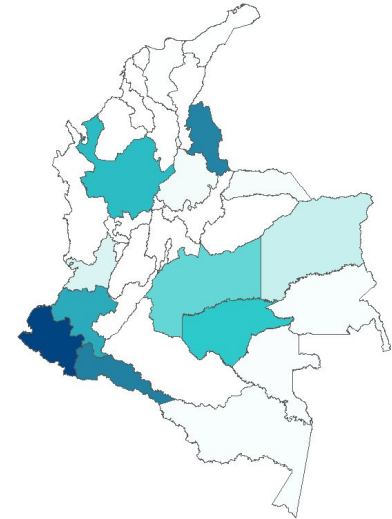
AVG. GROWTH GDP MINING SECTOR
(%, 2006-2023)



% 0 5 10 15

Source: BBVA Research with data from DANE

ILLICIT CROPS
(THOUSANDS OF HECTARES,
AVERAGE 2006-2022)

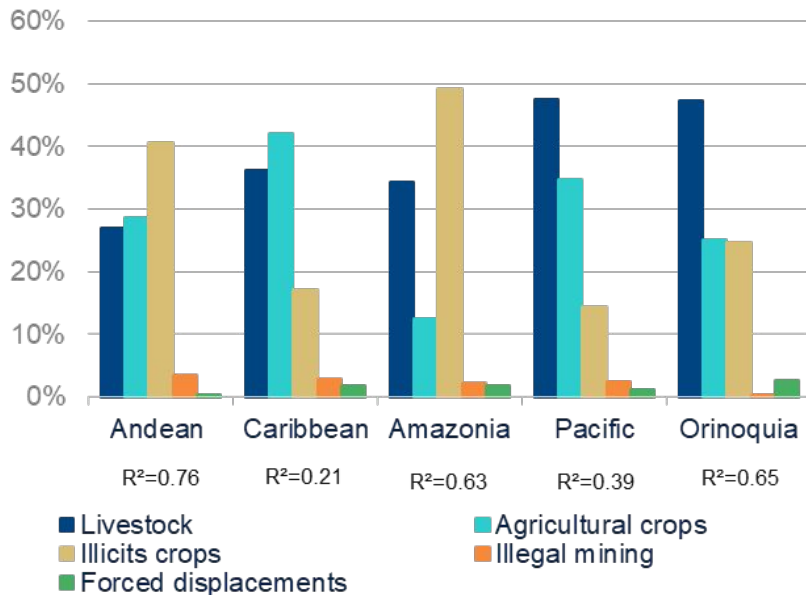


Thousand hectares
0 10 20

Source: BBVA Research with data from the Colombian Drug Observatory (ODC),

A statistical analysis of the classification of the causes of deforestation estimates the varying significance across regions...

XGBOOST(*) ANALYSIS AT THE REGIONAL LEVEL, 2006-2023. (% EXPLAINED VARIANCE)



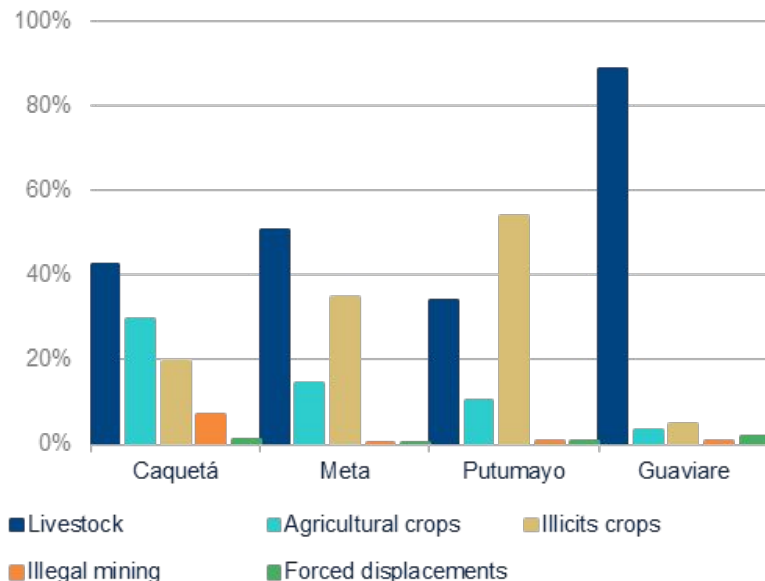
- Although the expansion of the agrarian and livestock boundary and illicit crops stand out as the main causes of deforestation, their **relative position varies by region.**
- In the **Amazon(**)** and the **Andean region**, illicit crops are the most important explanatory factors, while in the **Caribbean**, the **Pacific** or the **Orinoco** regions, agricultural crops and livestock dominate.
- (**) Detailed conclusions may be affected by the availability of data, which is scarcer e.g. in the Amazon.



Unsustainable deforestation | How to reverse deforestation

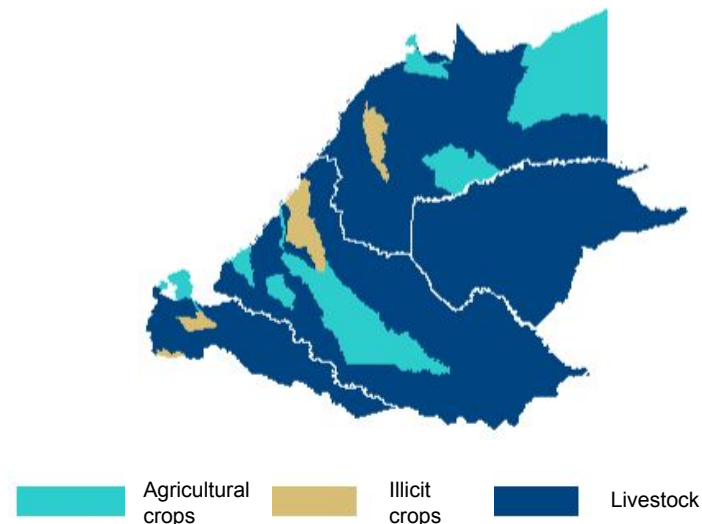
... and by departments and municipalities: in the Amazon arc, were 40% of Colombian deforestation occurs, the different relative relevance is confirmed

XGBOOST ANALYSIS AMAZON ARC DEPARTMENTS, 2006-2023. (% EXPLAINED VARIANCE)



Source: BBVA Research.

AMAZON ARC 2006-2023 (MAIN CAUSE(*) OF DEFORESTATION AT THE MUNICIPAL LEVEL)



(*) Higher percentage of explained variance.

More details in XGBoost methodology and national municipal map.

Source: BBVA Research.

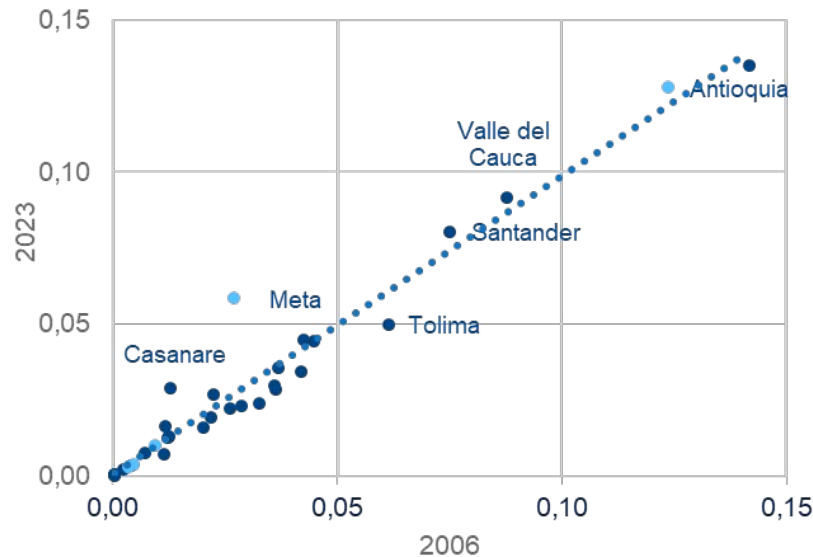
View Details



Is deforestation worthwhile? Greater weight of agricultural activity, without a pattern in the convergence of per capita GDP across departments ...

DEPARTMENTAL CONTRIBUTION TO NATIONAL AGRICULTURAL GDP

(2006 VS. 2023)

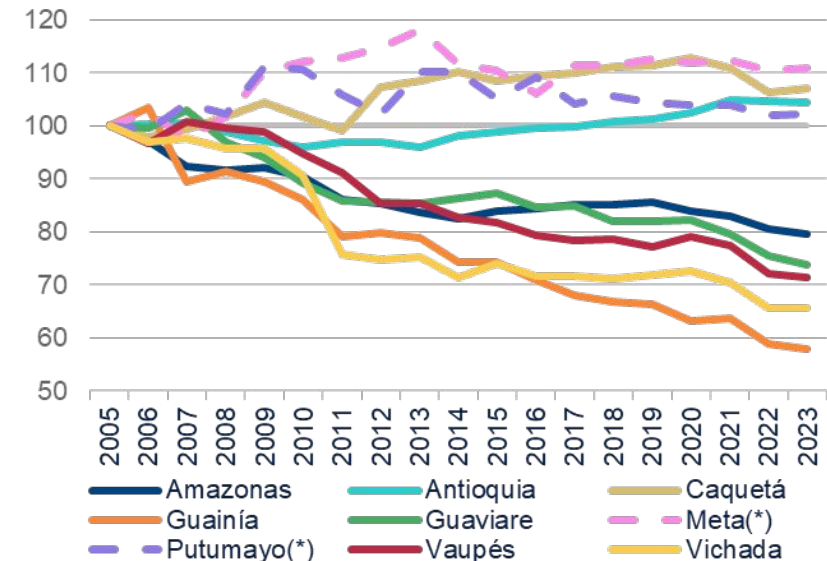


Note: in light blue, the departments with the highest deforestation (Caquetá, Meta, Antioquia, Guaviare and Putumayo) stand out.

Source: BBVA Research based on DANE data.

DEPARTMENTAL GDP PER CAPITA/ NATIONAL GDP PER CAPITA

(CONSTANT PRICES 2015, 2005=100)

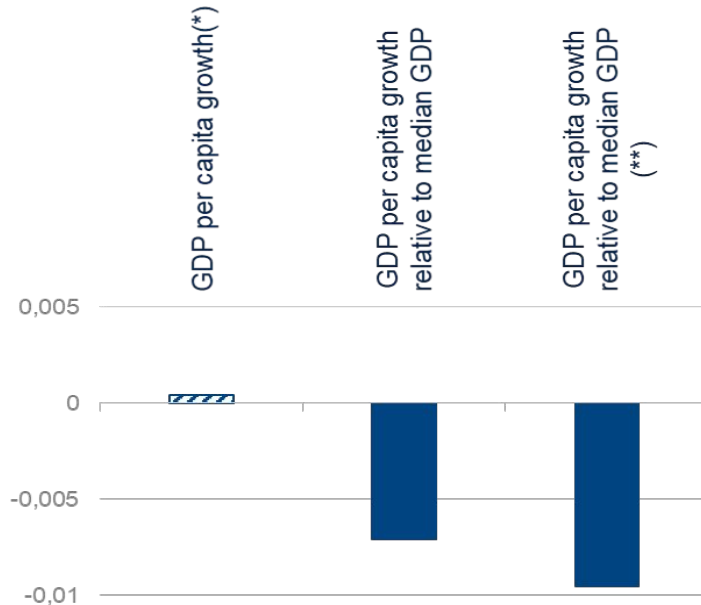


(*) Meta and Putumayo exclude GDP from the Mining and Quarrying sector.

