Info Note

Science effectively informs policy processes in Colombia toward low-emission agriculture

Reflections on the process of incorporating EC-LEDS research results into national low-carbon policies in agriculture

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Key messages

- The translation of low-emission development policies into implementation on the ground requires research outputs that can be developed in collaboration with key stakeholders. This helps to understand stakeholders' roles and policy processes as well as enhancing technical capacity that facilitates the uptake of scientific results.
- An improved GHG National Inventory by decreasing uncertainties in emission calculations and estimates of emission reduction potential from cacao plantations can help to achieve Colombia's Nationally Determined Contribution (NDC) target.
- Scaling the use of low-emission development research outputs needs institutionalization and capacity strengthening of key stakeholders at different levels.
- There is a need to better support decision makers' use of technical information for strategic emission reductions planning, policy development, and implementation to deliver significant mitigation outcomes in agriculture. The creation of an effective communication platform, including LED resources, can serve this purpose.

The climate change crisis demands effective actions to tackle climate challenges. Countries rely on improving science-based climate information and knowledge to strengthen decision-making and public policy. In Colombia, the sectoral greenhouse gas (GHG) mitigation targets for contributing to the national goal of decreasing GHG emissions from a business-as-usual (BAU) scenario by 20% by 2030 are currently under revision and updating. As part of its efforts to accelerate climate actions toward these commitments, Colombia formulated the Colombian Low-Carbon Development Strategy (ECDBC in Spanish)[1] that identifies needs and opportunities in economic sectors to achieve together the national GHG mitigation goals.

The ECDBC is currently promoting and supporting the design of Sectoral Climate Change Plans (PIGCCS in Spanish), which identify priority measures to transform economic activities for developing a low-carbon economy.

To support the efforts of low-carbon transformation in Colombia, the United States Department of Agriculture's (USDA's) Foreign Agricultural Service implemented the program "Enhancing Capacity for Low Emission Development Strategies (EC-LEDS)," which aims to provide technical assistance to developing countries to promote low-emission economic growth across many countries. In Colombia, the program has supported the Ministry of Agriculture and Rural Development (MADR) to (i) improve the construction of GHG inventories by diminishing uncertainties in N_2O emissions associated with applied nitrogen fertilizer, (ii) quantify the GHG mitigation potential of different cocoa production systems and their potential contribution to achieving NDC targets, and (iii) socialize the mitigation actions with strategic actors and strengthen their capacity for implementation. The overall

[1] According to CONPES 3700, the Colombian Low-Carbon Development Strategy is a long-term planning initiative to identify GHG mitigation actions and projects of economic sectors that do not affect the nation's long-term growth.

goal is to obtain GHG emission reductions from Colombia's agriculture, forestry, and other land use (AFOLU) sector.

This policy brief presents the current climate policy momentum of Colombia and links EC-LEDS research outputs to support implementation of the PIGCCS for Agriculture (PIGCCS-Ag), the updated NDC, and the National GHG Inventory for significant GHG mitigation outcomes in Colombia. This brief also identifies actions needed to generate large-scale impacts from the existing research outputs.

Agricultural sector contribution to national mitigation targets

Agriculture is a fundamental sector of the Colombian economy. Historically, the agricultural sector contributed approximately 6% to Colombia's GDP[2] for 2005–2019 (DANE, 2020). The sector is especially important for the livelihoods of millions; in 2019, 16.6% of Colombia's total workforce was employed in agriculture (World Bank, 2020). In 2019, cultivation area in Colombia was approximately 5 million hectares (MADR, 2020), a little more than the size of continental Costa Rica. Agricultural sector growth is projected to increase to meet the demand of the growing population, income, and changes in diet patterns in Colombia (OCDE/FAO, 2019). This agricultural growth is supported by Colombia's environmental characteristics, water supply, and suitable land for many crops and livestock production.

Colombian GHG emissions from human-induced activities increased by 9.6% during 1990–2014. Historically, GHG emissions from AFOLU have made the highest contribution to total GHG emissions in Colombia, on average 65% of the contribution from 1990 to 2014. In 2014, direct emissions of the AFOLU module reported 129.512 Gg CO_2eq and –22.659 Gg CO_2eq of carbon sink (IDEAM et al., 2018). Agricultural activities such as livestock and manure management, biomass burning, N_2O emissions from managed soils, croplands, and cultivation of rice added on average 26% of AFOLU emissions and 14% of the country's total emissions in 2014 (ibid.).

