Info Note

Scaling up the use of low-emissions development (LED) research outputs in Colombia

Linking science to policy for supporting country's LED agriculture

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Key messages

- National greenhouse gas (GHG) inventories can be improved to achieve Colombia's nationally determined contribution (NDC) target and support low-emissions development (LED) agriculture by reducing uncertainties in emission calculations using activity data for fertilizer application and estimates of emission reduction potentials from cacao plantations.
- Co-design of LED research outputs (i.e., activity data for fertilizer emission estimates and GHG mitigation potential of cacao plantations) and evaluation of their impact pathway with users ensures scaling up the use of outputs by implementing key actions along the impact pathway.
- Communication, engagement, and capacity-strengthening for the use of activity data for fertilizer emission estimates and GHG mitigation potentials of cacao plantations are key components of scaling research outputs and generating impacts.

GHG emissions from the agriculture, forestry, and other land use (AFOLU) sector contributed an average of 65% from 1990 to 2014 to the total GHG emissions in Colombia (IDEAM et al. 2018). Agricultural activities, such as livestock and manure management, biomass burning, nitrous oxide (N_2O) emissions from managed soils, croplands, and rice cultivation, contribute 26% to AFOLU emissions and 14% of the total GHG emissions (ibid). To reduce GHG emissions from AFLOU, Colombia prioritizes LED in its domestic climate change policies and international pledges, such as the Colombian Low Carbon Development Strategy and NDC (World Bank. 2014).

The United States Department of Agriculture's (USDA) Foreign Agricultural Service (FAS)–with funding from the Department of State through the Enhancing Capacity for Low-Emission Development Strategies (EC-LEDS) program–partnered with the International Center for Tropical Agriculture (CIAT) to identify the GHG mitigation potential of crop cultivation and cacao plantations. This partnership developed two key research outputs: activity data for fertilizer emission estimates and the mitigation potential of cacao plantations in Colombia.

Activity data for fertilizer emission estimates provides key information to improve Colombia's national GHG inventory. The activity data disaggregates the amount of nitrogen fertilizer use by crop type, area, and source. This data reduces the uncertainties in N_2O emission calculations associated with applied nitrogen fertilizer. These calculations can account for soil types, application methods, climate, and other factors. Rice, coffee, and pastures are the largest users of nitrogen fertilizer in Colombia, followed by sugar cane and potato cultivation. The improved activity data reduces the uncertainties in N_2O emission estimations of nitrogen application on crops.

The mitigation options evaluated for Colombian cacao plantations have a large potential to improve cacao production and farm income with mitigation co-benefits. Cacao productivity increases with selective pruning, increased tree density, selection of clones, and efficient use of fertilizers (Charry et al. 2019.). Selective pruning and high-density plantation also increase above-ground biomass and carbon sequestration. The mitigation potential of cacao-based agroforestry in Colombia ranges from 1.4 t CO_{2e} ha^{-1} (in traditional systems) to 2.2 t CO_{2e} ha^{-1} (with best practices). High-density plantations and

efficient use of fertilizer can increase the mitigation of GHG emissions of cacao plantations.

The USDA EC-LEDS program provided support to enhance the impact of the research outputs by increasing their use in Colombia. The CGIAR Research Program on Climate Change, Agriculture, and Food Security (CCAFS) Flagship for Low-Emissions Development and CIAT–in collaboration with Colombia's agriculture sector policymakers, the Institute of Hydrology, Meteorology and Environmental Studies[1] (IDEAM) and the NDC updating team–jointly evaluated the research outputs and co-designed an impact pathway. This work's main objective was to develop the action plan and implement the key activities for scaling the use of activity data for fertilizer emissions estimates and mitigation options for cacao plantations in Colombia.

