Promoting a Transition to Sustainable Support for Agriculture in Colombia: Tracking Public Expenses on Green Investments and their Impacts

Executive Summary

This analytical report brings together two complementary pillars to understand Colombia's transition toward greener agricultural support. First, using Colombia's DNP climate-finance MRV, the study tracks green public spending in agriculture from 2011 to 2023. In doing so, it finds that green public investment remains marginal, rising only from about 1.81% to 2.37% of total agricultural public investment. Going further, territorial allocation was found to be unaligned with related needs. In this regard, it emphasizes the need to align downstream public finance allocations in agriculture to meet the ambitious upstream commitments regarding climate and nature.

Second, the report presents an impact evaluation to test whether shifting public support toward greener interventions risks reducing yields or production. To this end, it implements a municipality-level impact evaluation that classifies public contracts as 'green' or 'traditional,' comparing the value of agricultural yields across recipient and non-recipient areas. Through doing so, the study finds that there is no evidence to claim that green support underperforms traditional support, even in the short term. In the long term, green support outperforms that of a non-green nature in most specifications. Going further, is aggregated analysis reveals that productivity gains are clearest for green material investments. Overall, the data do not support the concern that 'greening' agricultural support undermines productivity and thus food security in this setting, providing the evidence needed to accelerate and upscale the transition in a manner that aligns with territorial needs.

Against this backdrop, this study proposes the following policy options:

1. Build on a long-term strategy that goes beyond specific administrations, setting explicit, time-bound scaling targets to move well beyond the current ~2% share of green agricultural spending.

2. Adopt transparent targeting criteria such as deforestation pressure, erosion risk, water stress, climate risk, and green investment per agricultural hectare as a part of the standard approval criteria for projects to allocate financial flows and to track their impact.

3. Design new and refine existing fiscal policies, such as input subsidies and rural credits, to support producers in the short term, where the economic benefits of sustainable agriculture may not be able to cover transition costs.

4. Implement large-scale public awareness campaigns to ensure producers are aware of the long-term benefits of sustainable agriculture.

5. Provide top-down guidance, as well as capacity building, to ensure that public procurement is supportive of agroecology-informed extension services.

6. Implement safeguards and monitoring tools to ensure a sustainable transition in existing agricultural territories, and to prioritize low-frontier-expansion risk projects when needed.

Section 1: Analysis of finance for nature to support sustainable, inclusive, and resilient food systems

1.1. Introduction

The world is undergoing a triple planetary crisis, characterized by climate change, nature and biodiversity loss, and pollution. Given the role finance plays in raising and implementing ambitions, the Paris Agreement seeks to "make financial flows consistent with a path to low-greenhouse gas emissions and climate-resilient development." In addition, the Kunming-Montreal Global Biodiversity Framework aims to "align financial flows with the Kunming-Montreal Global Biodiversity Framework and the 2050 Vision for Biodiversity." To this end, countries will not only have to mobilize 'positive' flows in a new and additional way but also redirect 'negative' forms of financing with the potential to offset or even reverse the environmental benefits gained.

In this context, Colombia has adopted ambitious national commitments at the upstream level. Through its NDCs, the country has committed to a 51% reduction in emissions by 2030, and through its Long-Term Low Emission Development Strategies, it has committed to carbon neutrality by 2050. In parallel, its National Biodiversity Strategies and Action Plans commit to achieving 34% conservation and management of terrestrial, inland water, and marine-coastal areas by 2030. These commitments reinforce the importance of understanding whether public investment is evolving in a manner consistent with the country's environmental objectives.

This is particularly relevant for the agricultural sector. According to Colombia's third Nationally Determined Contribution under the Paris Agreement (NDC 3.0), net greenhouse gas emissions in 2021 were led by Land Use, Land-Use Change, and Forestry (LULUCF), followed by energy and agriculture, which account for 34%, 33%, and 21%, respectively. Hence, through its direct and indirect contributions to LULUCF, agriculture is among the major contributors and needs further refinement to achieve greater sustainability, while ensuring sufficient productive outcomes.[1]

Against this backdrop, following consultations with the government, two analytical needs were identified at the downstream level in the agricultural sector. First, it is

[1] National deforestation analyses show that forest loss in Colombia has been associated with an evolving combination of factors across regions and periods, including agricultural frontier expansion, extensive cattle ranching and pasture expansion, land grabbing and land tenure dynamics, agroindustrial expansion in some territories, illicit crops, mining, and weaknesses in territorial governance (González et al., 2018).

imperative to understand whether sufficient 'positive' public financial flows for green agriculture are in place, especially in a way that aligns with the environmental needs of the country. Second, since concerns about economic trade-offs often shape the discussion about a possible transition, it is important to assess how these green investments affect agricultural productivity relative to traditional forms of support. Together, these questions help shed light on the place of green public investment within the broader fiscal framework for agriculture and on the rationale for expanding, sustaining, or rethinking its role.