Because of the AFOLU relevance in national GHG emissions and the significant contribution of the agricultural sector to the Colombian economy, the government has focused on improving data activity and GHG calculations to better inform their decision-making processes. In 2014, the Institute of Hydrology, Meteorology and Environmental Studies[3] (IDEAM in Spanish) established the Improvement Plan for National GHG Inventory to ensure that emissions data and trends reflected the country's efforts in implementing GHG mitigation actions (IDEAM et al., 2018). This plan seeks to decrease the uncertainty of data activity by using improved emission factors and refining the transparency of collection, estimation, and reporting processes. In the AFOLU module, methodology levels (TIER 2) and the use of local emission factors, especially for livestock, land use, and rice, have been enhanced (IDEAM et al., 2018; Torres, 2020[4]).

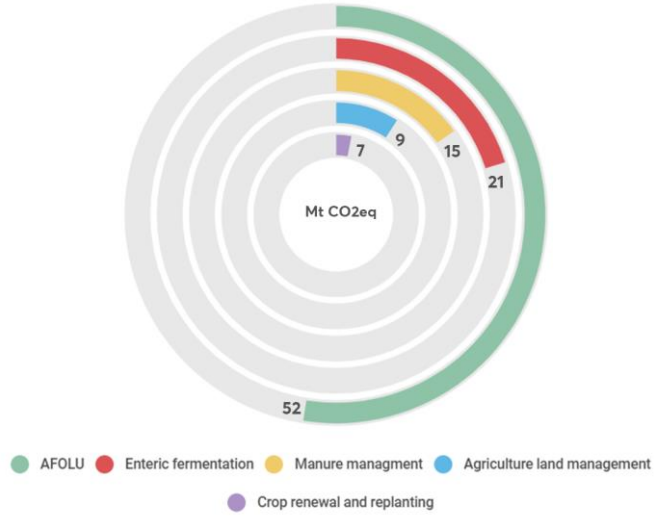


Figure 1. AFOLU emissions in 2014 (IDEAM et al., 2018).

To address GHG emissions of agricultural activities and contribute to national mitigation targets, the MADR has established mitigation actions and goals in its Agriculture Climate Change Plan (PIGCCS-Ag). The PIGCCS-Ag aims to identify, articulate, and address the implementation of measures to limit GHG emissions and decrease vulnerability to climate change in the agricultural sector. It also intends to enhance farm productivity and the food security of agriculture-dependent households by sustainable management of natural resources (MADR et al., 2020). The PIGCCS-Ag comprises five action lines that address mitigation and adaptation measures for a variety of agricultural activities and needs in the Colombian agricultural sector. Action lines include (i) information on climate change and risk management to guide decision-making; (ii) sustainable agricultural practices; (iii) resilience of the agricultural sector as a strategy to face risks due to extreme weather events; (iv) investment and policies for resilient and low-carbon rural development; and (v) institutional coordination, research, and capacity building.

Aligned with the Paris Agreement under the UNFCCC, Colombia is updating its Nationally Determined Contribution (NDC) to submit by the end of 2020. In doing so, the sectoral ministries, responsible for the implementation of Sectoral Climate Change Plans (Colombian Congress, 2018), are currently identifying mitigation actions defined in each PIGCCS to assess the feasibility to include them in the updated NDC and achieve

[2] Values at current prices, from 2005 to 2019 (provisional).

[3] Colombian Institution of Environmental Studies, which officially manages climate and environmental information of the country.

[4] Interview with Felipe Torres, AFOLU specialist of the National GHG Inventory. March 2020.

its sectoral emissions budget (MADS, 2019). Figure 2 shows the process flow of the sectoral engagement and participation in the NDC updating process. In this update, reference and mitigation scenarios are built from sectoral assumptions and mitigation measures that are fully formalized in Sectoral Climate Change Plans.

The design of NDC agricultural scenarios and targets is led by the MADR, which also manages the implementation of the PIGCCS-Ag. This ministry is currently evaluating mitigation potentials and baselines of sustainable livestock production, commercial forestry, sustainable rice production, and coffee and cocoa agroforestry systems in measures of its PIGCCS-Ag (MADR, 2019), as an input for the NDC update. In the process to define and validate the data and calculations, the MADR has developed working arrangements with a variety of stakeholders[5] in order to discuss the proper mechanisms to improve data sources and estimation uncertainties.

