



Natural climate solutions in Colombia

An opportunity for reducing emissions

About this report

The purpose of this case study is to provide policy makers with vital information that demonstrates the usefulness of implementing natural climate solution (NCS) within a country's nationally determined contributions (NDC). This document describes the results of the mitigation potential of three NCS pathways: avoided forest conversion, forest restoration and trees in agricultural lands (or silvopastoral) in Colombia. In addition to the differences in the Amazon, Andes, Caribbean, Orinoco and Pacific regions, the mitigation potential is also analyzed for protected areas and collective territories.

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Executive Summary

The AFOLU (agriculture, forestry and other land use) sector in Colombia contributes 62% of the country's emissions – compared with 24% of emissions at the global scale – mainly due to deforestation, forest degradation, and conventional cattle ranching. The high rate of emissions from this sector represents an opportunity to implement actions focused on protecting, managing, and restoring natural ecosystems to reduce emissions – also known as natural climate solutions (NCS).

In a decision published in late 2020, the Colombian government increased the ambition of its nationally determined contribution (NDC) emission reduction commitment to 51% compared to the 2010 baseline — equivalent to reducing around 169.4 Mt CO₂e annually by 2030. Nearly 75% of this total mitigation will come from measures related to the AFOLU sector including reducing deforestation, restoration, and/or improving silvopastoral and other agroforestry systems.

In Colombia, there is an opportunity for the government to improve and broaden its use of NCS information in the updated NDC, and increase ambition in current and future NDCs. To achieve this, TNC developed:

- A national NCS assessment of the three priority NCS pathways, including mitigation potential, cost-effectiveness and co-benefits.
- A policy analysis to identify barriers and opportunities to implementing NCS in Colombia, and an analysis of financial instruments to implement sustainable cattle ranching.
- A private sector analysis to explore NCS implementation opportunities in Colombia.

NCS pathways and trends

TNC identified 13 pathways related to NCS as relevant in Colombia and then prioritized three according to criteria such as mitigation potential, government interest, possible co-benefits, and data availability:

1. Avoided forest conversion: The maximum potential mitigation is 0.13 Gt CO₂e yr⁻¹ by 2030 over an area of 2.8 Mha
2. Forest restoration: The maximum potential mitigation is 0.16 Gt CO₂e yr⁻¹ by 2030 over an area of 14.1 Mha
3. Trees in agricultural lands: The maximum potential mitigation is 0.09 Gt CO₂e yr⁻¹ by 2030 over an area of 10.3 Mha

Our recommendations are as follows:

- Strengthen inter-ministerial coordination, through adoption of Natural Climate Solution measures.
- Revise and harmonize policies (Climate Change, Green Growth, Economic Recovery) to be less in competition with the other policies and lead to greater outcomes.
- Develop and adopt a Sustainable Livestock Strategy within the NAMA, to encourage the development of a sustainable market chain, address financial sustainability concerns and promote alignment with land use planning schemes and foster incentives for behavioral change.
- Develop policies and incentives to enhance restoration measures and identify financial resources required to meet restoration goals.
- Fully implement strategies to adopt Natural Climate Solutions on Avoided forest conversion, forest restoration and Silvopastoral systems and meet 52% of Colombia's NDC.

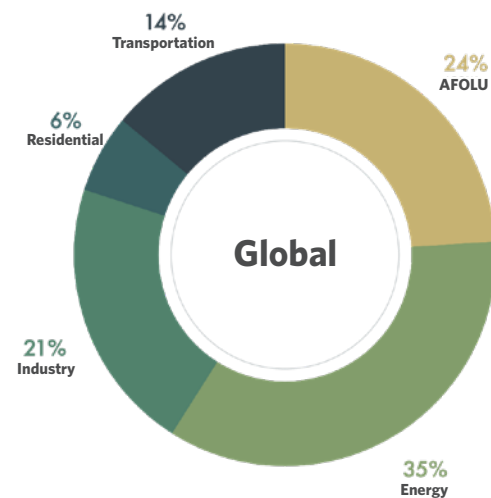
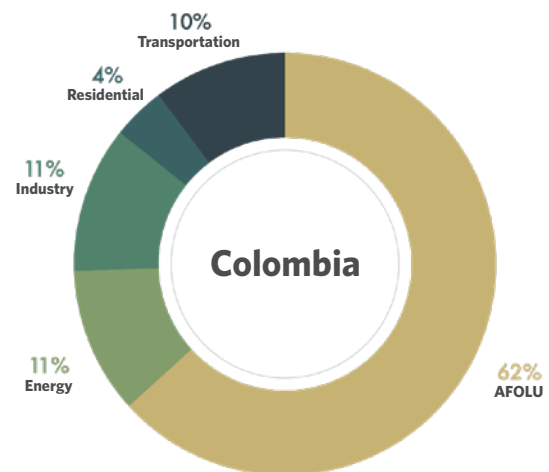
Introduction

The Paris Climate Agreement sets out a global framework to keep global warming well below 2°C and to make efforts to limit warming to 1.5°C. Achieving this goal will require rapid and significant reductions in global emissions of greenhouse gases (GHG) and an increase in the amount of carbon stored in natural systems, including forests, grasslands and wetlands. Under the Paris Climate Agreement, each country submitted its own NDC toward global efforts to reduce greenhouse gas emissions. Colombia ratified the Paris Climate Agreement, with a commitment to reduce emissions by 20% below the business-as-usual scenario by 2030.

Currently, the government has carried out a process to update the NDC in which complementary actions are being incorporated to the current commitments. Moreover, in November 2020, the Colombian government increased the ambition of its NDC emission reduction commitment to 51% compared to the 2010 baseline — equivalent to reducing around 169.4 Mt CO₂e annually by 2030.

In Colombia, global GHG emissions total 41,000 million tons of carbon dioxide equivalent, which means that the country generates 0.57% (236.7 Mt / Co₂eq) of global emissions. Among 184 countries, Colombia ranks 34th in emissions and fifth in Latin America, after Brazil, Mexico, Argentina and Venezuela (Second Biennial Climate Change Update Report, 2018).

According to Studer et al (2019), the AFOLU sector is highly relevant to Colombia's ability to meet its NDC commitments and increase its level of ambition. This sector represents around 55-62% of total national GHG emissions, one of the highest proportions in Latin America.



In November 2020, the Colombian government increased the ambition of its NDC emission reduction commitment to 51% compared to the 2010 baseline.