To contribute to this agenda, this document takes two policy-relevant analytical steps. First, it documents the trajectory of green public investment in agriculture in Colombia over time and across territories. Second, it examines the relationship between these green investments and agricultural outcomes, focusing on area, production, and yields. Rather than attempting to provide an exhaustive classification of all agricultural support instruments, the document concentrates on these two empirical margins in order to provide evidence on whether green public investment has expanded and on the potential social and economic impacts of an acceleration of the transition towards sustainable support to agriculture.

1.2. Institutional Framework

To begin with, this paper will analyze the fiscal framework for green agriculture in Colombia. Through the analysis, it was found that Colombia has made progress in establishing an institutional framework to align its agri-food systems with the sustainability principles embedded in its upstream commitments. To this end, the country has established a two-tier system that operationalizes its upstream ambitions and translates them at the downstream level.

Regarding the former, this is actualized through three levels of institutions. First, legislative mandates establish the binding framework that commits the country to meeting its international commitments. In particular, Law 1931 of 2018 on General Climate Change Policy and Law 2169 of 2021 on Climate Action are most relevant. Second, national policy guidance sets the strategic direction to achieve these commitments. This includes CONPES 3700 of 2011 on climate policy coordination guidelines (DNP, 2011), CONPES 3934 of 2018 on Green Growth Policy, CONPES 4058 of 2021 on mitigation and adaptation to climate change, and CONPES 4088 of 2022 on Low Carbon Development. Third, such high-level policy guidance is executed through the National Climate Change System (SISCLIMA) planning instruments, which include the National Adaptation Plan (PNACC, 2012; 2016), sectoral mitigation plans, and sub-national climate plans.

Concerning the latter, a set of additional policy instruments reinforces the transition to sustainability in the agricultural sector. For example, CONPES 4021 of 2020, which is the National Policy for the Control of Deforestation and Sustainable Forest Management, prioritizes the curbing of forest loss and the consolidation of sustainable agro-environmental systems, catalyzing agroforestry reconversion. CONPES 4050 of 2021, or the Protected Areas Policy, and Colombia's 2030 Biodiversity Action Plan, mainstream biodiversity into agricultural development, encouraging ecological diversification at farm and landscape scales. Resolution 331 of 2024, which is the Public Policy on Agroecology, establishes a normative pathway for agroecological transition, reducing dependence on external inputs, strengthening climate resilience, and generating social co-benefits in rural territories. CONPES 3886 of 2017 on Payments for Environmental Services (PES) incentivizes the conservation of strategic ecosystems, offering a bridge to reorient portions of traditional agricultural subsidies toward performance-based, sustainability-aligned schemes. Box 1 sets out the vast majority of policies, their objectives, and their alignment with the transformation of sustainable agri-food systems.

Both of these upstream and downstream policy layers serve as umbrella policies that host a portfolio of fiscal policies that contribute to achieving their objectives. These include both revenue and expenditure policies. With respect to the latter, Colombia relies on two complementary instruments that allow investment flows to be tracked.

The first is the Colombian Green Taxonomy (TVC, 2022). This classification system uses eligibility criteria and a 'do-no-significant-harm' standard to categorize whether certain economic activities can be considered sustainable. In this regard, it is designed to be interoperable with international references such as the EU taxonomy.

The second is the Monitoring, Reporting, and Verification (MRV) system within SISCLIMA, which classifies investment flows reported by government entities as being supportive of mitigation, adaptation, or both. Such classifications are informed by the methodology from the Department of National Planning (DNP). To begin with, an algorithm performs the pre-classification of projects registered in public financial systems,[2] scanning climate-action keywords in titles, objectives, and project files.

[2] SIIF for the national budget; CUIPO for territorial budgets; and Gesproy for projects financed with royalties.

Subsequently, a decision tree maps each detected action to the SISCLIMA climate taxonomy and assigns the main label, which is mitigation, adaptation, or both. Triangulated through expert review, this is complemented by an updated methodological guide released in 2025, which standardizes a list of 272 indicative climate actions across ten sectors. Finally, the MRV defines an exclusion criterion. Activities with potential negative environmental or social impacts are only classified as climate finance when they include adequate environmental and social risk management measures that are aligned with national and international standards (DNP, 2025).

Box 1: Matrix of sustainable public policies for climate and agricultural sector

Policy Name	**Main objectives**	**Sustainable production measures**	**NBS mentions**	**Linked financial instruments**	**Remarks**
National Development Plan 2022 - 2026: Colombia World Power of Life (2023)	Promote a sustainable productive transition, organize the territory around water and promote environmental justice	Promotion of agroecology, bioeconomy, ecological restoration, efficient use of water	Yes	Productive subsidies, green credit lines, agroecological incentives	Provides a high-level framework for aligning financing instruments with NBS sustainability and promotion
National Climate Change Policy (2017)	Reducing vulnerability to climate change and promoting sectoral adaptation	Agricultural adaptation, emission reduction, landscape restoration	Yes	Adaptation Fund, Climate Incentives	Multisectoral Climate Action Base Framework with a Focus on Resilience
Colombia's Biodiversity Action Plan - 2030 (2021)	Conting, restoring and sustainably using biodiversity	Ecological restoration, integrated management of	Yes	Payments for environmental services, biodiversity funds	Includes goals compatible with NBS and territorial approaches