Source: BBVA Research based on DANE data.

... but with statistical evidence of the drag of deforestation on the convergence of municipal per capita GDP, which is more severe in poorer municipalities

RESPONSE TO DEFORESTATION OF PER CAPITA GDP AND PER CAPITA GDP AT THE MUNICIPAL LEVEL (***)



(*) Not significant.

(**) Restricting for municipalities with a GDP per capita below the 75th percentile.

Source: BBVA Research.

The results of an Error Correction Model (ECM) for a municipal panel, 2011-2022 (***)

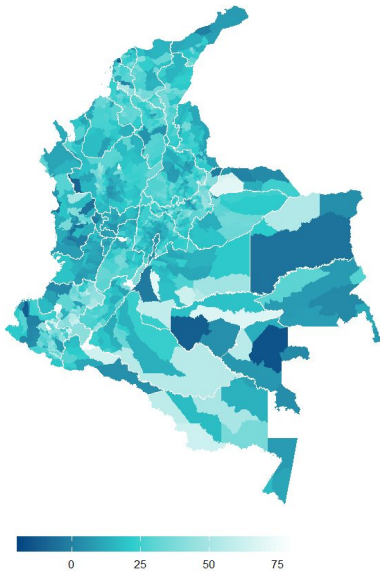
- **Deforestation does not help explain the variation in per capita income** (it is not significant).
- **Deforestation slows down the convergence of municipal per capita GDP** with respect to the national median.
- The **negative effect of deforestation is higher** when the **richest** (usually urban) municipalities **are excluded** from the sample.

(***) More details in ECM analysis



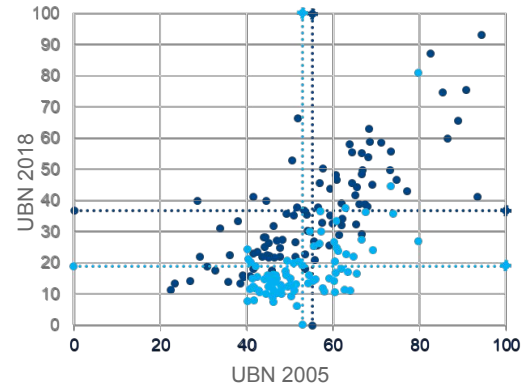
Deforestation also does not seem to be favourable to poverty reduction

CHANGE BETWEEN 2005 AND 2018 IN THE INDICATOR OF UNSATISFIED BASIC NEEDS -UBN- (PERCENTAGE POINTS)



Source: BBVA Research with data from DANE.

UBN COMPARED BETWEEN MUNICIPALITIES WITH HIGH AND LOW DEFORESTATION (PERCENTAGE POINTS)



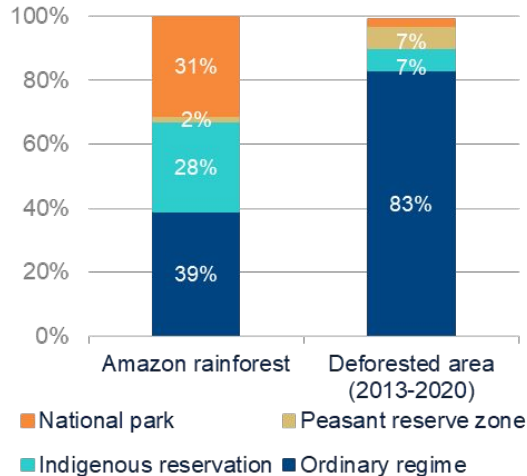
- Municipalities with 10% highest deforestation in 2018
- Municipalities with 10% lower deforestation in 2018 and a similar UBN average in 2005 as those with the highest deforestation

Source: BBVA Research, with data from DANE

- Between 2005 and 2018, the country has made significant **progress in unsatisfied basic needs**, with an improvement of 5pp in the national total, but with an improvement of 22.7pp in the simple mean at the municipal level.
- However, a comparison between the municipalities with the highest deforestation and those with the lowest deforestation with similar Unsatisfied Basic Needs (UBN) indices for 2005 shows that **improvements in social conditions have been greater in municipalities without deforestation.**

Are protected areas effective in preventing or mitigating deforestation? Relatively, the stricter ones are more effective.

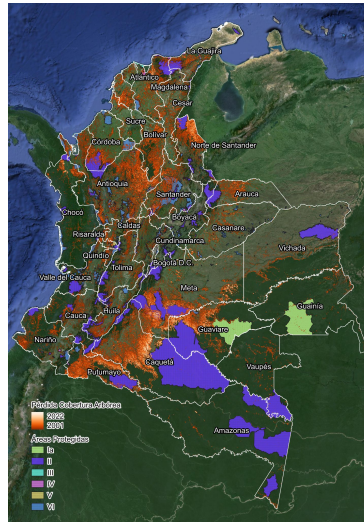
DEFORESTATION IN CGP(*) BY AREA AND LAND TENURE REGIME (% OF AREA)



Source: BBVA Research, based on Mirar el bosque más allá de sus árboles - Una estrategia para frenar la deforestación y avanzar en una prosperidad compartida en la Amazonía colombiana HKS, 2023.

(*): CGP corresponds to Caquetá, Guaviare and Putumayo.

CUMULATIVE TREE COVER LOSS AND PROTECTED AREAS (2001 - 2022)



Source: BBVA Research based on Hansen/UMD/Google/USGS/NASA and the National Land Agency (ANT).

Note: Indigenous Reservations Formalized until February 2024.

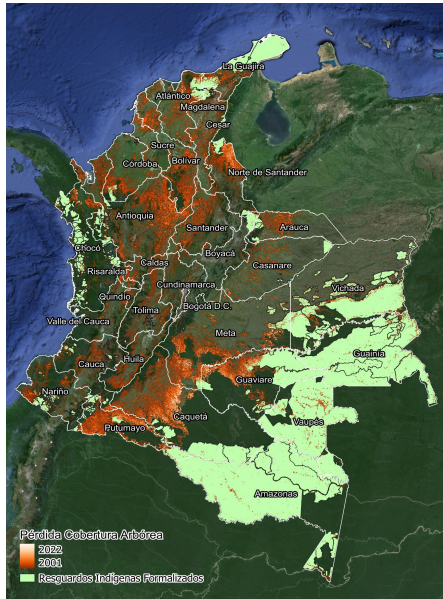
- A **stricter land tenure regime** correlates with **less deforestation**.
- **Deforestation** within protected areas and in surrounding areas has **accelerated** since the signing of the **Peace Agreement (2016)**.
 - Deforestation in National Parks and Natural Reserves (PNN, RNN) increased by 177% comparing the three years prior to the Peace Agreement (2013, 2014 and 2015) with the three years after (2016, 2017 and 2018). This demonstrates the **inability to safeguard areas that were “protected” by the conflict** (Clerici et al., 2020).

View Details



What about the indigenous reservations? They are relatively less at risk, although their economic isolation may also be helping

CUMULATIVE TREE COVER LOSS AND INDIGENOUS RESERVATIONS (2001 - 2023)



- **Indigenous protected areas and natural parks** do not allow the titling or alienation of land from future occupants, which **limits, at least legally, the settlement of lands**, especially for the purpose of their commercial use.
- Despite this, the **control of these areas is complex** and, especially on their border, there is a **latent** vulnerability with the expansion of deforestation.

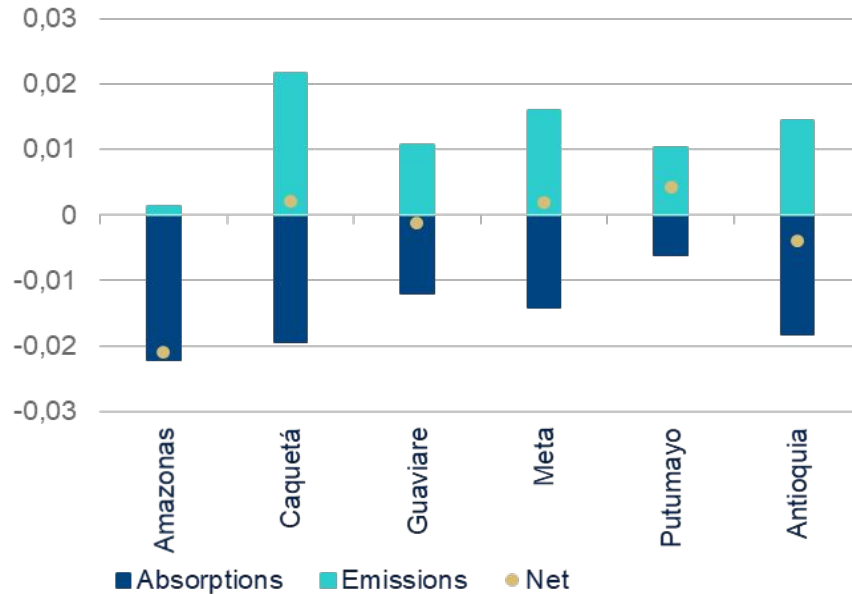
Source: BBVA Research based on Hansen/UMD/Google/USGS/NASA and the National Land Agency (ANT).

Note: Indigenous Reservations Formalized until February 2024.

Deforestation destroys the carbon capture and storage capacity of forests

ANNUAL AVERAGE OF FOREST CARBON FLOWS (*)

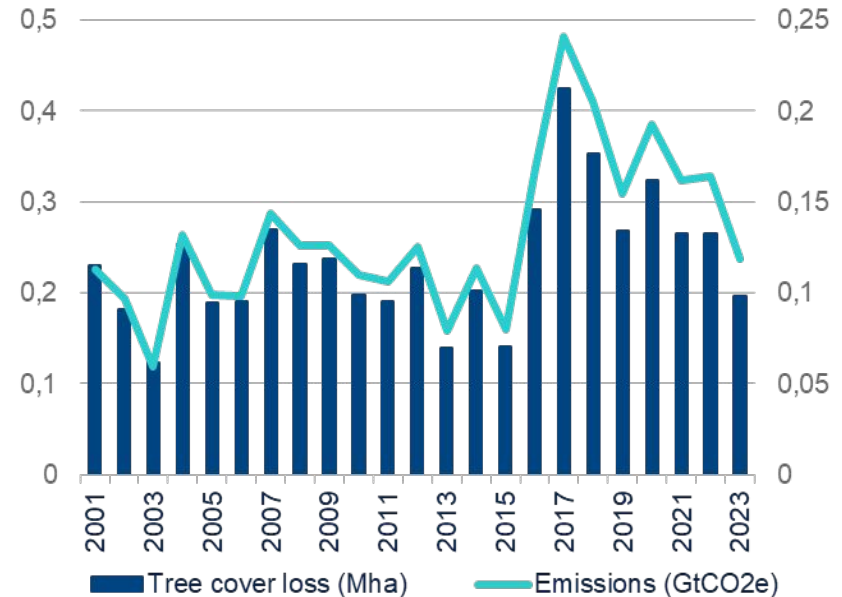
(2001-2023; GtCO₂e)



Source: BBVA Research based on Harris et al. (2021)

(*) Emissions, removals and net flow reflect the annual average over the modeled period. Emissions arise from stand replacement disturbances while removals occur where the forest was preserved or expanded.