Colombia's low GHG emissions and high forest coverage mean that NCS have a high potential to mitigate a considerable portion of national emissions, mainly avoiding deforestation, particularly associated with agricultural activities and livestock.

Colombia has developed a solid institutional, legal and climate policy framework during the last decade, in order to advance and meet commitments related to the framework of the Paris Agreement. However, to date there is no formal means to include the use of NCS to meet national commitments.

Natural climate solutions (NCS) vs. nature-based solutions (NbS)

As a term, nature-based solutions (NbS) is often recognized and used in Colombia; this term includes natural climate solutions (NCS). Both of these terms are used for the purposes of mitigation and adaption assessments and policy in the country. Hence, it is easier to engage key stakeholders about/on the topic of NCS due to their familiarity with NbS. Further, NbS efforts are connected with the Ministry of the Environment's work.

Literature review

A literature review was conducted to better understand cost-effective mitigation potential of NCS pathways in Colombia, using scientific papers published in indexed journals, online and physical theses stored in libraries from universities, official reports from the national government, and reports with results developed by TNC as well as other non-governmental organizations and the private sector. This included a collection of recent official reports and maps on deforestation, land suitability, and national plans for restoration, as well as country-specific information on carbon content and trajectories associated with business-as-usual land use changes (e.g., deforestation) and NCS alternatives (e.g., forest protection and restoration, or trees in agricultural lands). In addition, from previous analyses, TNC Colombia has developed information on carbon stocks and trajectories for key NCS pathways in the country in order to complement existing information.

TNC looked for main trends in Colombian public policy aimed at tackling climate change, particularly in the AFOLU sector, and identified potential links to NCS pathways that better contribute to meeting national and international goals. Some of the policies reviewed include the Colombian Strategy of Low-Carbon Development, the Climate Change National Policy, and the Strategy to Control Deforestation and Forest Management, which are associated with Colombia's NDC and aim to promote a link between economic growth and emission reductions. Both country- and region-wide programs were considered, such as the National Plan of Restoration or the program Vision Amazonia.



NCS pathways

In order to effectively prioritize NCS actions, TNC selected a study conducted by Griscom et al. (2017) that identified and quantified 20 conservation, restoration and improved land management actions, or pathways, that have a high potential in increasing carbon storage and reducing GHG emissions. These pathways fall under three main categories: forests, agriculture/grasslands and wetlands, as displayed in Figure 1.

Climate mitigation potential in 2030 (PgCO₂e yr⁻¹)

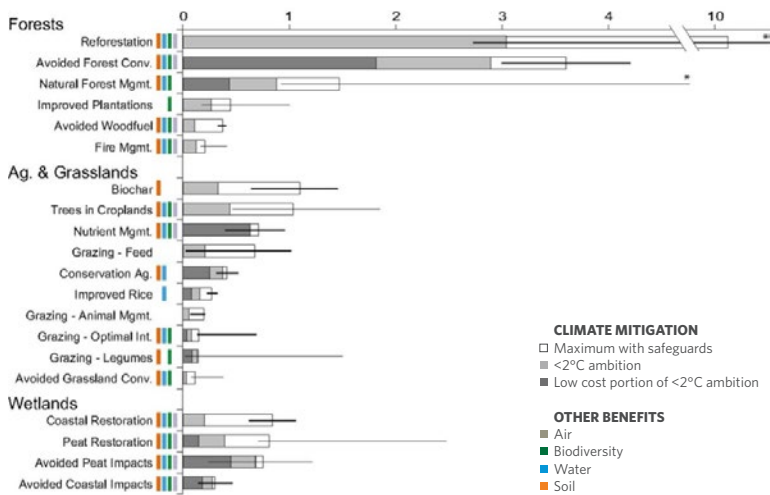


Figure 1: Griscom et al. (2017)'s 20 actions/pathways to reduce GHG emissions and co-benefits

TNC then identified 13 pathways as relevant in Colombia (see figure 2), and conducted a structured process for further prioritizing the pathways for analysis by rating them according to several potential criteria as assessed by a number of stakeholders: mitigation potential, government interest, possible co-benefits, data availability, and TNC staff capacity.

NCS Pathways

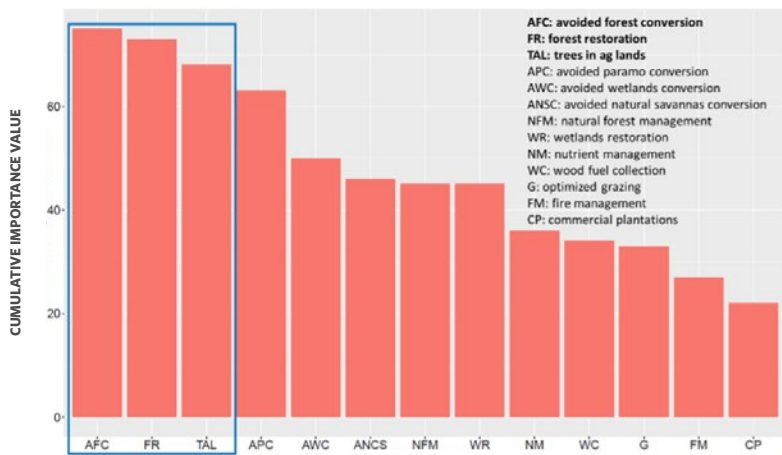


Figure 2: Priority NCS pathways in Colombia. Preliminary results of the NCS assessment in Colombia show that the maximum biophysical mitigation potential for selected NCS pathways by 2030 is 0.38 Gt CO₂e/yr, of which avoided forest conversion accounts for 34% of the total potential, reforestation, 41%, and trees in agricultural lands (silvopastoral systems), 25%. Draft results were shared with the Colombian government to inform the NDC update process in 2020.

TNC's strategy and process

Meeting with experts

Following the policy and literature reviews, meetings between the TNC team and experts from academic, public, and private sectors were important for prioritizing NCS pathways, as these meetings helped the team to understand their needs and strategic plans to reduce carbon emissions, and to explore with them potential barriers and opportunities to promote NCS as cost-effective alternatives to meet their emission reduction goals and support the NDC update process for Colombia.