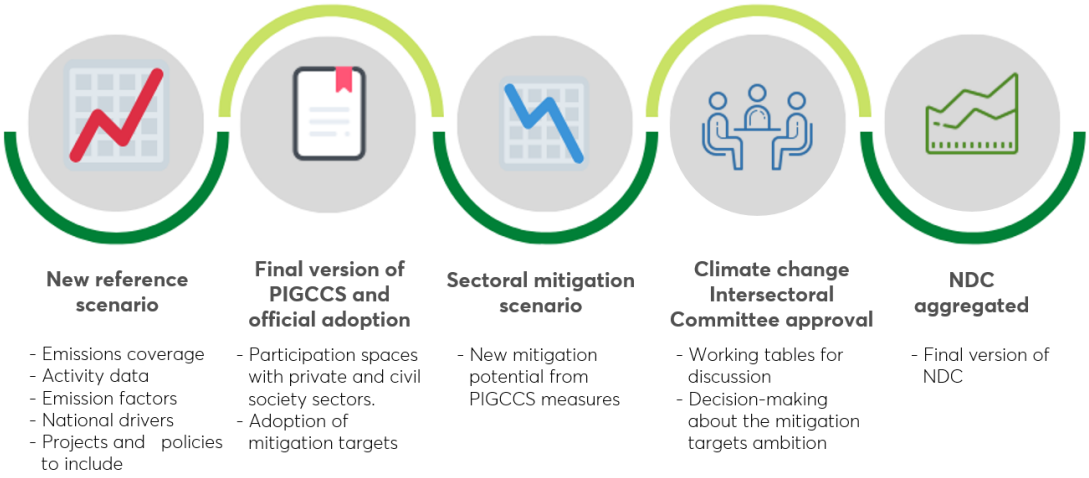


Figure 2. Sectoral engagement process for Colombian NDC building. Modified from MADS (2019).

Role of EC-LEDS research outputs in improving mitigation decision-making in the agricultural sector

In 2019, the EC-LEDS program worked with the International Center for Tropical Agriculture (CIAT), now the Alliance of Biodiversity International and CIAT,[6] and the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) to support Colombian institutions in enhancing national understanding on agricultural GHG emissions and better decision-making. This project has developed two research outputs: (i) a decrease in uncertainties in N_2O emission calculations associated with applied nitrogen fertilizer and (ii) assessing the mitigation potential of cacao agroforestry systems, carbon sequestration potential and best practices. The following sections develop the objectives, methodologies, and main results of these studies.

Decrease in uncertainties in N_2O emission calculations associated with applied nitrogen fertilizer

In 2014, nitrogen fertilization accounted for 28% of GHG emissions from the management of agricultural lands (Aggregate Sources and Non-CO_2 Emissions, IPCC category 3C) and 2.6% of the total agricultural sector of Colombia (AFOLU module) (IDEAM et. al., 2018). The uncertainty associated with these emissions ranges from 11% to 14%, which is mainly driven by the limited information about fertilizer use in the agricultural sector (Pulido et al., 2019). The estimation uses only 17% of total fertilizer sales in Colombia. Moreover, the emission calculation is made with aggregated nitrogen fertilizer data (ibid.). The emissions from urea application are not calculated in Colombia so far due to the unavailability of urea-use data.

The National Inventory Report of 2019 (Pulido et al., 2019) and the IDEAM team informed the needs to decrease uncertainties in the estimation of direct and indirect N_2O emissions from fertilizer use in crop production. Therefore, information about the amounts of nitrogen in fertilizer applied per crop in crop production by region can support estimates of GHG emissions with minimum errors. This estimation can account for soil types, application methods, climate, and other factors.

The EC-LEDS' study focused on improving the estimations of soil N_2O emissions associated with applied nitrogen fertilizer, disaggregated by region and crop type, and the calculations of CO_2 from urea fertilizer application.

[5] In the first workshop in November 2019, 53 people from different organizations participated, including IDEAM, MINAMIBENTE, MINAGRICULTURA, CIPAV, REFOCOSTA, PNUD, FEDEPANELA, NATURAL HERITAGE, FENALCE, FEDEGAN, CIAT, UPRA, ACTION FUND, FEDEMADERAS, FAO, FEDEARROZ, FEDEPALMA, and GIZ.