LOSS OF TREE COVER AND INCREASE IN EMISSIONS (MILLIONS OF HECTARES AND GT OF CO₂e)

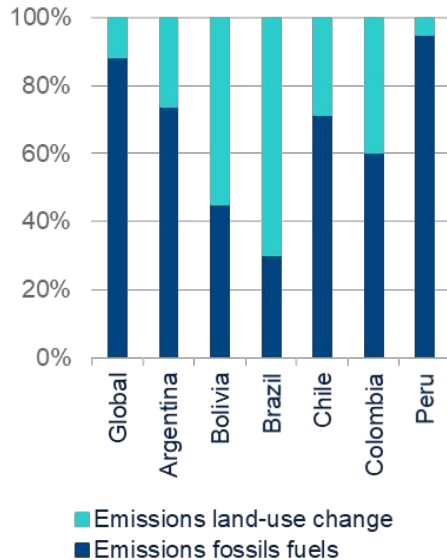


Source: BBVA Research based on Harris et al. (2021)

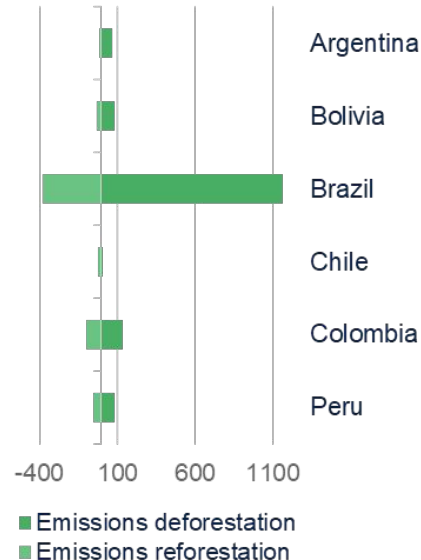
Note: Loss of tree cover on the left axis and emissions on the right axis. "Loss" does not equal deforestation.

Forests and GHG emissions: Loss of tree area increases emissions, especially in developing economies

CO2 EMISSIONS FROM FUELS AND LAND USE CHANGE
(%, AVERAGE 2013-2022)



CO2 EMISSIONS (DEFORESTATION/REFORESTATION)
(MILLION TONS, AVERAGE 2013-2022)



- **Carbon emissions from combustion and land-use change.** 90% of global carbon emissions come from fossil fuels, and the remaining 10% from land-use change, including forests.
- **Increased significance of emissions from deforestation in developing economies.** In developing economies, with a smaller fossil combustion footprint, emissions from land-use change have greater importance.
- **Net deforestation accounts for about 50% of Brazil's carbon emissions and 30% of Colombia's.**

02

How to reverse deforestation?

Multiple sides to address the problem of deforestation:

Review of the land tenure and use regime, incentive for commercial operation and assignment of value to natural assets

Land ownership and land use regimes

A structural review of the land ownership regime is required, including its geographical and economic delimitation, the safeguarding of protected areas and a greater presence of the State.

Productive exploitation of designated areas

It is necessary to build capacities and increase the productivity of the areas that are to be designated as spaces for economic exploitation. This includes investment in public goods and infrastructure, connectivity, increasing productivity per hectare.

Value of natural assets

A real and competitive value must be assigned to natural assets to avoid them being plundered and subject to the tragedy of the commons. This can be achieved, among other ways, through carbon markets.

This is a shared responsibility, with a special role for government in the reformulation of the legal framework, the development of the regulatory framework, and the deployment of public policies. But it requires support from the private sector and therefore efficient incentives.

Land ownership and use regime

Strengthening land tenure rights, delimiting land use and effectively designating protected areas

Clarity in ownership, geographical delimitation and economic use of protected lands

- **Reforming and strengthening the land tenure regime to protect forest areas.** Clear legal status, which prevents future land grabbing, explicitly prohibiting activities that encourage deforestation.
 - **Accelerate the multipurpose cadastre with prioritization of forest areas, to ascertain their use and status.**
 - **Delimiting,** beyond the current areas of natural parks and indigenous reservations, the **protected areas with their limited use policies.**
 - **Reviewing land claiming** laws; currently with biased incentives for settlement that do not protect forest areas.
- **Increase the efficient presence of the State in protected** areas. With the aim of deterring the advance of deforestation, guaranteeing land ownership and especially limiting its exploitation for unauthorized purposes.
 - **Strengthening and expanding forest ranger programs** (local population employed in the protection of protected areas)
 - **Forming units for the defense of protected areas** (police or military forces)
 - **Increase the presence of State institutions** (access to the most relevant institutions in land, the environment and the legal system that allows an expeditious development of the control mechanisms of these areas).

Supporting environmentally responsible development in protected areas

Support the development of activities that do not threaten the conservation of protected areas but improve the welfare of local communities

Definition of activities related to the protection of forest areas

- **Capacity-building for creating endogenous value in areas designated for protection.** Search for alternatives to agricultural or mining production to generate sustenance for the populations within the protected areas.
 - **Developing responsible tourism and ecotourism programs.** Assistance is needed in training and infrastructure, as well as interconnection capabilities that ensure the protection of the protected areas.
 - **Ranger programs.** Strengthening the ranger program with support to the communities of protected regions and creating awareness of the conservation and value of natural assets.
 - **Research programs.** Supporting research programs aimed at identifying, mapping and providing knowledge on the natural resources of the protected areas.
 - **Responsible and limited crops.** Supporting and delimiting processes and spaces to develop crops that are sustainable and meet the needs of protected regions but can also eventually establish commercial processes without threat to the environment.

Productive utilization of the areas designated for economic exploitation

Create an enabling environment to make areas designated for economic exploitation more productive, limiting the extensive use of resources

Public policies aimed at increasing the productivity of areas

- **Focusing on increasing the productivity of areas designated for traditional economic utilization.** Public and private sector partnerships are needed to boost the regional economy.
 - **Developing infrastructure projects in areas of economic activity.** Developing irrigation districts, transport routes (local), collection centers.
 - **Supporting channels for distribution and marketing of products.** Development of direct purchase schemes avoiding intermediations. This is enhanced with an adequate infrastructure and logistics for transport.
 - **Increase in social infrastructure.** Investment and improvements in education, health, justice, security, institutions that improve the living conditions and development capacities of the beneficiary populations.
- **Increase in resources to finance activity and risk mitigation.** Programs are needed to increase the flow of resources to productive activities in these areas. However, it is essential to limit the risks at the outset of the development of these projects in order to achieve a critical mass of activity and resources.
 - **Development of risk mitigation programs.** They can be deployed through existing guarantee mechanisms or through the creation of insurance policies that group activities and regions to mitigate the concentration of risks.
 - **Incentives to grant credits in agricultural development zones and low-interest loans with government support.** To achieve the required scale, programs can be established that encourage lending or that have support or subsidies from government in terms of interest rate or principal.

Value of the natural asset:

Carbon pricing mechanisms in Colombia have an uneven progress: Strategic ambition to be defined

Mechanisms for the assignment of economic value to natural resources

Carbon tax

In force
% of greenhouse gas emissions covered (12% to 14%) and price (USD5)



Voluntary Market (*)

In force
(*) in addition to other payments-for-results mechanisms, such as REDD+



PNCTE (ETS)

Legally created,
pending development

“... Currently, there is a **lack of vision on the role of carbon markets in meeting environmental objectives in climate change policy** and in the planning instruments of our country...”.

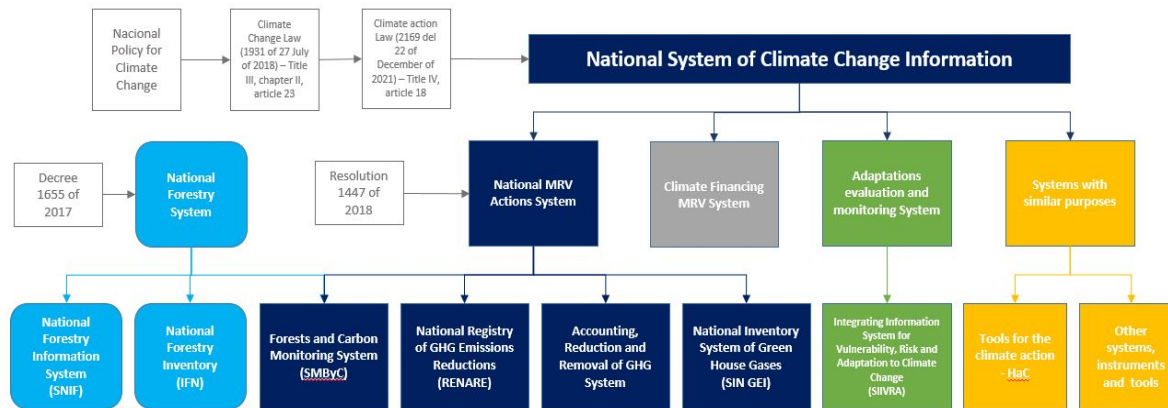
Source: Study Commission for the Promotion and Development of Carbon Markets in Colombia. Final Report, July 2023

In Colombia, a carbon tax coexists with an ETS pending implementation, a voluntary market whose dynamism depends domestically on the non-taxation of the tax and globally on governance/standards to be defined/improved, as in other mechanisms such as REDD+.

Value of natural assets

First stage: Measurement, accounting and institutionality. Colombia has created an institutional network that is apparently robust but is in reality complex and therefore ineffective

Environmental institutionality - emphasis on forestry issues in Colombia



COMPONENTS OF MRV (Monitoring, Reporting and Verification)

National System of Greenhouse Gas Inventories (SINGEI): **Not legally regulated**

National Registry for the Reduction of Greenhouse Gas Emissions (RENARE): **Limited progress due to technological and legal issues**

GHG Emission Reduction and Removal Accounting System (SCRR-GHG): **Under construction**

Forest and Carbon Monitoring System (SMByC): **Operational - with delays in information**

Mandatory Emissions Registry (ROE): **In the process of being regulated**

Value of natural assets

The voluntary carbon market is a mechanism to monetize the worth of the natural resource to co-finance the required developments and protections

Measures to strengthen carbon markets in Colombia

- **Establish regulations and implement the mechanisms for measurement, reporting, and verification.** It is necessary to implement the institutional framework created to monitor projects and protected areas.
 - Building upon a substantial improvement in the land tenure and use regime, the creation of sustainable projects with an emphasis on conservation but also with desirable social effects can be maximized.
- **Ensure quality standards of the credits issued** (certification and permanence of the capture, **additivity, without double counting**).
 - **Boost internationally** recognized standards: REDD+, VERRA, development of Article 6 of the Paris Agreement.
- **Assigning value to the natural asset allows it to be treated as a marketable product that expands the economic offer of protected areas.** It can represent a potential to generate income and resources for protected areas but also for the State to co-finance the economic and social needs of these areas. One strategy in this second point is the establishment of "royalties" that can take the form of remuneration in carbon bonds or money. However, this strategy must always be transparent to investors, without changes in the current rules (recommended for new projects).
- **Explore the establishment of a special natural asset focused on areas in the Amazon with no current threat of deforestation but potentially affected if the economic frontier advances.** Assigning value to these areas helps to reduce the risk of future deforestation but also serves to create resources to finance protection programs in these areas.

Possible sources of funding for forest protection

The funding sources don't just add up... in this case, they multiply

Resources from taxation

Carbon Tax: expand the collection base and amount to be charged for this tax.

Property tax: designation of a fraction of the tax for forest protection purposes

Multipurpose cadastre: updating the value of real estate assets will allow to increase resources that can generate less stress for a portion to be used for the protection of forests.

Resources from multilateral cooperation

Green funds: establish and strengthen cooperation funds for green purposes, defense of the forests.