From the Colombian public sector, TNC met with the Ministries of Environment and Sustainable Development, Agriculture and Rural Development, and External Affairs to learn about the government's strategy to update the NDC and to promote NCS as a way to support the update process. Other technical agencies in charge of producing national forest and GHG inventories and deforestation reports were also invited to participate in these meetings. This helped TNC understand the availability of official spatial and carbon-related information that could be included in the NCS assessment. Finally, meetings with private stakeholders, including companies from the energy and industry sectors in Colombia who have committed to reduce their emissions, helped to identify NCS pathways that can contribute to meeting their emission reduction goals and are aligned with their interests.

Selection of NCS pathways for Colombia

Following the informal and formal expert meetings, TNC worked to prioritize NCS pathways from the 20 pathways presented by Griscom et al (2017) for mitigation potential analysis at the first phase. The three pathways that were prioritized — avoided forest conversion, forest restoration and trees in agricultural lands (Silvopastoral systems)— were rated as having the highest potential to contribute to climate change mitigation and as relevant for Colombia to achieve its recently increased emission reduction goal.



Methodology and results for 3 NCS pathways

1. Avoided forest conversion

The maximum mitigation potential of avoided forest conversion was estimated by using the following maps (scale 1:100,000) and model:

- Forest – Non forest 2018
- Carbon content in above-ground biomass based on life zones (temperature + precipitation)
- Model of deforestation 2018 – 2030

As result, we found that the maximum potential mitigation from avoided forest conversion is 0.13 Gt CO₂e yr⁻¹ by 2030 over an area of 2.8 Mha (see figure 3).



Figure 3: Maximum mitigation potential (t CO₂e) from the NCS pathway avoided forest conversion in Colombia during the period 2018-2030.

2. Forest restoration

In the case of forest restoration, the maximum mitigation potential was estimated by using the following maps (scale 1:100,000):

- Agriculture frontier: this map gives us official information on land aptitude/suitability for Colombia, including areas where land aptitude is conservation or restoration
- Ecosystems: official information about natural ecosystems in Colombia
- Natural savannas: a category of the ecosystems map and was used as a layer to prevent afforestation activities on natural ecosystems
- Forest/non forest 2018
- Deforestation 2010–2018: according to national legislation all areas deforested during this period must be subject to restoration activities
- Paramos: it's another category of the ecosystems map and was used as a layer to prevent afforestation activities on natural ecosystems
- National restoration plan: this is an official initiative that aims to restore degraded areas in the country, and includes forest restoration, silvopastoral systems among others.

As result, we found that the maximum potential mitigation from forest restoration is 0.16 Gt CO₂e yr⁻¹ by 2030 over an area of 14.1 Mha (see figure 4).

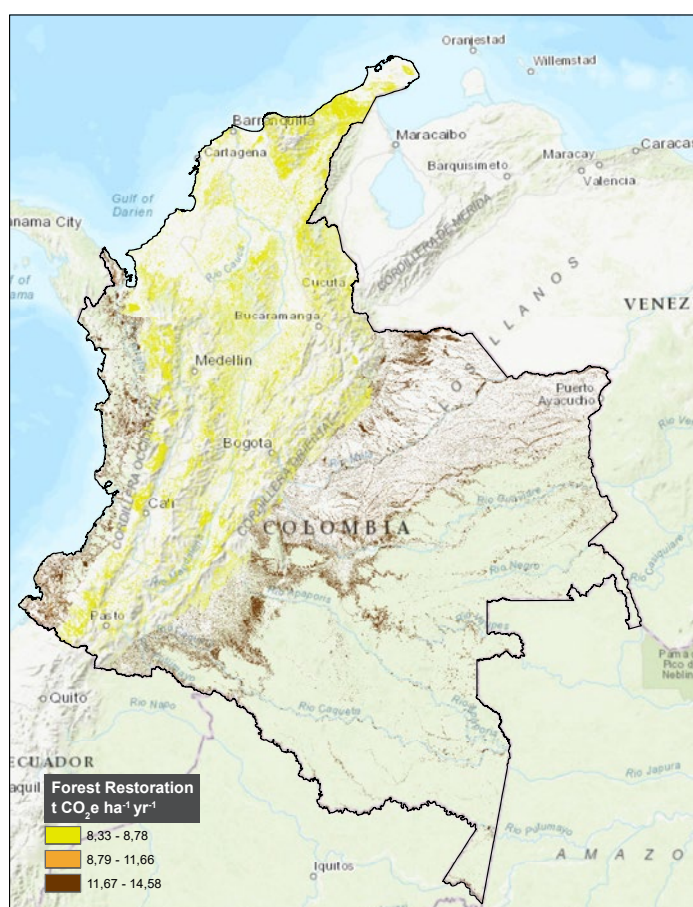


Figure 4: Maximum mitigation potential (t CO₂e) from the NCS pathway Forest Restoration in Colombia during the period 2018-2030.

3. Trees in agricultural lands (silvopastoral systems)

In the case of forest restoration, the maximum mitigation potential was estimated by using the following maps (scale 1:100,000):

- Agriculture Frontier (in this case, the map gives us official information on land aptitude for cattle ranching activities [for beef and milk] in Colombia where silvopastoral initiatives might be implemented),
- Ecosystems (including official information about natural ecosystems in Colombia),
- Natural Savannas (a category of the Ecosystems map and was used as a layer to prevent afforestation activities on natural ecosystems),
- Forest – Non forest 2018,
- Deforestation 2010 – 2018 (according to national legislation all areas deforested during this period must be subject to restoration activities,
- Paramos (another category of the Ecosystems map and was used as a layer to prevent afforestation activities on natural ecosystems),
- National Restoration Plan (an official initiative that aims to restore degraded areas in the country, and includes forest restoration, silvopastoral systems among others).

As result, we found that the maximum potential mitigation from Trees in Ag Lands is 0.09 Gt CO₂e yr⁻¹ by 2030 over an area of 10.3 Mha (Figure 5).