[6] Since 2020, Bioversity International and the International Center for Tropical Agriculture (CIAT) have joined forces to create an Alliance in response to the global challenges of poverty, malnutrition, climate change, land degradation, and biodiversity, delivering research-based solutions that harness agricultural biodiversity and sustainably transform food systems to improve people's lives. https://ciat.cgiar.org/alliance/

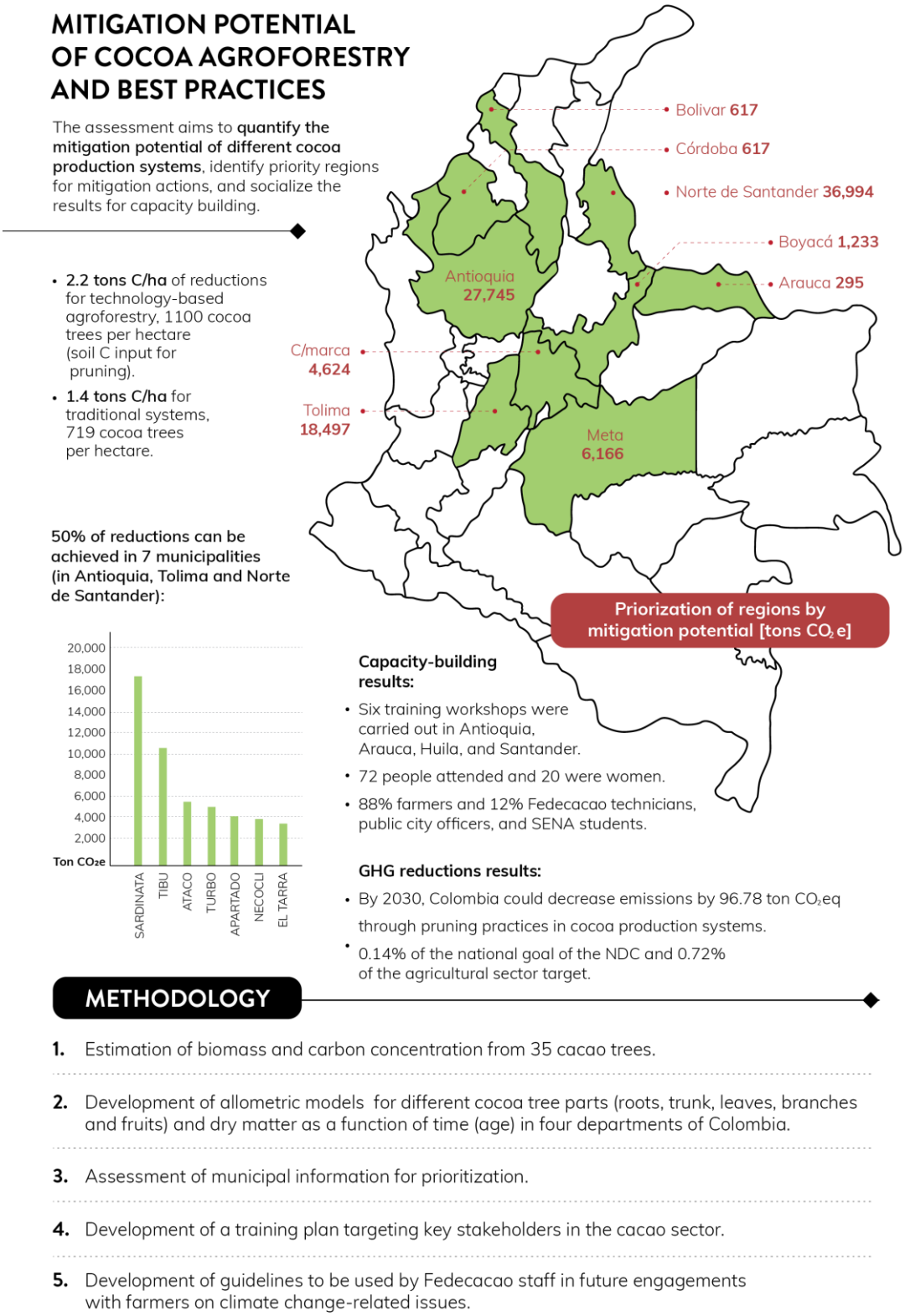


Figure 3. Methodology and results in decreasing uncertainties in N_2O emission calculations associated with applied nitrogen fertilizer.

The results of the study impact the National GHG Inventory in the subcategories 3C3 (urea application), 3C4 (direct N_2O emissions from managed soils), and 3C5 (indirect N_2O emissions from managed soils; volatilization and leaching).