Leverage biodiversity: the defense of tree cover in Colombia involves regions with high biodiversity density, unique species, and complex networks of animal and plant life.

Leverage social impact: the areas with the highest deforestation in Colombia also have serious social disparities.

Carbon market resources and emission allowances

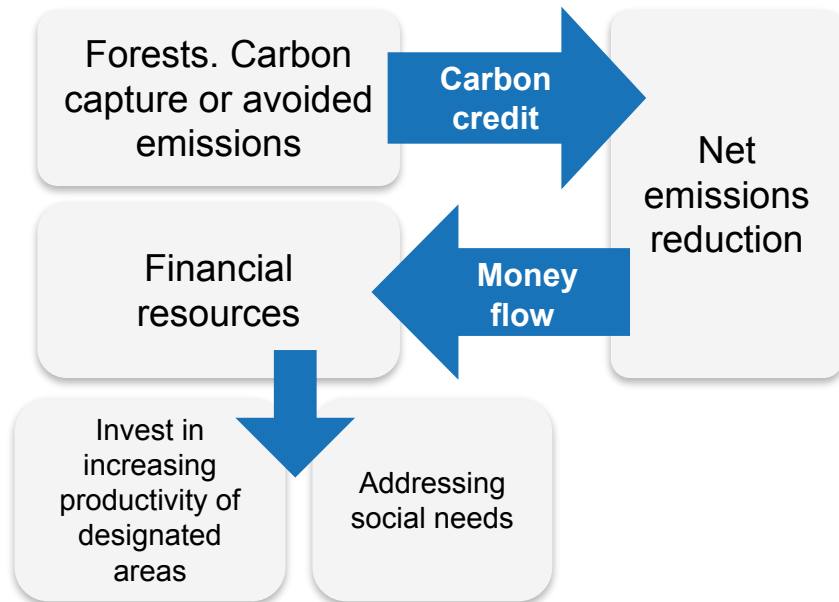
Regulate the emission allowances scheme: despite the existence of the mechanism, there is a lack of regulation; this will make it possible to give a signal to limit emissions.

Expand demand for carbon bonds: the current composition of activity in Colombia limits the need for broad carbon and quota markets, so fostering the required conditions to grow the external market for carbon credits may be the gateway to increase these resources.

Value of natural assets: forest-based carbon credits to channel investment that contributes to sustainable development

SUSTAINABLE FINANCING WITH CARBON CREDITS

(ASSETS: THE POSITIVE EXTERNALITY OF CARBON CAPTURE BY FORESTS; UNLIKE OTHER PROJECTS THAT MUST BE FINANCED, DO NOT GENERATE LIABILITIES).



CARBON CREDITS, A DIFFERENT SUSTAINABLE FINANCING

- Most climate finance, whether domestic, international, public or private, generates **financial liabilities**, generally with finance costs and repayment of the principal.
- **Carbon credits, activating forests.** Carbon credit revenues are a form of financing that rewards projects for the climate benefits they generate from assets whose services (positive externalities) are internalized.

The forest, a lever for sustainable development in Colombia



Deforestation in Colombia is environmentally and economically unsustainable



- Colombia loses between 200 and 300 thousand hectares of tree cover annually due to the expansion of agriculture, livestock and illegal activities. These causes have a widely varying impact across departments and at the municipal level.
- The destruction of forests is not sustainable from an environmental point of view, but neither is it economically or socially sustainable. Deforestation hinders the convergence of municipal per capita GDP, with an even more intense effect if relative income is lower. Deforestation also does not correlate with the improvement of basic needs indicators as a proxy for poverty. In fact, the opposite happens.

Levers to reverse deforestation



The levers for reversing deforestation must act to effectively protect the areas to be safeguarded and, at the same time, expand their opportunities for development

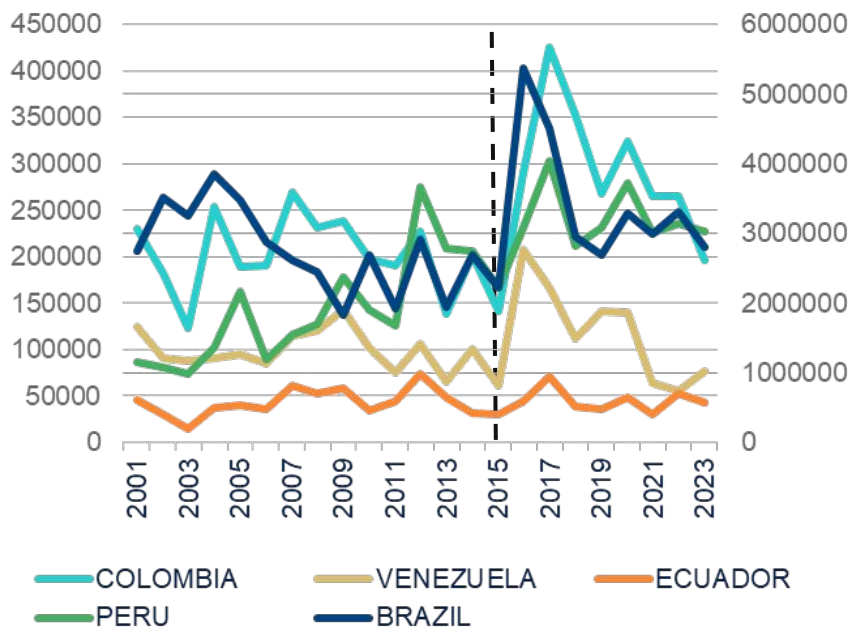


- Strengthening of the land tenure and use regime.
- Promotion of productive utilization as opposed to the current extensive farming.
- Internalization of the natural value of forests with projects that generate carbon credits and reward the protection of biodiversity.
- **The challenge.** Achieving projects with quality supply and sustained demand (and higher revenues) requires coordinated public policies and a long-term vision. The role of the authorities is decisive, defining the objective to be achieved (reversing deforestation, promoting development), aligning the multiple necessary policies and their financing, and providing certainty to economic and social agents.

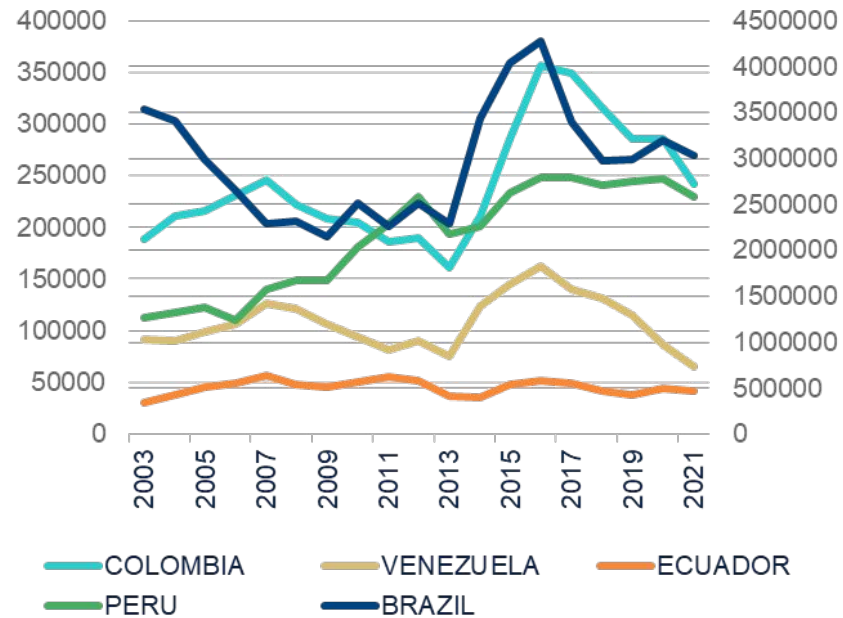


Trend in deforestation

LOSS OF TREE COVER, ha



LOSS OF TREE COVER 3-year moving average, ha

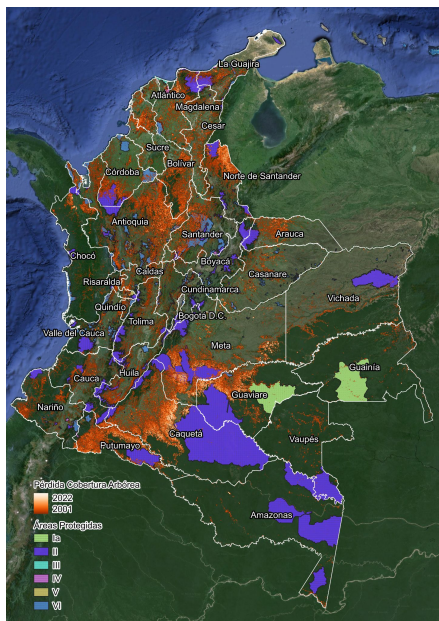


Source: BBVA Research with GFW.
Notes: Brazil on the right vertical axis.



Are protected areas effective?

CUMULATIVE TREE COVER LOSS AND PROTECTED AREAS (2001 - 2022)



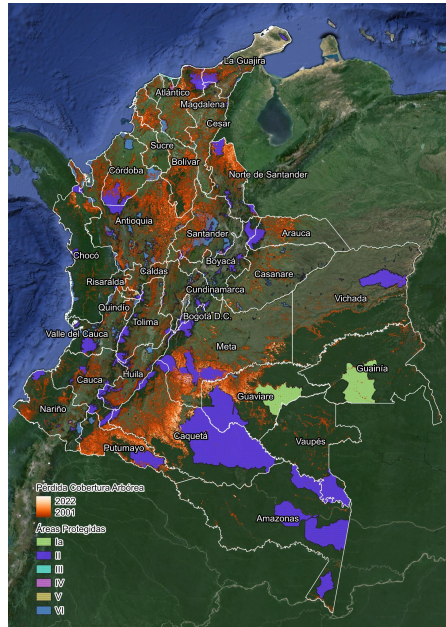
Protected Area Type	Description
Ia. Strict nature reserves	Preserve biodiversity and geological features, allowing very limited human intervention, such as for scientific studies. Monitored to understand the impact of indirect human disturbances.
Ib. Wilderness Areas	Areas to preserve ecological processes with limited human use. Modern infrastructure is not permitted, but indigenous communities can maintain subsistence lifestyles.
II. National parks	Preserve large ecosystems and promote conservation. Human visits allowed, infrastructure for recreation, and contribute to the local economy.
III. Monuments or national features	They protect natural features or monuments of historical, spiritual, or environmental significance. They are small areas with a high human impact due to tourism.
IV. Habitat and species management areas	Conservation of specific populations or habitats within larger ecosystems. Carefully managed (e.g. habitat restoration, hunting ban).
V. Protected landscapes and seascapes	Areas formed by human use that combine ecological protection with commercial activities (e.g. ecotourism). Covers entire land or sea bodies.
VI. Protected areas with sustainable use of resources	Areas for natural resource management and support for local livelihoods. Low level of human occupation and non-industrial development. Part of the landscape remains in a natural state.

Source: BBVA Research based on Hansen/UMD/Google/USGS/NASA and the National Land Agency (ANT).

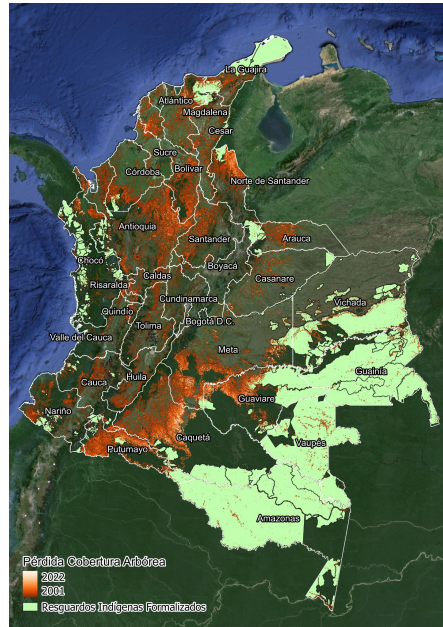
Note: Indigenous Reservations Formalized until February 2024.