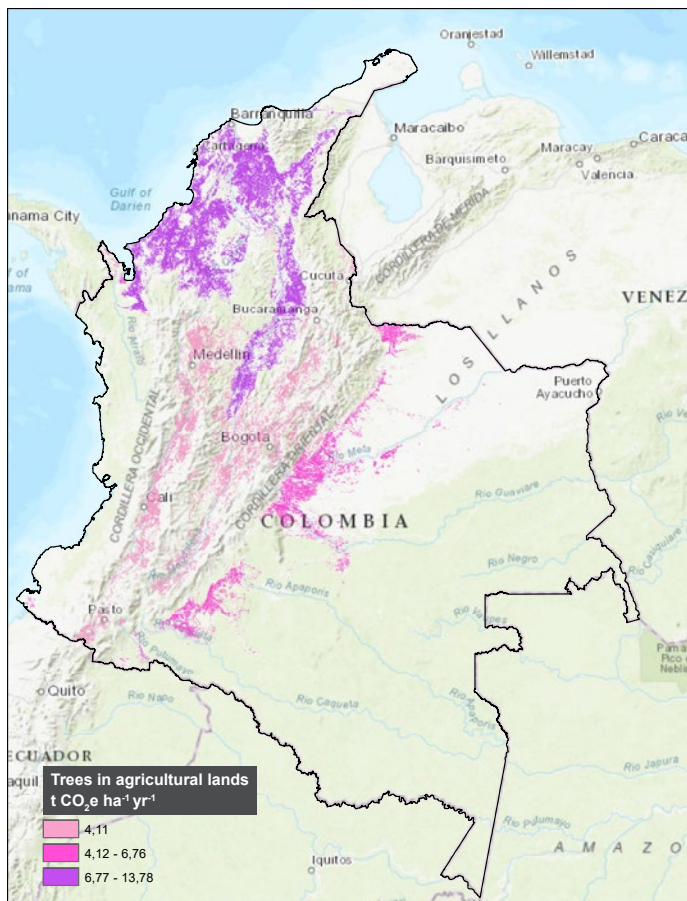


Figure 5: Maximum mitigation potential (t CO₂e) from the NCS pathway Trees in Ag Lands in Colombia during the period 2018-2030.

Multiple benefits from NCS pathways

An analysis of biodiversity, water and social co-benefits, as well as territorial viability linked to the mitigation potential of each NCS pathway, was recently undertaken, in order to prioritize key areas to protect and restore in Colombia. The TNC team assessed the habitat and distribution of more than 7,000 species of vertebrates, with an emphasis on threatened and endemic species. This assessment was intended to relate the mitigation potential of priority NCS pathways in Colombia with biodiversity indices regarding richness and abundance of species. In addition to the biodiversity study, the team conducted an assessment of water-related co-benefits, and a cost analysis of each NCS pathway at different carbon prices, including the current price of the carbon tax in Colombia (set at 5 USD per ton of CO₂e).

Biodiversity

The biodiversity co-benefits of the implementation of several NCS pathways in Colombia were evaluated. For this, distribution maps of 3,410 species were used to analyze the response of implementation of NCS pathways. This analysis was made at the regional level, using different taxonomic groups and other characteristics (endemic, threatened, etc.). The results showed that the region with the highest level of biodiversity for most of the groups was the Andes region, while Orinoquía showed the least biodiversity. The NCS pathways associated with each region of the country illustrate the richness of diversity, despite the fact that each pathway had vastly different carbon values. This means that there was not a direct correlation between high biodiverse and high carbon value areas, unless another variable was included like intact healthy forests, restored lands or silvopastoral systems.

Forty-six maps and nearly ten thousand figures of biodiversity benefits were generated based on the combination of six spatial and taxonomic criteria. This resulted in a rich dataset to evaluate biodiversity co-benefits under different conditions and scenarios. For instance, in the Colombian Andean region, the conservation sites with 2,583 tons of carbon accumulated in 10 years showed 134 endemic species of all taxonomic groups. Moreover, this indicated a co-benefit for the site or taxonomic group of interest.