The study included the collection of official sales' information on fertilizer, type of crop, and area of application. These data were compiled in collaboration with fertilizer companies and the Colombian Institute of

Agriculture (ICA in Spanish). Figure 3 summarizes the methods and results of the study.

Mitigation potential of cacao agroforestry systems, carbon sequestration, and best practices

Cacao productivity increases by renovating plantations through selective pruning, increasing tree density, selecting clones, and using fertilizer (Charry et al., 2019). In Colombia, the average in-field yield of cacao of the past 5 years was 542 kilograms per hectare per year (MADR, 2020), which is far below the potential yield of a cacao plantation. Cacao crops in Colombia are characterized by being understory crops on plantations with high shading and almost no external labor costs. The Colombian Cacao Producers' Federation (FEDECACAO in Spanish) has identified the rehabilitation and renovation of plantations as a key activity of its National Plan for Cacao Development. According to this plan, with increased technical support and good market prices, the area under intensive cacao production is expected to rise with modified existing and new plantations. Under these conditions, selective pruning (increasing soil carbon inputs), more tree density (carbon sinks), and efficient use of fertilizer are key options for mitigating GHG emissions from cacao plantations. The priorities in cacao in Colombia focus on plantation rehabilitation and pruning. The study was validated by FEDECACAO technicians and cacao producers. Figure 4 presents the methods and results of the study in detail.

Contribution of EC-LEDS research outputs to national climate policies

The results of the studies supplement national climate policy processes in two ways: (i) the National GHG Inventory and the forthcoming Third Biennial Update Report (emissions 2014–2016) and (ii) the PIGCCS-Ag, the sectoral input to NDC. Figure 5 shows the relation between the EC-LEDS research outputs and national public policies and the actions taken during the first semester of 2020.

National GHG Inventory and the forthcoming Third Biennial Update Report

The research output "*Reduction of uncertainties in N_2O emissions calculations associated with applied nitrogen fertilizer*" contributed to IDEAM's aim to improve national GHG estimations. The results of this study enhanced data activity of IPCC categories 3C4 and 3C5 and systematized new information for urea application in IPCC category 3C3.

During the study, data assessment and actors' engagement activities were carried out with supervision and continuous support from IDEAM's GHG inventory team. Their understanding of IPCC methodologies, national statistics, and institutional capacity were crucial for refining information and calculations. This collaborative work made it possible to integrate the results as an input for the GHG National Inventory.

Currently, Colombia is preparing its sixth GHG inventory, with emissions updated to 2016. For the AFOLU module, it is planned to include the improvements in nitrogen fertilizer data to calculate direct and indirect N_2O emissions from managed soils and urea application data for new category 3C3. It is expected that the uncertainties of these calculations will decrease by 10% to 20% for the numbers in the Aggregate Sources and Non-CO_2 Emissions (IPCC category 3C). This inventory can be reported to UNFCCC in Colombia's Third Biennial Update Report of 2021.

PIGCCS-Ag and sectoral input to the NDC

In Colombia, the NDC updating process consists of assessing the mitigation actions of sectoral climate policies and evaluating how feasible it is to implement them with different stakeholders. For the agricultural sector, the MADR is using the mitigation measures defined in its PIGCCS-Ag to assess the viability and include them in the NDC accountability. EC-LEDS research outputs not only contribute to effectively leading PIGCCS-Ag toward low-emission agriculture but also provide essential information for current NDC calculations within the updating process.

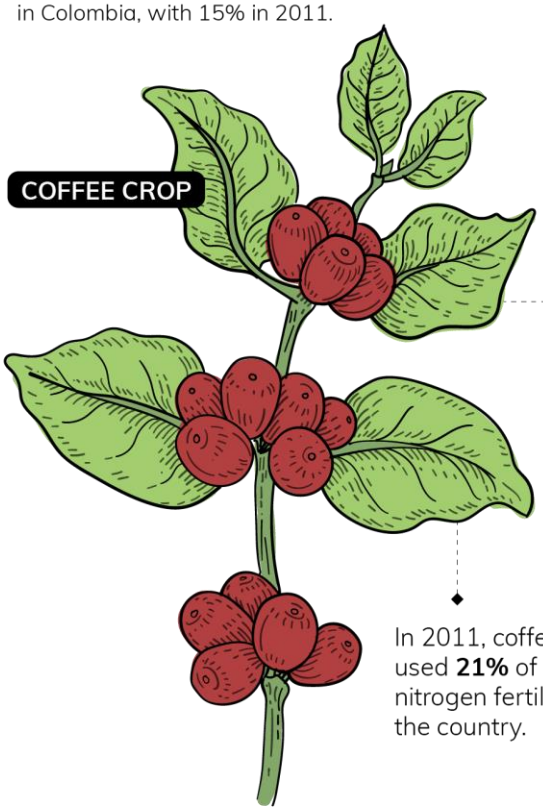
The research output on decreasing uncertainties in N_2O emission calculations helps the MADR to include better information on nitrogen fertilizer in its PIGCCS-Ag. In Measure 1.1 about generating information related to climate change and risk management useful for decision-making in the agricultural sector at national, regional, departmental, and municipal levels, the numbers on GHG emissions and fertilizer by crop were updated in Measure 1.1 For future decision-making on decreasing rates of fertilizer in crops, the updated plan highlights the importance of these emissions for the agricultural sector.