Are protected areas effective?

CUMULATIVE TREE COVER LOSS AND PROTECTED AREAS (2001 - 2022)



LOSS OF FOREST COVER AND INDIGENOUS RESERVATIONS (2001 - 2022)



INDIGENOUS RESERVATIONS

Indigenous Reservations as a socio-political legal institution made up of a recognized territory of a community of Amerindian descent, with inalienable, imprescriptible and unseizable land title, collective or communal, governed by a special self-governing statute, with its own cultural patterns and traditions.



National and international experience: Active participation of local communities

YAEDA VALLEY PROJECT: >

The Hadzabe Tribe and Carbon Tanzania obtained a cession of ownership of a part of their native valley. In exchange for the protection of the valley, they were able to generate carbon credits that they sold together with Carbon Tanzania. This project has **generated \$350,000 for the tribe in 10 years**, and has made **deforestation in this area 20 times lower than** in the rest of the valley.

SURUI FOREST CARBON PROJECT: >

The Surui Tribes managed to launch a project in which they carried out activities related to environmental development. All the revenues they earned went to the Suruí fund, which was used to finance the economic development of the tribe. Its activities include the **sale of 250000 carbon credits**. Due to the project's connection to the tribe, the **market price was higher than average**. This project lasted 5 years, as diamond and gold mines were found on its territory in 2018.

KEY POINTS:

- **A legal** regime that avoids purposes other than **reducing deforestation and favoring local development**.
- According to some governments, such as Kenya, the **lack of financial** knowledge of tribes can be a problem.
- **Active** participation of local communities: the local **connection increases the demand for credit**.

National and international experience: The role of governments in previous experiences

ZAMBIA: >

The government intends to impose that 50% of revenue from voluntary markets go to the public treasury. Still, Zimbabwe would like to **negotiate revenue sharing** on a case-by-case basis.

ZIMBABWE: >

Zimbabwe went so far as to establish that 50% of the revenue would go to the government, and another 20% to local investors. When this measure was approved, the Minister of Information suggested the possibility of **declaring void all previous** contracts with a distribution of profit different from the one recently established, which caused great uncertainty among investors. Three months later they changed the proposal for the distribution of profits again.

POINTS TO HIGHLIGHT:

- **Regulatory certainty is key**, especially in those countries where the legal framework is more vulnerable to arbitrariness. Long-term commitments policy.
- The government has a key role to play in ensuring the **reinvestment of VCM revenues** in projects that seek **sustainable economic growth** for the country.

National and international experience: Successful social and environmental programs in Colombia

"CONSERVAR PAGA" PROGRAM: >

This program seeks to reduce deforestation by providing economic incentives to communities located in the Amazon rainforest to commit to the protection and conservation of forests. This program has managed to **reduce deforestation** by 61% between 2021 and 2023 in the areas prioritized for aid. By 2024, **the budget per family has trebled**, and the number of families benefiting has also increased. This measure shows the Colombian government's commitment to the conservation of the Amazon rainforest.

'VIDA MANGLAR' PROGRAM: >

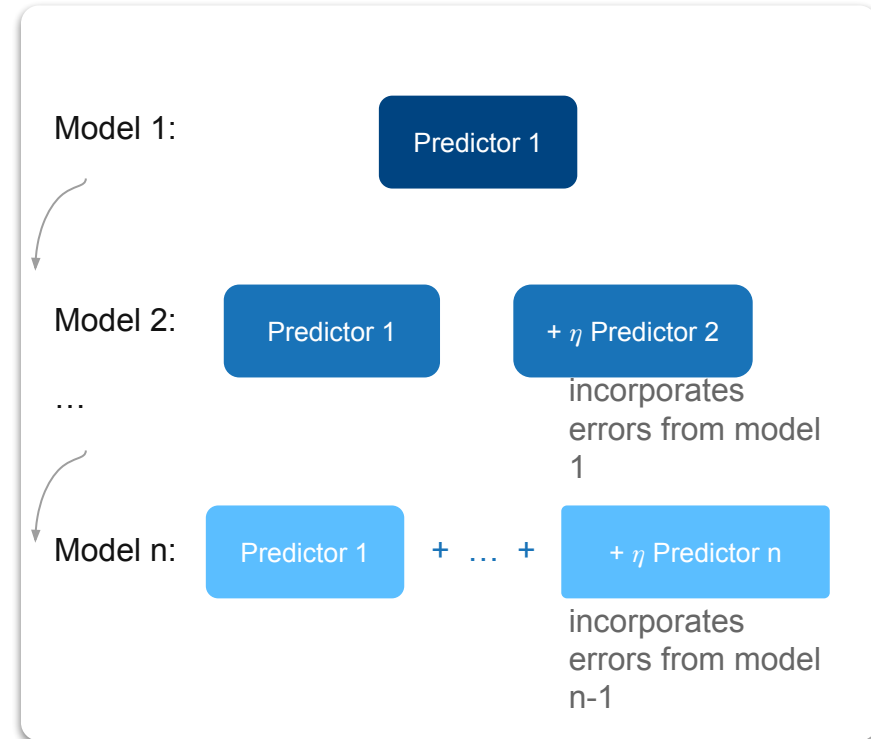
Mangroves are coastal ecosystems that have the characteristic that they capture on average more carbon than any other tree. In addition, they are highly valuable for local communities. To prevent deforestation, a **project based on carbon credits has been carried out**. In the first monitoring of the project, it has been observed that **unplanned deforestation has been reduced by 69%**, and it is expected that the **project will capture 1 million tons of carbon** in the next 30 years. Moreover, of revenues from carbon credits, **92% of the proceeds are returned to local communities**. This, together with the direct and indirect creation of employment, has managed to improve the living conditions of the locals.



The possible causes of deforestation. Methodology

Methodology: XGBoost

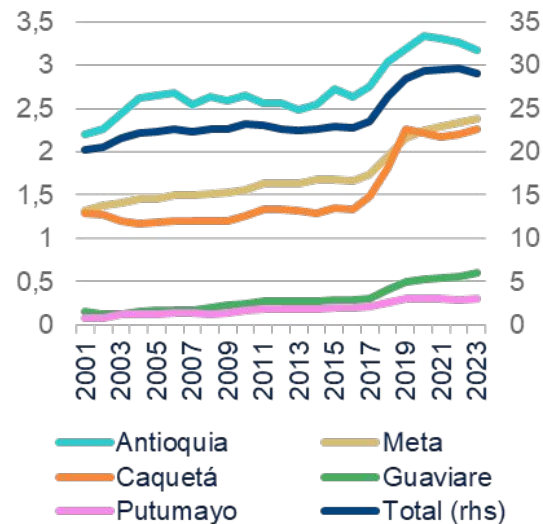
- Tree boosting is a machine learning method that improves prediction models through successive iterations. After each iteration, a new tree is added to the model to correct errors that the previous model could not predict correctly. The goal is to minimize loss.
- **XGBoost** is an efficient implementation of tree boosting that also prevents overfitting and allows researchers to handle missing values.
- Reference papers: [Ganzenmüller, Sylvester and Castro-Núñez \(2022\)](#). [Chen and Guestrin \(2016\)](#).



The possible causes of deforestation. Description of the variables

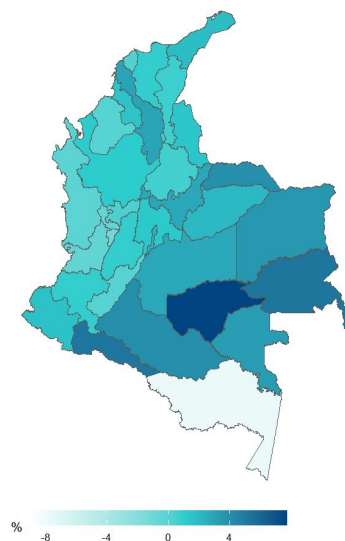
AGRICULTURAL FRONTIER

HEADCOUNT OF CATTLE AND BUFFALO (MILLION HEADS, 2001-2023)



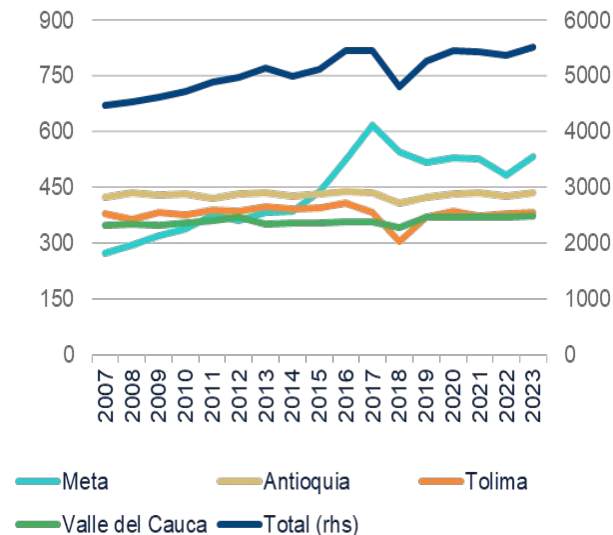
Source: BBVA Research with FEDEGAN data.
Note: The right axis corresponds to the total series for Colombia. Main regions - top5.

HEADCOUNT OF CATTLE AND BUFFALO (% , 2006-2023)



Note: Avg. growth of the cattle herd (% , 2006-2023).

AGRICULTURAL CROPS (THOUSANDS OF HECTARES, 2007-2023)

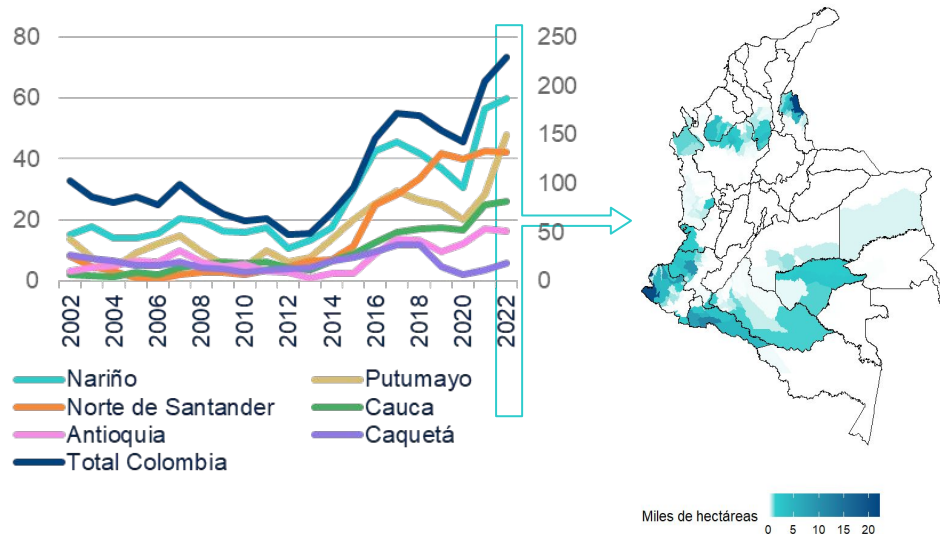


Source: BBVA Research with EVA data
Note: Change in the EVA 2007-2018 and EVA 2019-2023 series. Main regions - top4.