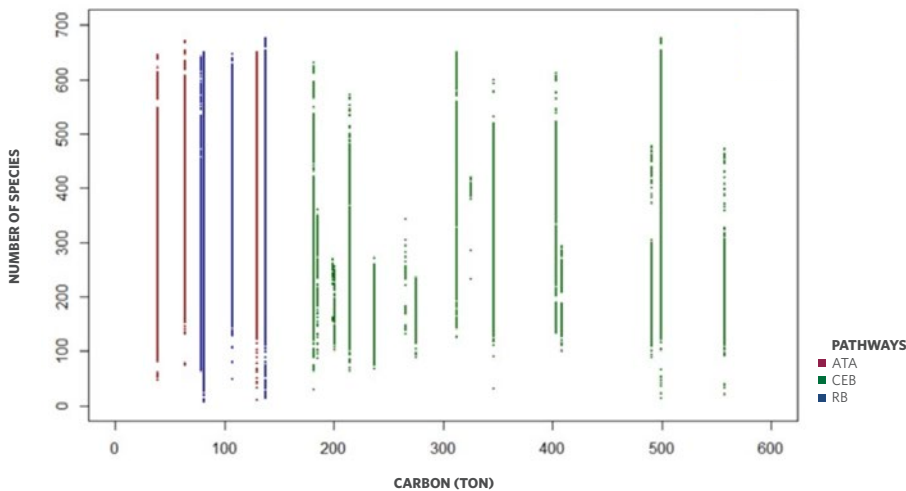


Figure 6a: Total number of species per pathway

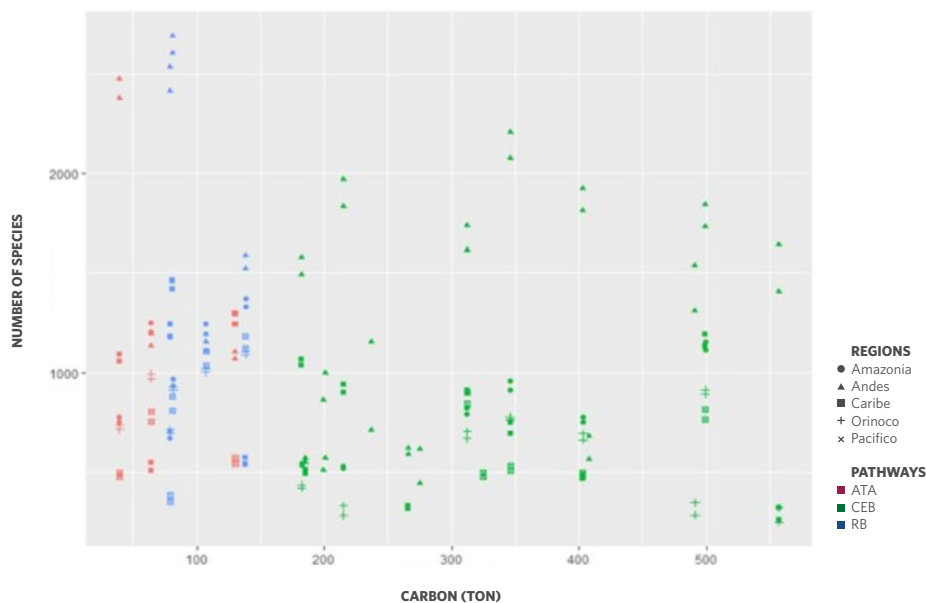


Figure 6b: Total number of species per pathway

Water

An estimation of the water co-benefits was carried out by generating intervention scenarios using a water balance model after its calibration and validation. For the three pathways, changes were made in the parameters and inputs of the model. The changes were related to cultivation coefficients, runoff coefficients, soil water storage capacity, and maximum infiltration rates. The climate component characterized for the period 1982-2011 remained constant for all scenarios. Subsequently, a series of indicators of the state of the water resource were proposed that seeks to evaluate the trade-offs of the impacts derived from the implementation of mitigation actions. The indicators used were the long-term annual real water yield and evapotranspiration, and the monthly water yield and base flow in extreme dry conditions. Finally, based on these indicators, a weighted integral indicator was constructed that quantitatively reflects the level of water co-benefits.

On a national scale, the results showed that all mitigation actions would not only exert favorable results on the availability of water resources, increasing the annual yield by about 21%, but also increasing the distribution of water resources in conditions of extreme drought., in particular, for the trees in agricultural lands (silvopastoral) and forest conservation scenarios, by 28% and 31% respectively. The greatest co-benefits of water potential are related to implementation mitigation actions under the trees in agricultural lands (silvopastoral) scenario in the Caribbean, Amazon, and Andes regions, followed by actions of the forest conservation scenario in the Andes and the Caribbean regions.

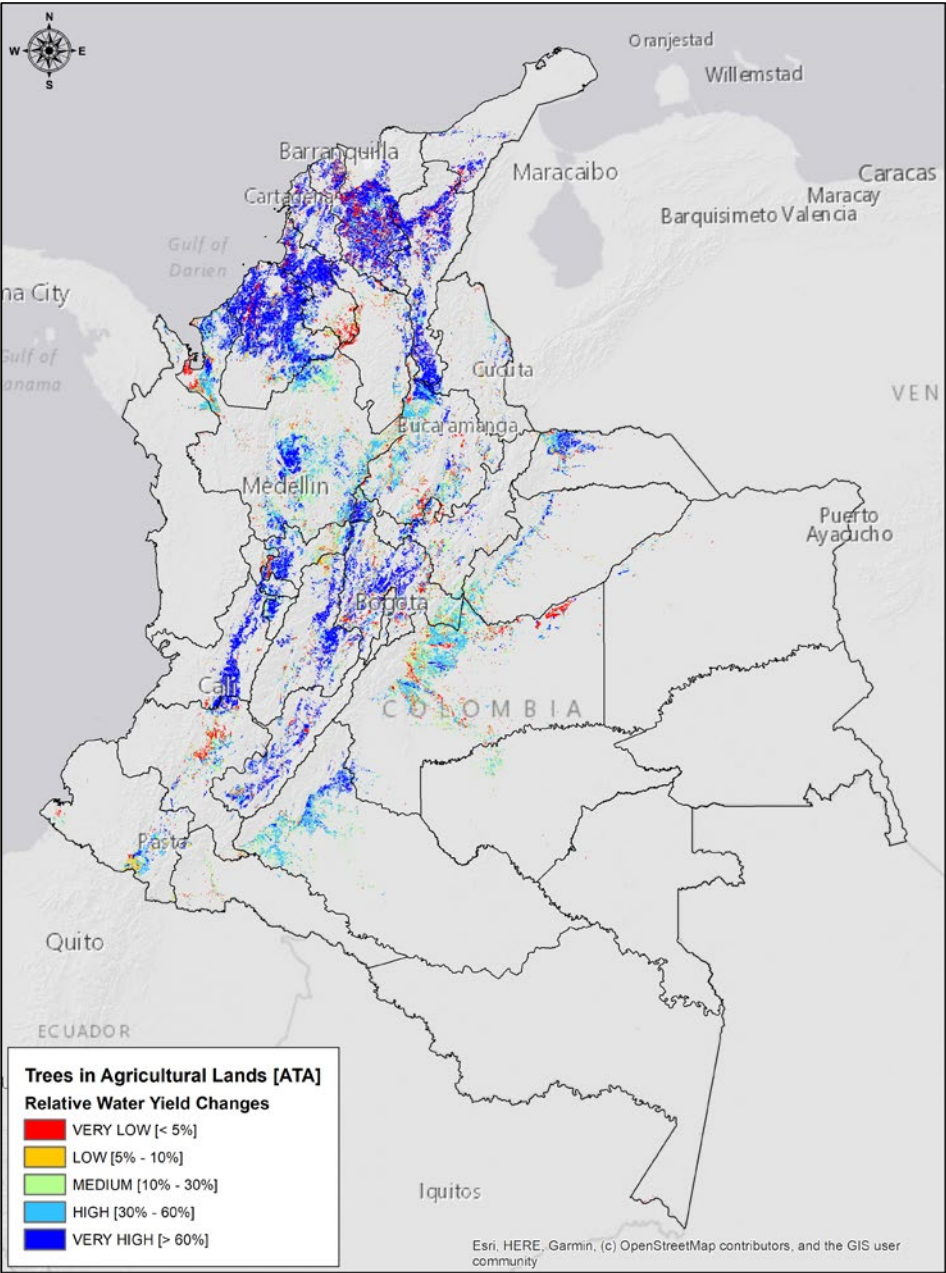


Figure 7a: Spatial distribution of the water co-benefits for Trees in Agricultural Lands