The mitigation potential of cacao agroforestry systems provides information on the carbon balance of cocoa production and its potential to decrease GHG emissions in different regions. Since cacao plantations are promoted as development policy, the MADR acknowledges the carbon benefits from the renewal and restoration of plantations. Therefore, the estimations of carbon reduction potential and the regions' priority were included in the PIGCCS-Ag, Measure 2.3, "Increase the biological diversity of agricultural production systems to reduce GHG emissions, decrease their vulnerability to climate change, and improve preparedness for the risk of disasters due to climate-related phenomena."

DECREASING UNCERTAINTIES IN ESTIMATING N_2O EMISSION ESTIMATES

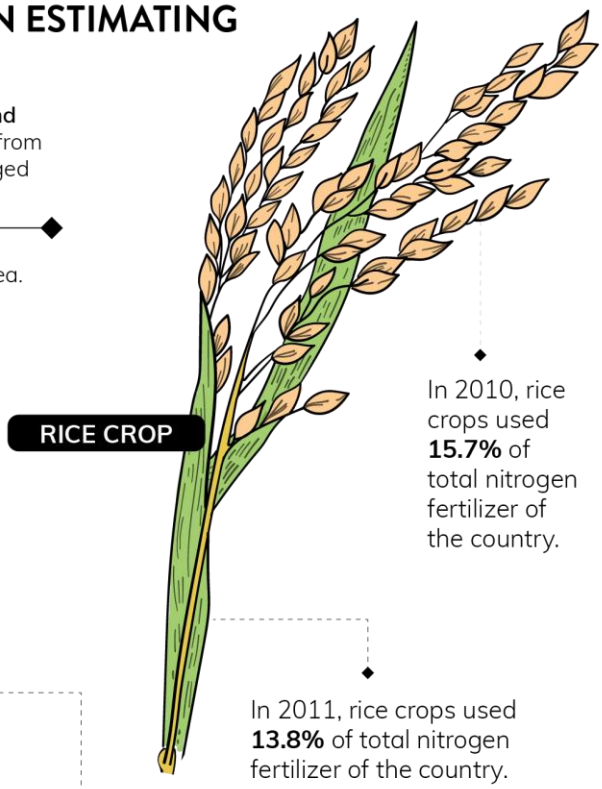
The assessment aimed to **improve the activity data and calculations of urea application**, direct N_2O emissions from managed soils, and indirect N_2O emissions from managed soils subcategories for the **Colombian GHG Inventory.**

- Rice, coffee, and pastures; are the largest users of urea.
- 90% of fertilizers are sold by six companies.
- In 2010, sugar cane, coffee, potato, and pastures together used 8% of the total nitrogen fertilizer in Colombia, with 15% in 2011.



In 2010, coffee crops used **31%** of total nitrogen fertilizer of the country.

In 2011, coffee crops used **21%** of the total nitrogen fertilizer of the country.



In 2010, rice crops used **15.7%** of total nitrogen fertilizer of the country.

In 2011, rice crops used **13.8%** of total nitrogen fertilizer of the country.

- Uncertainty decreases by 1020%- in 3C3 (urea application), 3C4 (direct N_2O emissions from managed soils), and 3C5 (indirect emissions from managed soils; volatilization and leaching) subcategories of the National GHG Inventory.
- 3C3 (urea application) is a new IPCC subcategory calculated for the National GHG Inventory and the forthcoming Third Bienal Update Report of Colombia.