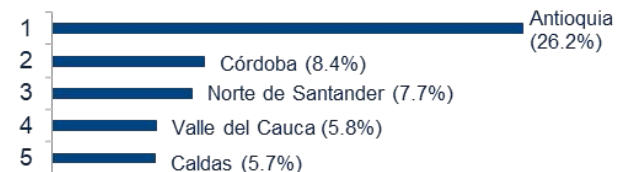
The possible causes of deforestation. Description of the variables

ILLICIT ACTIVITIES

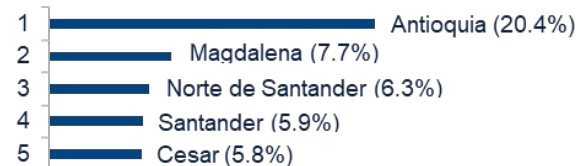
COCA CULTIVATION (THOUSANDS OF HECTARES)



ILLEGAL MINING (RANKING OF DEPARTMENTS, % TOTAL)



CASES OF FORCED DISPLACEMENT (RANKING OF DEPARTMENTS, % TOTAL)

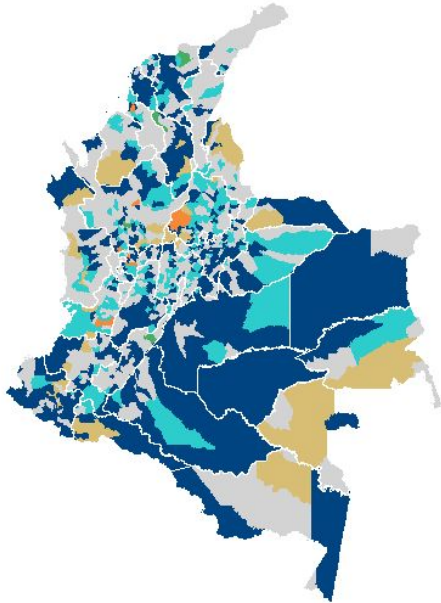


Source: BBVA Research with data from the Colombian Ministry of Justice and Law.
(*) The right axis corresponds to the total series for Colombia.

Source: BBVA Research, based on data from the Colombian Ministry of National Defense and the Observatorio de Memoria y Conflicto del Centro Nacional de Memoria Histórica.



The possible causes of deforestation. Grouping by municipalities



- The study has been replicated for all municipalities, including those in which a significant R squared is not obtained as a result of the lack of data on some variable(s) or, directly, due to an insignificant relative presence of deforestation.
- For example, the allocation of illicit crops as the most relevant cause of deforestation in municipalities in the Amazon may be due to a lack of data on other variables.



Is deforestation worthwhile? Deforestation helps to explain the lack of economic convergence at the municipal level

- Error Correction Model (ECM) for a municipal-level panel - annual, 2011-2022.
- This model allows us to differentiate between the short- and long-term effects of deforestation and other economic variables on municipal economic growth.
- Regression equation:

$$\Delta \text{GDPpc}_{it} = \alpha_i + \lambda(\text{GDPpc}_{it-1} - \sum_{j=1}^n \beta_j X_{jit}) + \sum_{j=1}^n \gamma_j \Delta X_{jit} + \epsilon_{it}$$
- Dependent variable: (1) municipal per capita GDP; (2) municipal per capita GDP with respect to the national median GDP; (3) same as (2) restricting the sample to the 75th percentile.

	(1) D.L.gdppc	(2) D.L.gdppc_median	(3) D.L.gdppc_median Percentile 75
D.L.deforestation	0.000424 (0.34)	-0.00706*** (-4.46)	-0.00955*** (-6.07)
D.L.primary_GVA	0.221*** (14.30)	0.196*** (13.93)	0.152*** (13.03)
D.L.secondary_tertiary_GVA	0.770*** (54.62)	0.362*** (18.38)	0.293*** (14.42)
D.L.violence_cases	-0.00683*** (-8.96)	-0.00722*** (-9.32)	-0.00837*** (-10.20)
L.Residuals	-0.175*** (-11.80)	-0.168*** (-12.36)	-0.320*** (-13.44)
Constant	-0.0124*** (-10.39)	-0.0500*** (-30.94)	-0.0416*** (-24.14)
Observations	12331	12331	9244
Adjusted R^2	0.731	0.534	0.566

t statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

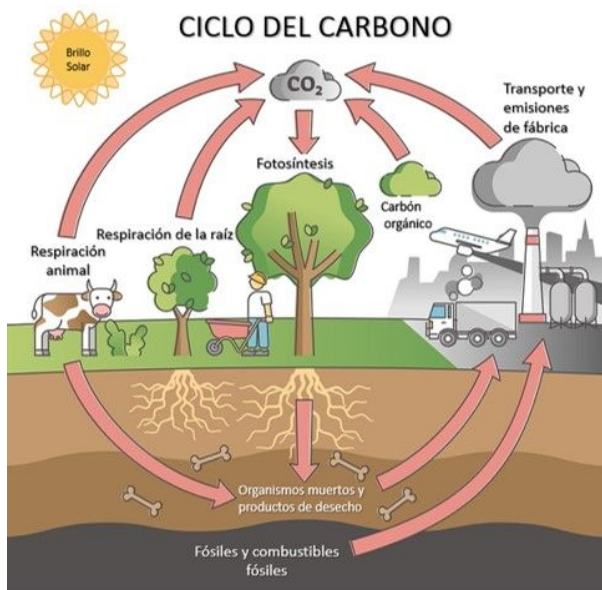


04

The carbon cycle, price and markets

Forest ecosystem services: carbon capture

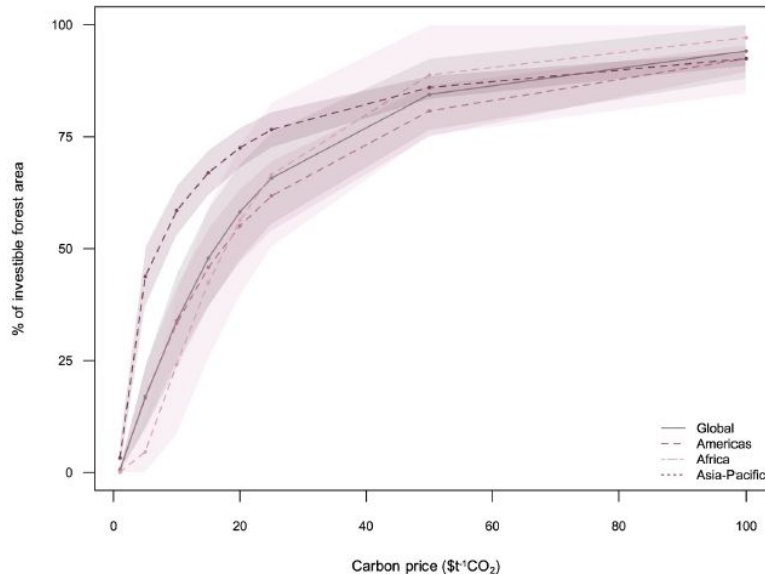
CARBON CYCLE



- Forests **capture and store carbon** from the atmosphere, contributing to **mitigating climate change and the impairment of ecosystem services** (support for the output of food or commodities, regulation of the water cycle and local temperature, biodiversity and tourism services).
- Internalize the positive externality.** Ecosystem services that do not generate monetary flows, in particular carbon capture and storage, are not accounted for.
- Carbon markets.** The establishment of carbon markets internalizes the positive externality of forests to mitigate climate change, contributing to their conservation by generating monetary flows that can facilitate social development and, at the very least, make transparent the cost of activities that depreciate natural capital and slow sustainable growth.

Carbon price: opportunity cost of deforestation, cost of reforestation

CARBON PRICING AND FINANCIAL VIABILITY OF FOREST CARBON SITES



Source: [Carbon prospecting in tropical forests for climate change mitigation | Nature Communications](#), taken from [Forest-based-carbon-markets-pitfalls-and-opportunities](#). The figure indicates the proportion of forest carbon that is financially viable. The shades around the lines represent confidence bands based on the standard deviation.

- **Carbon price, opportunity cost.** The price given to each tonne of CO₂ captured must cover the cost of alternative uses of the land occupied by the forest or that is intended to be occupied (opportunity cost compared to agriculture, livestock, mining, illegal activities), as well as its maintenance and future conservation.
- **Carbon trading.** The carbon captured by the forest is an asset that is demanded to offset emissions, generating monetary flows that internalize the positive externality of the forest
- **Carbon revenues for sustainability.** Proceeds from the sale of carbon rights are redistributed to help finance the transition to a socially and environmentally sustainable economy.

Carbon markets. Fundamentals

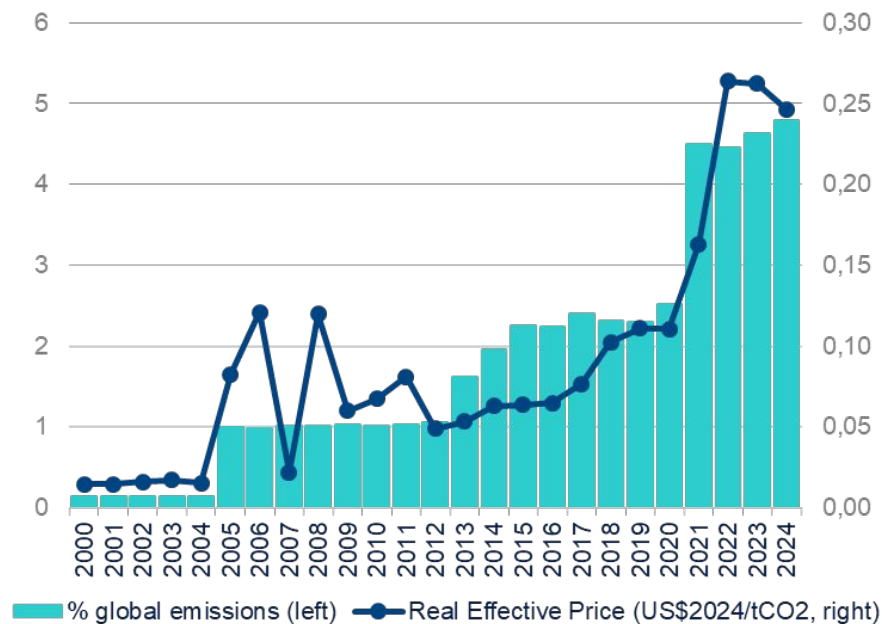
CARBON MARKETS

Type of Market	Mechanism	Issued Product
Compliance Carbon Markets (CCMs)	Cap-and-trade mechanism	Carbon emission allowances
	Baseline-and-credit mechanism	Carbon emission allowances
Voluntary Carbon Markets (VCMs)	Project-based mechanism	Reduction or Avoidance carbon credits Removal/Sequestration carbon credits.
Article 6.4 of the Paris Agreement	Project-based mechanism	Art.6.4 Emission Reductions (Art.6.4 ERs)
Clean Development Mechanism (CDM) ¹⁰	Project-based mechanism	Certified Emission Reductions (CERs) Credits

- **Carbon markets.** Markets trade emission rights or carbon credits captured or avoided, regulated by authorities or with voluntary agreements between supply and demand that define quality standards.