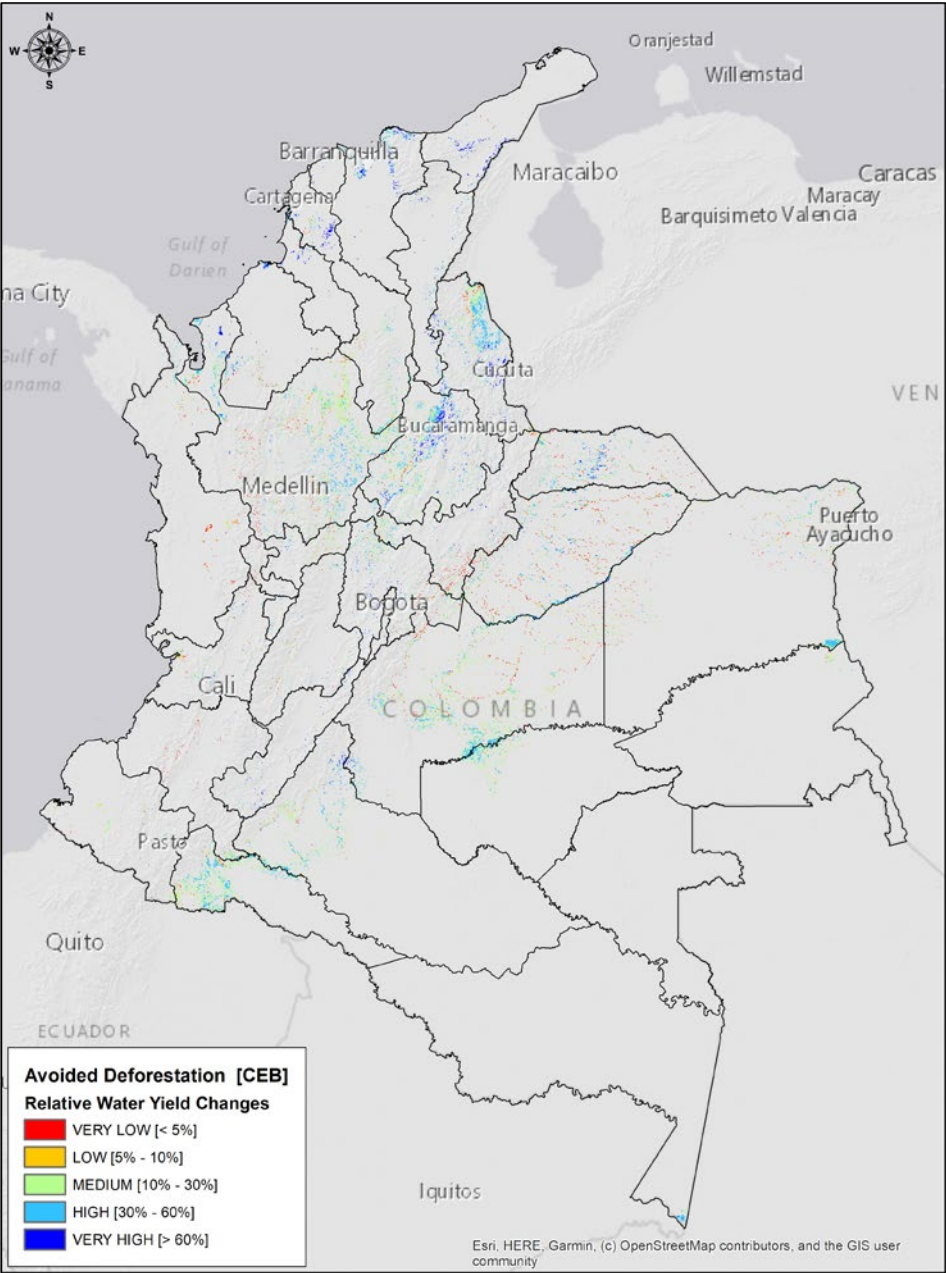


Figure 7b: Spatial distribution of the water co-benefits for Avoided Deforestation