Estimations results for 2010

3C3 (urea application):
90.7 Gg CO_2e

3C4 (direct N_2O emissions from managed soils)
1401 Gg CO_2e

3C5 (indirect N_2O emissions from managed soils)
Volatilization: 140.2 Gg CO_2e
Leaching: 315 Gg CO_2e

**The assessment was commissioned by USDA through the EC-LEDS program and developed by CIAT-CCAFS.*

METHODOLOGY

1. Data collection for 20 crops (crop area, area of fertilizer application, amount of fertilizer sold, etc.)
2. Identification of nitrogen requirements by crop.
3. Identification of fertilizer use per crop.
4. Distribution of the amount of nitrogen fertilizer applied by crop.
5. GHG emissions estimations by crop.

Figure 4. Assessing the mitigation potential of cacao agroforestry systems, carbon sequestration potential, and best practices.

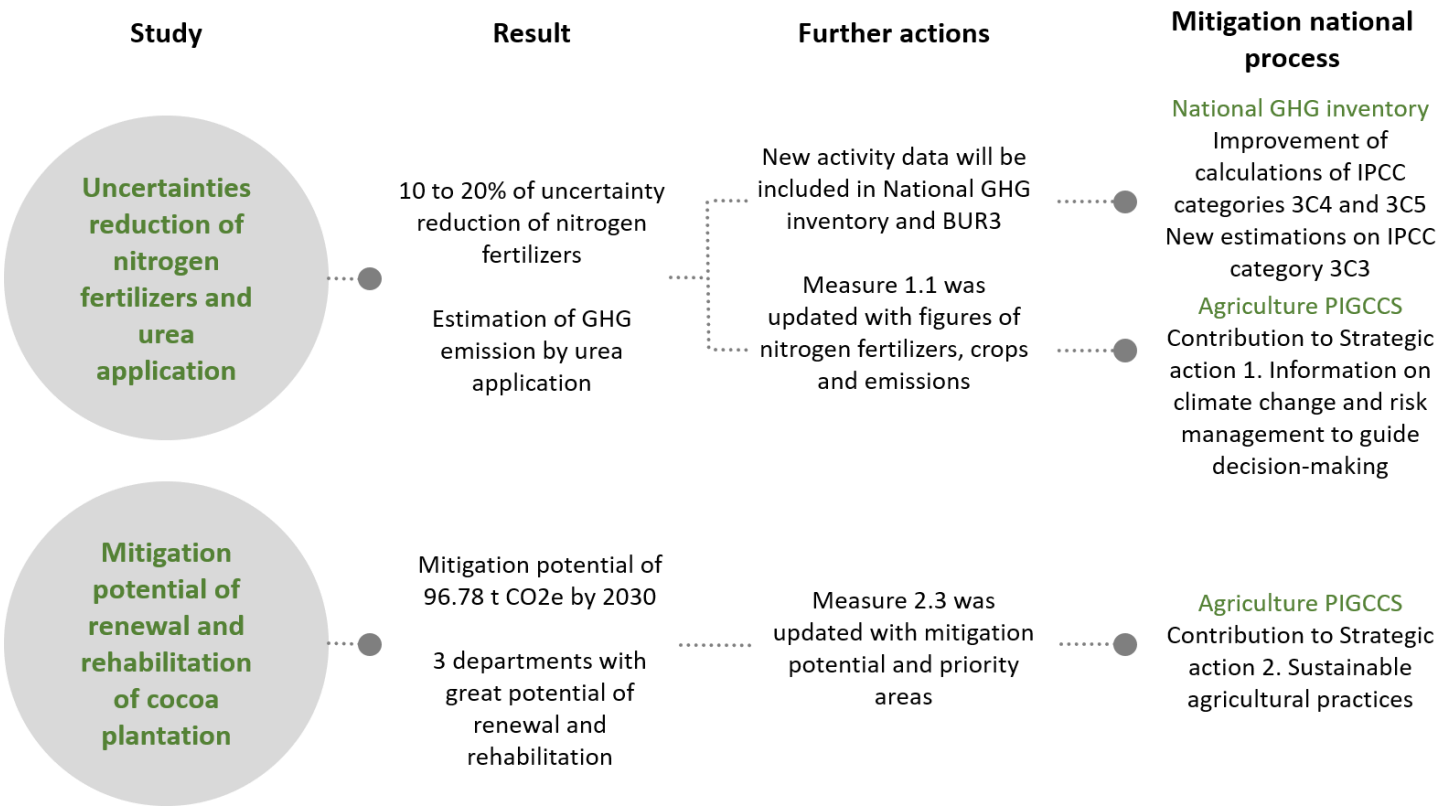


Figure 5. Impact of EC-LEDS research outputs for national climate policies and processes.