Carbon markets. Fundamentals

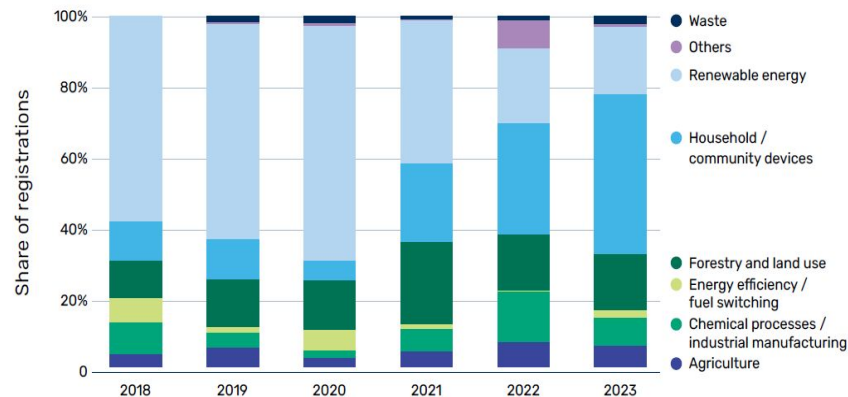
COMPLIANCE MARKETS. PERCENTAGE OF EMISSIONS COVERED AND ACTUAL CASH PRICE



- **Carbon markets.** Markets trade emission rights or carbon credits captured or avoided, regulated by authorities or with voluntary agreements between supply and demand that define quality standards.
- **Compliance markets.** Regulated by public authorities, tradable allowances are issued for a volume of emissions that is gradually reduced, incentivizing decarbonization.

Carbon markets. Fundamentals

CARBON CREDITS REGISTERED IN INDEPENDENT MECHANISMS (%)

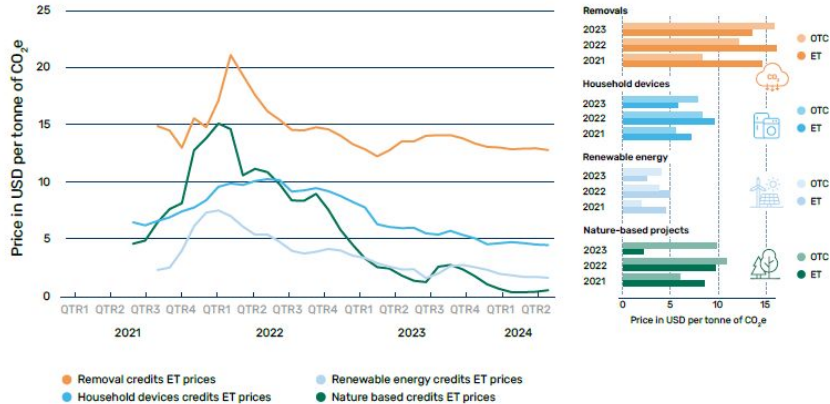


- **Carbon markets.** Markets trade emission rights or carbon credits captured or avoided, regulated by authorities or with voluntary agreements between supply and demand that define quality standards.
- **Compliance markets.** Regulated by public authorities, tradable allowances are issued for a volume of emissions that is gradually reduced, incentivizing decarbonization.
- **Voluntary markets/carbon credit markets.** Credits for carbon previously captured in different types of projects, which may or may not be discounted in compliance markets, are generally traded in voluntary markets.

Carbon markets. Fundamentals



CARBON CREDIT PRICES. STANDARDIZED AND OVER-THE-COUNTER MARKETS

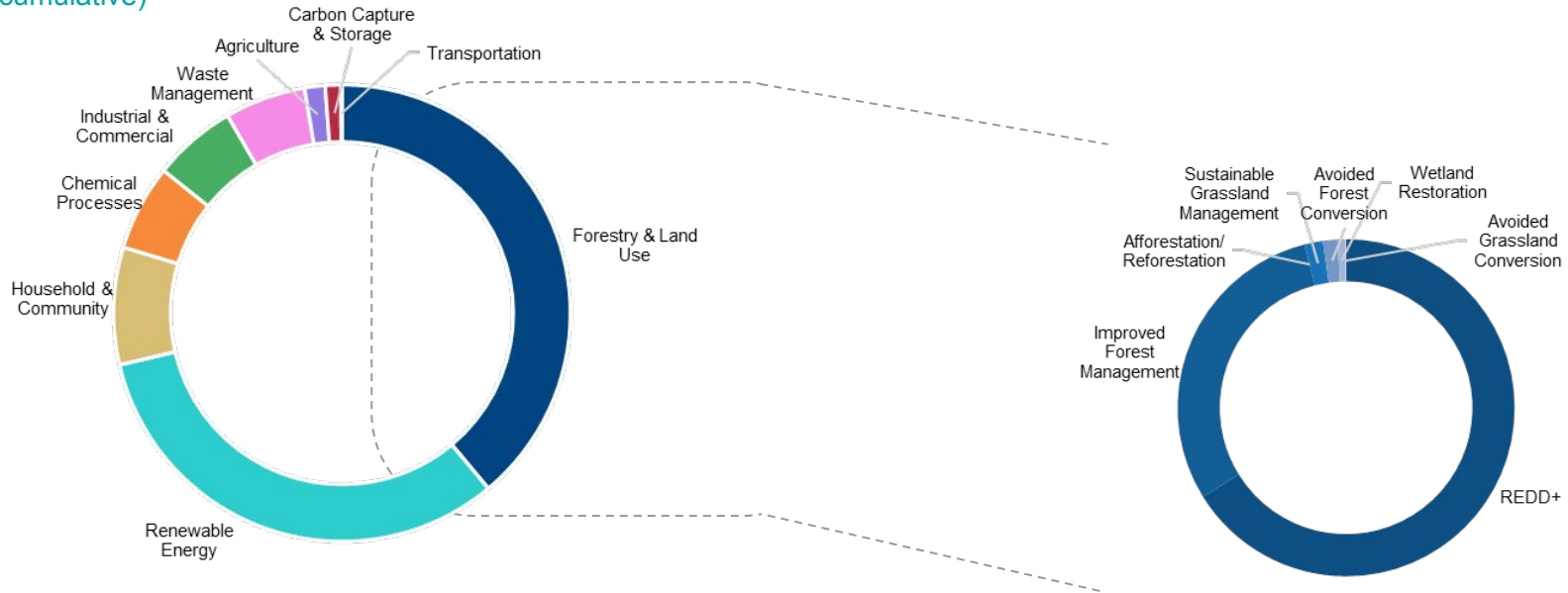


- **Carbon markets.** Markets trade emission rights or carbon credits captured or avoided, regulated by authorities or with voluntary agreements between supply and demand that define quality standards.
- **Compliance markets.** Regulated by public authorities, tradable allowances are issued for a volume of emissions that is gradually reduced, incentivizing decarbonization.
- **Voluntary markets/carbon credit markets.** Credits for carbon previously captured in different types of projects, which may or may not be discounted in compliance markets, are generally traded in voluntary markets.
- **Credit quality, demand incentives.** The development of voluntary/carbon credit markets depends on credit quality (integrity) standards and demand incentives.

Voluntary markets: International perspective and potential of forest conservation projects (REDD+)

CREDITS ISSUED AT GLOBAL LEVEL, 1996-2023

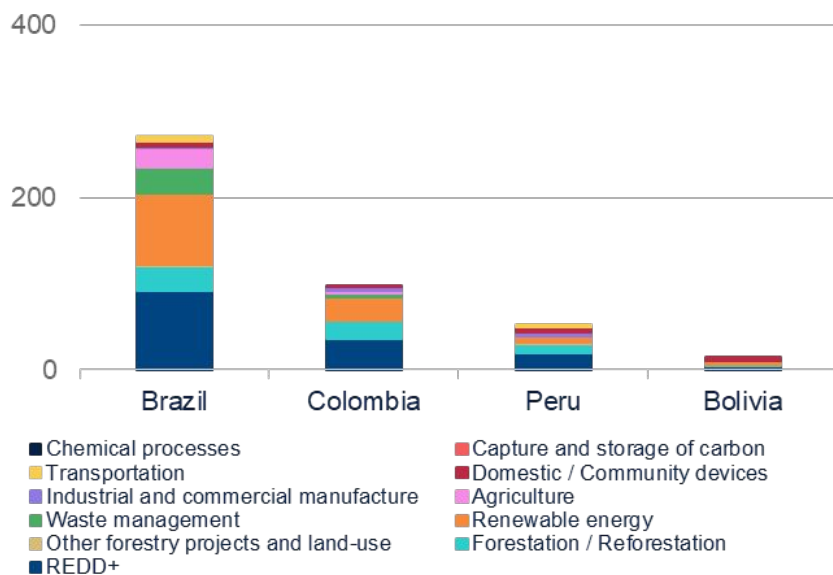
(%, cumulative)



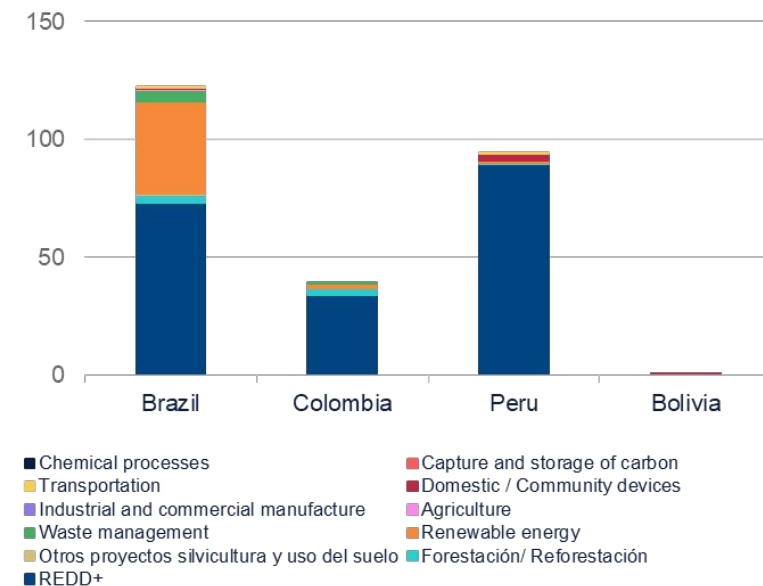
Source: BBVA Research based on [the Voluntary Registry Offsets Database](#). Carbon offset projects, credit issuance and credit retirements listed globally by four major voluntary offset project registries: American Carbon Registry (ACR), Climate Action Reserve (CAR), Gold Standard and Verra (VCS).

Voluntary markets: International perspective and potential of forest conservation projects (REDD+)

NUMBER OF VOLUNTARY REGISTRATION OFFSET PROJECTS, 2002-2023



CREDITS ISSUED (MILLIONS OF CARBON OFFSET CREDITS) AND EMISSIONS REDUCTION ESTIMATE PRIOR TO IMPLEMENTATION, 2002-2023

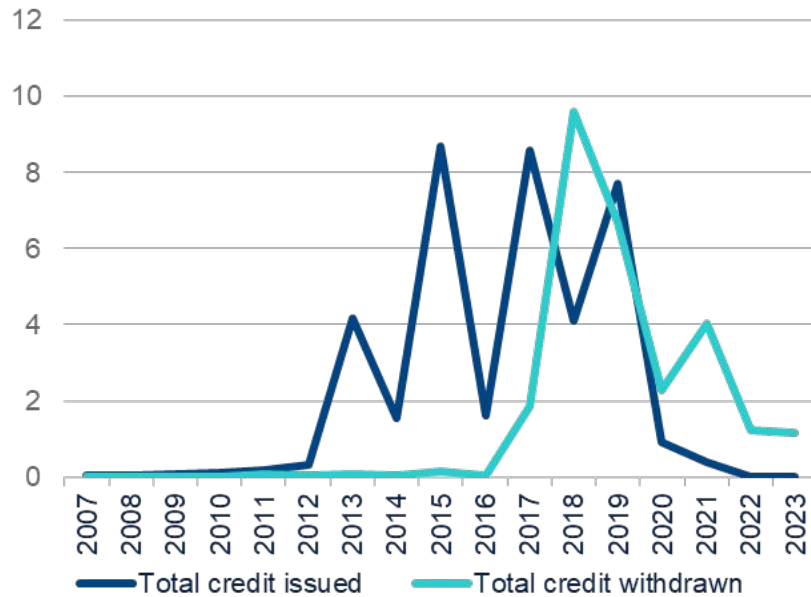


Source: BBVA Research based on [the Voluntary Registry Offsets Database](#). Carbon offset projects, credit issuance and credit retirements listed globally by four major voluntary offset project registries: American Carbon Registry (ACR), Climate Action Reserve (CAR), Gold Standard and Verra (VCS).