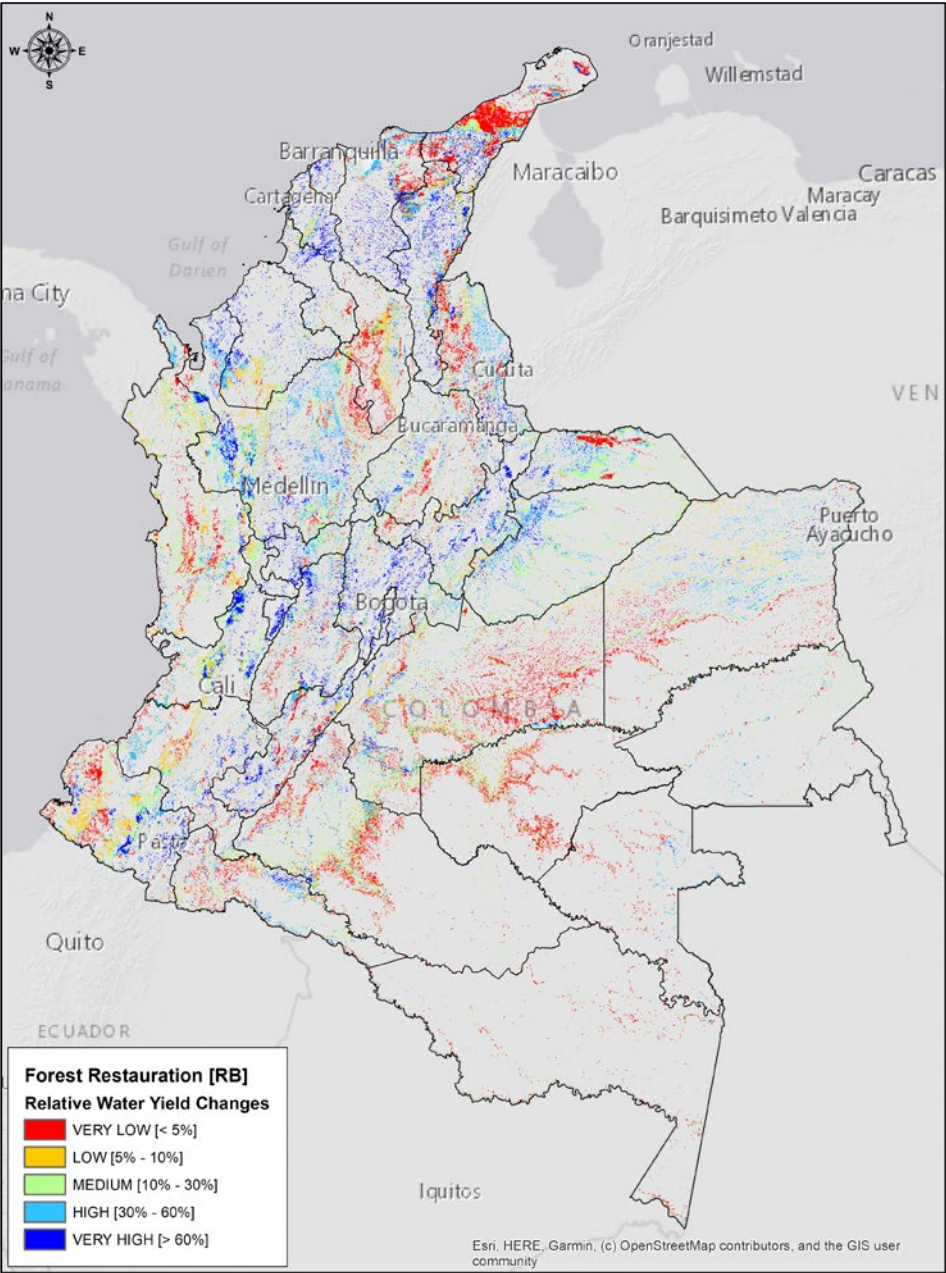


Figure 7c: Spatial distribution of the water co-benefits for Forest Restoration

Social

The objective of this analysis was to identify the co-benefits associated with the prioritized NCS pathways and to estimate the viability of the pathway implementation in the municipalities belonging to the five regions of the country. To this end, a quantitative exercise was undertaken that allowed the identification of the viability of the implementation of NCS routes in the national territory as well as its potential for the generation of social co-benefits identified in the municipalities and regions of the country.

Six feasibility indicators were calculated for the generation of social co-benefits for poverty reduction and improvement of the quality of the governance of the territory and its resources through the implementation of the NCS routes for trees in agricultural lands, forest conservation and forest restoration. A national analysis is carried out, by calculating the indicators through the process of looking at the basic enabling conditions for the generation of social co-benefits through routes associated with the NCS initiatives. This data is mostly taken from the 2014 National Agricultural Census. It is concluded that the routes associated with forest conservation and silvopastoral systems present significant viability in 71% and 66% of the municipalities, respectively, while the route associated with restoration is viable only in 34% of the national territory. A major finding of the study was that the contribution of the silvopastoral route to reduce poverty is greater in the Orinoquía region, while in the Amazon and Pacific regions this co-benefit is more likely to be present through the forest conservation pathway. Another key finding is the viability of the NCS routes presents a positive correlation with the multidimensional poverty indicators in rural areas.

Amazon region

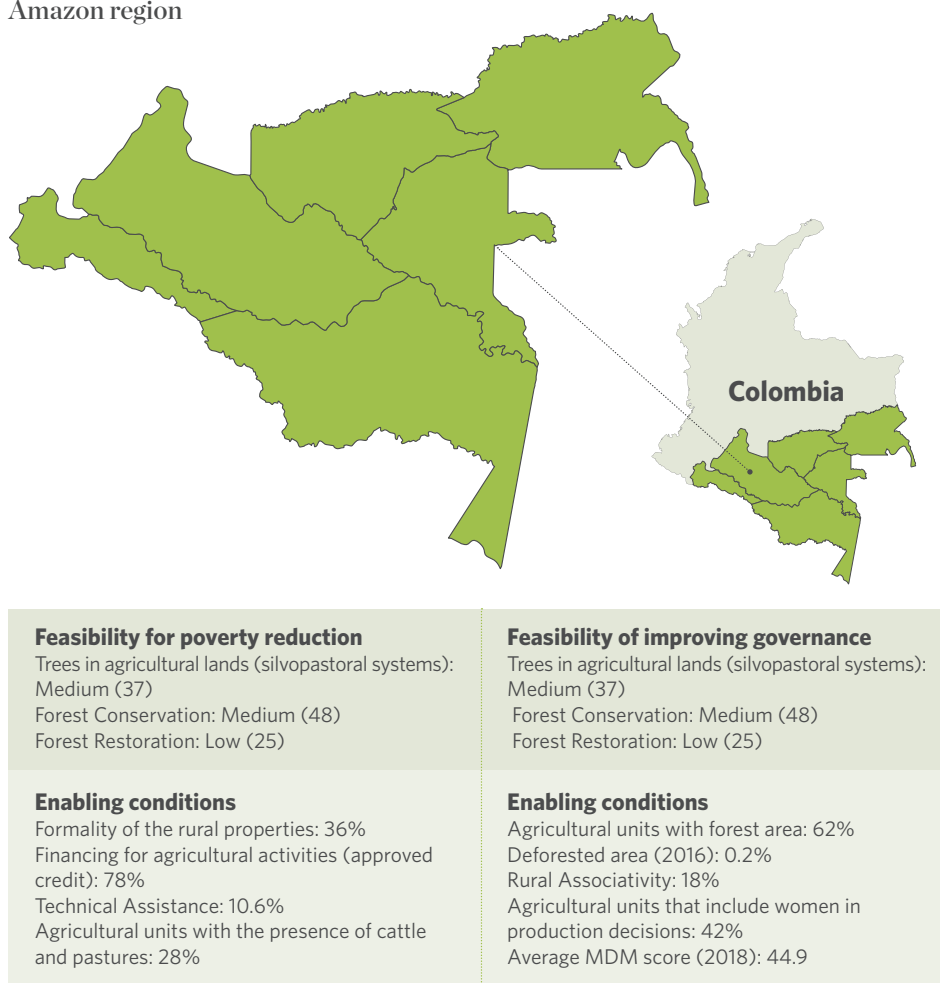


Figure 8: Example of social co-benefit results in the Amazonian Region in Colombia.

Policy implications

National Carbon Tax

In 2017, Colombia published the National Carbon Tax, which applies to companies using fossil fuels^[1, 2]. Currently, the price of the tax is 5.00 USD per ton of CO₂e, increasing annually, adjusted to the country's inflation rate. In the current national context, it is important to highlight that there are two possible uses for emission reduction units. The first option is to use the units in the non-causation mechanism of the national carbon tax and the second is to use the reduction units to offset the carbon footprint of private companies. For a private company, the voluntary compensation of emissions can also represent financial alternatives around carbon markets.

Silvopastoral NAMA

The bovine cattle raising NAMA aims to diminish the greenhouse gas emissions generated from cattle production and increase the carbon sinks of the pasture agro-ecosystems, through an environmental and productive management system at a regional level, promoting conservation and/or restoration of natural ecosystems, encouraging sustainable productive landscapes through the harmonization of the different public policy tools. Some of the goals of this project include the implementation of intensive and non-intensive Silvopastoral systems that can intensify cattle raising production and at the same time ensure efficient management of a productive system; the conservation and restoration of natural systems by pinpointing areas in cattle farms; and the proper management of manure and utilization of gas generated in the sacrifice lots.