The need for upscaling the use of research outputs

Uncertainties in N_2O emission calculations associated with nitrogen fertilizer application on crops are a major barrier to improving national GHG inventories. The uncertainty associated with these emissions in Colombia is between 11-14%, which is driven by the limited information on fertilizer use in the Colombian agriculture sector (Pulido et al. 2019). The current estimation uses only 17% of total fertilizer sales in Colombia and the emissions from urea applications are not calculated due to a lack of data on urea use. The National Inventory Report of 2019 and the IDEAM indicated a need to reduce uncertainties in the estimation of direct and indirect N_2O emissions from the nitrogen fertilizer use in crop production. The activity data for nitrogen fertilizer use in different crops and regions can improve Colombia's national GHG inventory and guide prioritization of mitigation options by crop and region.

The Government of Colombia is responding to an increasing domestic and international demand for cacao by promoting new farms and the renewal of old plantations in areas suitable for cacao cultivation. Additionally, the Colombian Association of Cacao Producers has identified the rehabilitation and renovation of plantations as a key activity of its National Plan for Cacao Development. The promotion of selective pruning, high-density planting, and efficient use of fertilizers are key options for mitigating GHG emissions from the plantations. Also, this can potentially contribute to achieving the NDC target of reducing 20% of total GHG emissions from a business-as-usual (BAU) scenario by 2030.

Implementation of key actions

The impact pathway (Fig. 1) of scaling the use of activity data for fertilizer emissions estimates and mitigation options for cacao plantation includes actions required to generate mitigation outcomes in the Colombian agriculture sector. Key actions were identified by assessing the research outputs for their relevance in the country, communication and engagement with the stakeholders, and the progress to date along the impact pathway. An action plan was developed in consultation and collaboration with the policymakers responsible for LED strategies in Colombia's agriculture and allied sectors.

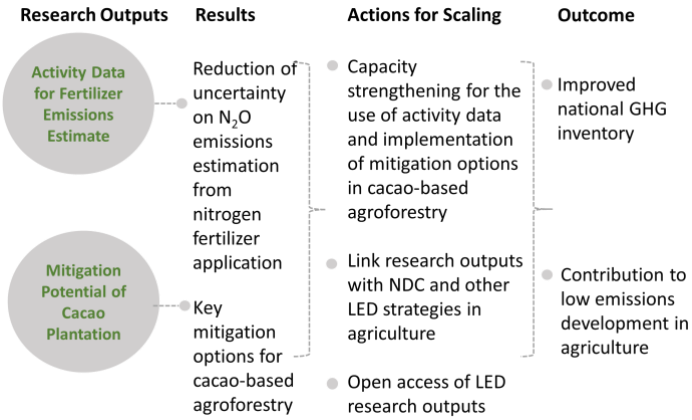

Figure 1. Impact pathway of scaling the research outputs to support LED agriculture

The key actions implemented for scaling the use of research outputs in Colombia include:

Capacity strengthening: The activity data of fertilizer emission estimates and mitigation options for cacao plantations support government planners, extension officers, and cacao farmers by enabling robust estimates of GHG emissions from fertilizer use and prioritizing mitigation options for cacao. Capacity strengthening activity included identifying and collecting reliable activity data, improving knowledge of activity data sources, collection methods, and emission calculations for synthetic fertilizer use on different crops.

Institutions that directly or indirectly contributed to improving the national GHG inventory and promoting cacao mitigation options participated in the training activities. The key institutions were the IDEAM, the Ministry of Agriculture and Rural Development (MADR), the National University of Colombia, National Cereals Federation (FENALCE), the National Federation of Cacao Growers (FEDECACAO), the Ministry of Environment and Sustainable Development (MADS), the Colombian Corporation for Agricultural Research (AGROSAVIA), the

[1] IDEAM is the Colombian institution of environmental studies who officially manages the country's climate and environmental information

National Federation of Rice Producers (FEDEARROZ), and fertilizer companies.

Linking with the national LED strategy: The IDEAM focuses on improving the collection of activity data and GHG calculations to make informed LED strategy decisions. Activity data of nitrogen fertilizer use for emission estimates can improve the decision-making related to the Sectoral Climate Change Plan for Agriculture (PIGCCS-Ag), NDC updating, and mitigation actions in agriculture. The PIGCCS-Ag aims to identify, articulate, and address measures to limit GHG emissions from the agricultural sector. As per the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC), Colombia is reviewing and updating its NDC for submission to the UNFCCC by the end of 2020. The activity data of fertilizer emission estimates and mitigation options were updated in the PIGCCS-Ag.