The MADR participated in and supported developing research outputs through the advocacy of research activities, including meetings and workshops with key actors. Prior knowledge of the research outputs and institutional involvement helped to include the results of research outputs in the PIGCCS-Ag.

Scaling the use of research outputs

Although the funding of EC-LEDS projects in the agricultural sector has led to technical outputs, uptake of these outputs can be strengthened. At the same time, decision makers for LED strategies have not had timely, accessible, or integrated technical information. There is a need to better support decision makers' use of technical information to support strategic emission reduction planning for the NDC, agricultural policy development, and the National GHG Inventory. During the first semester of 2020, KIMSA7 met with relevant actors[8] to identify the key actions needed to enhance decision-making on low-carbon development in agriculture.

Further strengthening research outputs

Although the National GHG Inventory has been strengthened through research outputs in data activity for nitrogen fertilizer, opportunities still exist to decrease uncertainties in categories 3C3, 3C4, and 3C5. Currently, the National GHG Inventory reports uncertainties of 11–14% in category 3C4 and 11–13% in category 3C5. The improvement in data activity and emission factors will strengthen IDEAM's capacity as well as the reporting of GHG emissions in the AFOLU module.

Higher certainty regarding data on nitrogen fertilizer will improve the understanding of emissions in the agricultural sector and will lead to improving the decision-making of MADS and MADR for national and subnational policies, for example, PIGCCS-Ag, NDC updating, and climate actions of agricultural associations.

On the other hand, institutional arrangements are needed to guarantee the reporting of data on nitrogen fertilizer to IDEAM. Currently, most of this information is collected by the Colombian Institute of Agriculture and fertilizer traders; however, the data are not systematically organized nor do traceability procedures exist. Therefore, it is essential for national GHG accountability to generate agreements on collaboration and systematic procedures of data transfer with ICA and fertilizer sellers to allow IDEAM to have regular and timely data on the use of nitrogen fertilizer in the country.

[7] Consultancy company that assesses the needs of public climate policies and current processes of NDC updating and it elaborated an Action Plan to strengthen the impact pathway of EC-LEDS study outputs.

[8] MADR, MADS, IDEAM, Colombian LED, CIAT, FEDEARROZ, AGROSAVIA, FENALCE, FEDECACAO, FEDECAFE, and FINAGRO.

The Cacao Producers' Federation suggests developing an explanatory guide on mitigation actions in cacao plantations elaborated within the low-carbon cacao project and improved inventories for Colombia. The implementation of mitigation options in cacao plantations requires biophysical and socioeconomic characteristics of the regions and cacao growers.

An MRV pilot of GHG reductions and/or removals in the renovation/rehabilitation of cacao plantations can help to explore the real decreases and the contribution of cacao producers to the NDC targets. In addition, the Cacao Producers' Federation has shown great interest in implementing actions on measurement and reporting of its practices in national platforms such as RENARE, which is managed by MADS.

Institutionalization of research outputs

Uptake of the research outputs and their inclusion in institutional systems are key for the use of research outputs to reach scale. The NDC updating process consists of assessing the mitigation actions of sectoral climate policies and evaluating how feasible their implementation is with different stakeholders. For the agricultural sector, the MADR is using the mitigation measures defined in its PIGCCS to assess the viability to include them in NDC accountability.

The inclusion of results of data activity for fertilizer emission estimates and estimates of carbon balance for cacao agroforestry systems in the PIGCCS-Ag can inform Colombia's NDC. These mitigation actions will be reflected in the National GHG Inventory and Colombian mitigation targets. The MARD can initialize capacity-building activities on nitrogen fertilizer use and cacao production with low-emission options in its extension program. This will ensure continuation of research outputs using GHG mitigation actions.

Developing a LED knowledge platform

There is a need to better support decision makers' use of technical information for strategic emission reduction planning, policy development, and implementation to deliver significant mitigation outcomes. Creation of a comprehensive website or other effective communication platforms will showcase LED best practices, data, guidelines, and tools that can support LED experts and policymakers in the country. The platform can be linked to other currently available platforms such as USDA Climate Hubs, CCAFS data portal, and FAO that can provide information to design and implement LED actions in Colombia.

Further reading

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