During the 15-year period of the project's implementation, NAMA expects to have achieved:

- Implementation of 1,250,000 ha of Silvopastoral Systems and 370,000 ha of Intensive Silvopastoral Systems
- Intervention of eco-efficient management of improved foliage on 2,200,000 ha
- Restoration of 2,000,000 ha of bovine livestock grounds
- Reduction of 4 Mton CO₂e by enteric fermentation,
- Capture of 6 Mton of CO₂e by SSP implementation
- Capture of 167 Mton of CO₂ capture by restored ecosystems.
- Avoid deforestation of 2,500,000 ha of forest and mitigating 1,228 MtonCO₂e

In addition, NAMA expects that the project will benefit almost 200,000 families across 15 departments in the country. The total investment of the project would be USD\$900 million, assuming an abatement cost of 4.16 \$USD/TCO₂e.

2050 Climate Strategy

Nature-based solutions are prominently featured in Colombia's long-term Climate Strategy (2050), currently under preparation by the government. Adopting NbS implementation strategies for mitigation will not only contribute to Colombia's NDC goal for 2030, but also to the national carbon neutrality goal for 2050. TNC is currently participating in the technical advisory group created by the Ministry of the Environment to support the creation of this NbS for mitigation strategy.

1. The Congress of Colombia. 2016. [Ley 1819 de 2016](#) [in Spanish].

2. Ministry of Environment and Sustainable Development (Colombia). [Decree 926 of 2017](#).

Lessons learned

Colombia has a robust policy and institutional framework for climate change which sets criteria to implement NCS. However, this existing framework brings with it a set of barriers that affects the implementation of NCS. Barriers the TNC team has identified include:

- High turnover of civil servants impacts the effectiveness of decision-making bodies.
- Inter-institutional and territorial coordination is not supported by budget allocation and personnel, which makes its implementation difficult and reliant on the will and personal capacity of individual civil servants.
- In Colombia, only 37% of rural households are landowners, and of these households only 59% have legal titles.
- There are no simple and standardized metrics to assess NCS effectiveness that work at different geographic scales and that are adapted to the specific intervention contexts, and there is low interoperability among sectors and the regional and national monitoring mechanisms.
- Each sectoral and territorial climate change plan must identify and include the sources of financing required to implement the prioritized measures and reduce excessive dependence on international cooperation resources.
- The municipalities that account for 84% of deforestation in Colombia are also those most affected by violence, poverty, illicit economies, and institutional and administrative weakness.

The analysis on barriers and opportunities to implement NCS activities in the private sector of Colombia have shown that:

- The environmental investments or activities that matter the most to the average private company are the ones that affect directly, and in the short term, their core business and finances. This could indicate the AFOLU and energy sectors are more likely to implement NCS actions.
- The lack of knowledge within financial entities about NCS projects, their profitability, risks, and types of guarantees become a barrier for the private sector to invest in NCS initiatives.
- Very few companies or individuals have the capacity to carry out biodiversity and climate change projects on the large scale needed for their effectiveness.
- Land tenure in Colombia is legally weak, which acts as a barrier to carry out many projects and land acquisition.

Recommendations

The main actions we consider relevant to overcome the barriers identified in the previous section include:

- Contribute to the design of local strategies for land use planning at the landscape scale in those territories targeted to implement NCS.
- Support the National Government in the definition of inter-sector strategic agendas and in the implementation of strategy of rationalization and harmonization of relevant policies for the implementation of NCS.
- Complement the efforts of land use planning at the local level by adopting a micro-land planning perspective in NCS implementation processes.
- Facilitate spaces for participation that promote territorial planning dynamics in the territories prioritized for the implementation of NCS.
- Undertake greater efforts to align climate change planning and land use planning with a monitoring system that guarantees implementation of a spatial assessment of each program throughout the country.
- Complement the intervention models associated with NCS income generation schemes that integrate value-chain-strengthening activities with landscape management actions, mainly in municipalities that are in deforestation hotspots, which are areas most affected by violence and community vulnerability.

The NCS study also yielded these general recommendations:

- Develop and adopt a Sustainable Livestock Strategy within the NAMA, to encourage the development of a sustainable market chain, address financial sustainability concerns and promote alignment with land use planning schemes and foster incentives for behavioral change.
- Develop policies and incentives to enhance restoration measures and identify financial resources required to meet restoration goals. These policies would promote the use of a common monitoring platform to track restoration activities and assess impacts of offset measures.
- Revise and harmonize policies (Climate Change, Green Growth, Green Recovery) to be less in competition with the other policies and lead to greater outcomes when adopting Natural Climate Solutions. Revised policies will do more to fight deforestation, poverty reduction and create norms to encourage agricultural production and intensification rather than destructive practices and agricultural expansion.



Conclusion

There is reason for cautious optimism, with deforestation rates declining since 2015-6. The country reduced deforestation by 19%, or 38,264 hectares, in 2019 after two consecutive years of significant forest loss in 2017 and 2018. This is promising and the first time that deforestation has been reduced since a peace agreement was signed in 2016. The launch of Amazon Vision programs is another positive contributing factor to declining deforestation rates. However, as the overall deforestation rate remains high, making further progress to implement Natural Climate Solutions remains critical. An emerging opportunity to make an immediate difference would be to integrate NCS results into the strategies being developed around the national Green Recovery Plan.

Even though Colombia has a robust legal and institutional framework to tackle climate change, the biggest challenge is effective policy implementation. Stronger coordination by government, NGOs, communities to take an active part in addressing climate change would advance implementation. The private sector needs to play a much larger role to address climate change, especially where they have the biggest impacts – in supply chains and sustainable agricultural production.

Colombia only contributes 0.4% of global emissions, yet its updated NDC is one of the most ambitious in Latin America (Vergara et. al, 2021). This increased ambition is noteworthy -- Colombia's previous goal was 30%, the updated 2020 NDC commitment rose to a 51% reduction of total emissions. From TNC's Natural Climate Solutions study, significance contributions can be found in the top three NCS pathways. Adopting sustainable practices in these pathways (36% Avoided Forest conversion, 10% Forest Restoration and 6% Silvopastoral systems) would contribute more than half (52%) of Colombia's NDC.

Although Colombia only contributes 0.4% of global emissions, its updated NDC is one of the most ambitious in Latin America.

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