Open-access for research outputs: Making activity data for fertilizer emission estimates and mitigation options open-access can increase their use across the country. The research outputs, including resources related to agricultural emissions estimates, mitigation options, policies, and programs in Colombia, are included in the open-access webpage. Open-access LED resources give national policymakers better access to LED research outputs and other resources for mitigation planning in agriculture.

Key Outcomes

Use of activity data for national GHG inventories

The research output "Activity data for fertilizer emission estimation" contributed to improving the national GHG inventory of Colombia. The IDEAM, responsible for improving the national GHG inventory, has incorporated the activity data for fertilizer emission estimation. This output enhanced activity data of the Intergovernmental Panel on Climate Change (IPCC) categories 3C4[2] and 3C5[3] and systematized new information for urea fertilizer application in the IPCC category 3C3[4].

Colombia is preparing its sixth national GHG inventory with updated emissions from 2016 estimates. For the AFOLU module, the activity data contributed to calculating direct and indirect N_2O emissions from managed soils and fertilizer applications for the new IPCC category 3C3. This updated inventory will be reported to the UNFCCC in Colombia's Third Biannual Updated Report of 2021.

Agricultural sectoral inputs to Colombia's NDC

The Ministry of Agriculture and Rural Development (MADR) assesses the viability of mitigation measures defined in its PIGCCS-Agriculture and includes them in the NDC accountability. The research output on reducing uncertainties in N_2O emission calculation (Activity Data) enables the MADR to include activity data in its climate change plans (PIGCCS-Ag). GHG emission estimates and fertilizer use by crop type were updated in the PIGCCS-Ag Measure 1.1. The updated plan highlights the importance of fertilizer use and emission reduction from the different crops in Colombia.

The mitigation potential of cacao agroforestry systems provides information on mitigation options and their GHG emission reduction potentials in different regions. The MADR acknowledges the carbon reduction benefits from the renewal and restoration of cacao plantations in Colombia. Thus, the estimates of carbon reduction potentials and the regions' priority were included in the PIGCCS-Ag, Measure 2.3. The updated plan highlights the importance of fertilizer use and emission reductions from different crops in Colombia.

Conclusions and recommendations

The partnerships among governments, researchers, and bilateral organizations in Colombia are crucial to developing and refining LED research outputs, communication with stakeholders, and integration into the country's LED policies and strategies. The "last mile" actions, such as evaluating impact pathways of research outputs and identifying and implementing key actions, supported the use of research outputs by LEDS decision-makers and NDC implementers. The collaborative work with MARD and IDEAM made it possible to integrate the results as an input for the national GHG inventory and Colombia's Climate Change Plans for Agriculture (PIGCCS-Ag).

Research outputs' suitability for policy needs and contribution to LED strategies enhance policymakers' participation in the different steps of the LED impact pathway. In Colombia, agriculture is one of the major sources of GHG emissions, and their current policies and programs target reducing agriculture emissions without compromising agricultural growth and income. The LED research outputs developed and evaluated in Colombia can help plan the improvement of fertilizer use efficiency in croplands and enhance cacao production with GHG mitigation co-benefits. These research outputs fit the policy needs and contribute to the country's LED strategies outlined in the NDCs and other policies.

[2] IPCC 3C4: Aggregate Sources and Non-CO2 Emissions Sources on Land - Direct N2O Emissions from Managed Soils)

[3] IPCC 3C5: Aggregate Sources and Non-CO2 Emissions Sources on Land - Indirect N2O Emissions from Managed Soils)

[4] IPCC 3C3: Urea fertilizer application

The work helped increase the uptake of the EC-LEDS research outputs by developing and integrating them into its LED strategies. Scaling the use of research outputs by many stakeholders requires substantial investments in institutional transformation and extension services, especially from public budgets and private sector investment. Mobilization of domestic and international climate finance is necessary to increase the LED research outputs use and support NDC implementation in Colombia.

Further reading

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