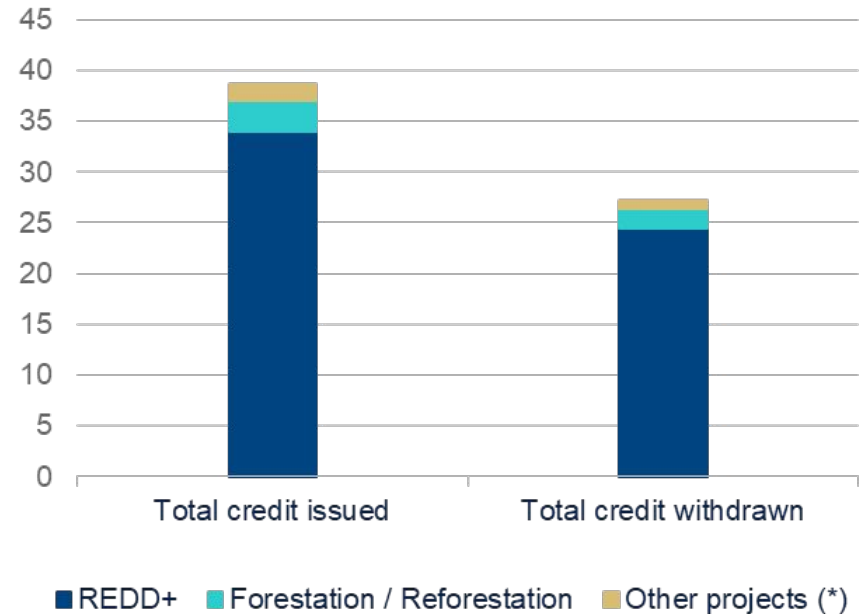
Voluntary markets in Colombia. Trend marked by domestic factors (2022 change of causation) and global factors (criticism of standards)



MARKET PERFORMANCE: CREDITS ISSUED AND WITHDRAWN IN COLOMBIA (MILLIONS PER YEAR)



CARBON OFFSET CREDITS IN COLOMBIA (MILLIONS, CUMULATIVE 2007-2023)



Source: BBVA Research based on [the Voluntary Registry Offsets Database](#). Carbon offset projects, credit issuance and credit retirements listed globally by four major voluntary offset project registries: American Carbon Registry (ACR), Climate Action Reserve (CAR), Gold Standard and Verra (VCS).

(*) Other projects include both forestry and land use projects as well as the rest of the scopes (renewable energies, waste management, etc.).

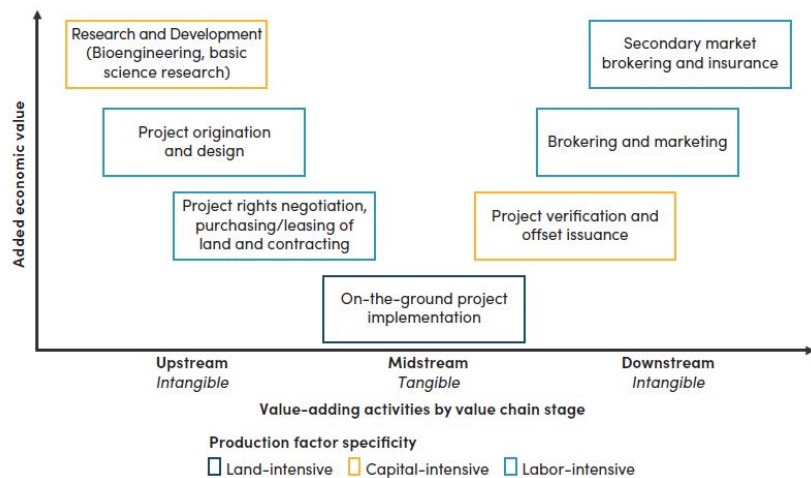
05

References

Robust institutions to leverage the revenues that local communities receive from carbon markets

(Forest-Based Carbon Markets. Pitfalls and Opportunities. Cárdenas, Guzmán)

FOREST CARBON MARKETS VALUE CHAIN



- Establish National Carbon Federations** dedicated to administering carbon markets, ensuring that local communities receive a fair share of revenues, and preventing market failures.
- Implement robust safeguards and robust processes** to mitigate potential negative impacts, such as population displacement, rising food prices, and biodiversity degradation. Ensure that land ownership is respected and that projects do not cause harm to vulnerable communities.
- Promote transparency and fairness in market mechanisms** by ensuring that high value-added activities, such as monitoring, verification, and assurance, benefit host countries.

Urban development, land tenure reform, and coordinated environmental and economic policies to curb Amazon deforestation

(Harvard Kennedy School, 2023)

1. Control de la Deforestación

1.1. Definir el Bosque a Proteger

- Apoyar la culminación acelerada del Catastro Multipropósito en municipios PDET de alto riesgo de pérdida forestal.
- Colocar las áreas forestales protegidas bajo un régimen legal que prohíba la futura formalización de la tierra, la construcción de caminos y la mayoría de las actividades económicas, incluida la ganadería.
- Modificar las leyes forestales y de tierras para eliminar el riesgo moral en tierras amazónicas
- Institucionalizar capacidades legales y operativas para recuperar tierras deforestadas.

1.2. Hacer que la protección de los bosques sea rentable

- Un impuesto mínimo nacional sobre la propiedad en tierras rurales
- Un mecanismo de seguimiento y trazabilidad para garantizar ganado libre de deforestación
- Mejorar la comerciabilidad, la aplicación y la escala de los créditos de carbono.

1.3. Alinear Incentivos Públicos

- Condicionar transferencias departamentales y municipales al desempeño de la deforestación
- Alinear la financiación de los donantes para implementar el marco de política nacional

2. Desarrollo Económico Sostenible

2.1. Políticas productivas para un nuevo modelo económico

- Crear una Mesa para el desarrollo productivo de la Amazonía.
- Promover el clúster turístico.
- Reorientar los incentivos públicos hacia un modelo económico sostenible.
- Promover la intensificación agropecuaria fuera de la Amazonía

2.2. Política estratégica de transporte

- Implementar una selección estratégica de proyectos viales para conectar con mercados externos.
- Promover el transporte aéreo en la región Amazónica.

Agroforestería Sustentable



- Cacao
- Açaí
- Palmitos
- Agroindustria
- Caucho natural
- Camu camu
- Acuicultura

Turismo



- Operadores turísticos
- Hotelería boutique
- Servicios de ecoturismo
- Servicios de comida y bebida

Servicios de Transporte



- Servicios de transporte aéreo
- Servicios de transporte terrestre
- Servicios de mecánica

- **Encourage urban development to reduce pressure on the forest.** Invest in the urban areas of the region to attract rural population.
- **Reform the legal regime and protect forest areas.** Clear legal status, which bans future land grabbing, explicitly prohibiting activities that encourage deforestation.
- **Coordinated public policies.** The protection of the rainforest must be economically viable: Development of effective carbon markets, implementation of taxes and monitoring mechanisms to certify deforestation-free livestock.

A potential supply curve for forest carbon credits in South America



SUPPLY CURVE OF CARBON CAPTURED BY FOREST REFORESTATION IN SOUTH AMERICA

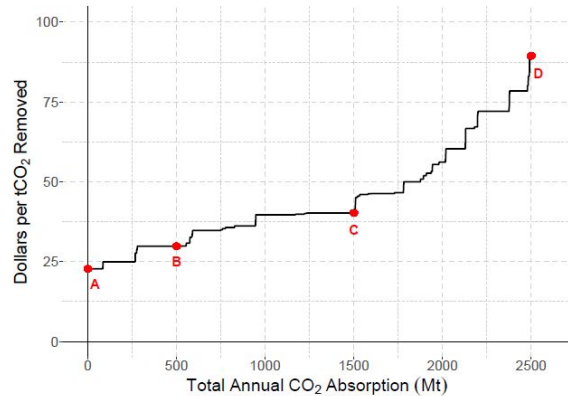


Figure 2: Supply curve for forest-based atmospheric CO₂ removal in South America. The curve shows the marginal cost (in 2020 US dollars) of removing one ton of CO₂ per year as a function of total forest-based CO₂ removal. Each point on the curve corresponds to a land grid element.

- The supply curve plots the marginal cost of removing one ton of CO₂ as a function of the total CO₂ removed.
 - Approximately 1.5 Gt of CO₂ can be removed annually through reforestation at a cost of \$45 per ton, and approximately 2.5 Gt can be removed at a cost of \$90 per ton.
- **How much land can potentially be reforested? The absolute reforestation of the available land - approximately one billion hectares - could remove about 10 Gt of CO₂ per year from the atmosphere**

Disclaimer

This document, prepared by the BBVA Research Department, is informative in nature and contains data, opinions or estimates as at the date of its publication. These arise from the department's own research or are based on sources believed to be reliable and have not been independently verified by BBVA. BBVA therefore offers no express or implicit guarantee regarding its accuracy, completeness or correctness.

Any estimates contained in this document have been made in accordance with generally accepted methods and are to be taken as such, i.e. as forecasts or projections. Past trends for economic variables, whether positive or negative, are no guarantee of future trends.

This document and its contents are subject to change without prior notice, depending on variables such as the economic context or market fluctuations. BBVA is not responsible for updating this content or for giving notice of such changes.

BBVA accepts no liability for any direct or indirect loss that may result from the use of this document or its contents.

Neither this document nor its contents constitute an offer, invitation or request to acquire, disinvest or obtain any interest in assets or financial instruments, nor can they form the basis for any kind of contract, undertaking or decision.

The content of this communication or message does not constitute a professional recommendation to make investments under the terms of Article 2.40.1.1.2 of Decree 2555 of 2010 or the regulations that modify, replace or supplement it.

With particular regard to investment in financial assets that could be related to the economic variables referred to in this document, readers should note that under no circumstances should investment decisions be made based on the contents of this document; and that any persons or entities who may potentially offer them investment products are legally obliged to provide all the information they need to make such decisions.

The content of this document is protected by intellectual property laws. Reproduction, transformation, distribution, public communication, making available, extraction, reuse, forwarding or use of any nature by any means or process is prohibited, except in cases where it is legally permitted or expressly authorised by BBVA on its website www.bbvarresearch.com.

The forest, a lever for sustainable development in Colombia*

J. Julián Cubero, Nara González, Rafael Ortiz, Diego Pérez, Alejandro Reyes, Juana Téllez

October 2024

* We appreciate the space for discussion with the teams of Asobancaria, Asocarbono, Verra, Allcot, Conservation International and the different areas of BBVA Colombia, Spain and Mexico.