		productive landscapes			
CONPES 3934 of 2018 - Green Growth Policy (2018)	Promote low-carbon economic growth and efficient use of resources	Promotion of the bioeconomy, energy efficiency, sustainable agriculture	Yes	Green credits, incentives for efficiency in the use of resources	Intersectoral framework for moving towards sustainable models
Resolution 331 of 2024 - Public Policy on Agroecology (2024)	Promoting the agroecological transition in production systems	Incentives for agroecological practices, differentiated technical assistance	Yes	Agroecological subsidies, special rural credit lines	Explicit policy promoting NBS principles and rural sustainability
CONPES 3886 of 2017 - National Program of Payments for Environmental Services (2017)	Recognize and compensate for the voluntary conservation of strategic ecosystems	Payments for environmental services, community conservation	Yes	PSA, conservation incentives	Financial scheme directly aligned with NBS
CONPES 4021 of 2020 - National Policy for the Control of Deforestation and Sustainable Management of Forests (2020)	Halting deforestation and promoting sustainable forest use	Support for sustainable forest production models, territorial governance	Yes	Forestry incentives, PES, resources from the Sustainable Colombia Fund	Articulates productive and conservation actions at the territorial level

Decree 690 of 2021 - Sustainable Management of Wild Flora and Non-Timber Forest Products (2021)	Regulate the sustainable use of wild flora and non-timber forest products	Certifications, management plans, responsible trade	Yes	Conditional permits, conservation incentives	Key for rural communities that depend on these resources
CONPES 4050 of 2021 - Policy for the consolidation of the National System of Protected Areas (SINAP) (2021)	Consolidate the integrated management of protected areas and strategic ecosystems	Conservation approach compatible with sustainable production	Yes	PES, international cooperation, territorial resources	Direct link between conservation, production and well-being
Resolution 126 of 2022 - Sustainable Cattle Farming Policy 2022-2050 (2022)	Promoting the conversion towards environmentally sustainable livestock farming	Promotion of silvopastoralism, pasture restoration, water efficiency	Yes	Subsidies, technical assistance, green lines	It provides clear instruments for the transformation of the subsector
Resolution 355 of 2021 - Comprehensive Agricultural Sector Climate Change Management Plan (2021)	Establish the adaptation and mitigation strategy for the agricultural sector	Water management, agroecology, productive restoration	Yes	Territorial plans and projects eligible for cooperation	Integrate practical actions with a climate focus for the sector

CONPES 3918 of 2018 - Strategy for the Implementation of the Sustainable Development Goals (SDGs) (2018)	Establish guidelines for the fulfillment of the 2030 Agenda in Colombia	Sustainable production, rational land use, rural poverty reduction	Yes	Integration with public budgets and cooperation	Comprehensive Framework for National Strategic Alignment
Law 1876 of 2017 - National System of Agricultural Innovation (SNIA) (2017)	Organize and strengthen agricultural research, extension and training	Agricultural extension, territorial innovation, technology transfer	No	Resources for Research and Technical Assistance	Operational base for integrating sustainable practices in the field
National Policy on Ecological Restoration (2022)	Guiding and scaling ecological restoration processes at the national level	Restoration of soils, productive ecosystems, biological corridors	Yes	Projects with resources from the Environmental Fund, PES	Articulated with sustainable agricultural incentives
National Climate Finance Strategy (EFIC)	Identify sources and mechanisms for financing climate action	Climate subsidies, green public investment, adaptation in rural sectors	Partial	Green credits, international cooperation	Green financial action framework that can integrate rural incentives

1.3. Related Investment Flows

Therefore, we use the official MRV data from 2011 to 2023 as an empirical basis to analyze 'green' public investment in agriculture for three reasons. First, the MRV can be filtered to exclusively capture public finance. Second, the MRV offers a subset of investments that are classified as being agricultural in nature. Third, these subsets of projects are mapped against environmental objectives, such as mitigation, adaptation, conservation of ecosystems and biodiversity, water and soil management, circular economy, and pollution prevention and control.

To assess whether the MRV can serve as an appropriate proxy for ‘green’ investment, we provide a didactic mapping of the correspondence between MRV and TVC activities and objectives in the figure below, rather than a one-to-one concordance of terms. This alignment is supported by two additional keyword-based triangulation measures. The first, conducted and validated by the Ministry of Finance, maps MRV-classified activities to TVC-eligible actions, confirming strong alignment for the agricultural sector. As shown in Table 1 of Appendix A1, MRV entries without a direct TVC match are primarily projects supporting cooperative or community-based production for resilience, with the rest having a direct correspondent. The second is the reverse exercise. We take the full list of TVC-eligible agricultural activities and verify if each is also contemplated in the MRV action list. The result, as detailed in Appendix A1 Table 2, is that none of the TVC-listed activities are absent from MRV. These findings reinforce the alignment between the two systems.

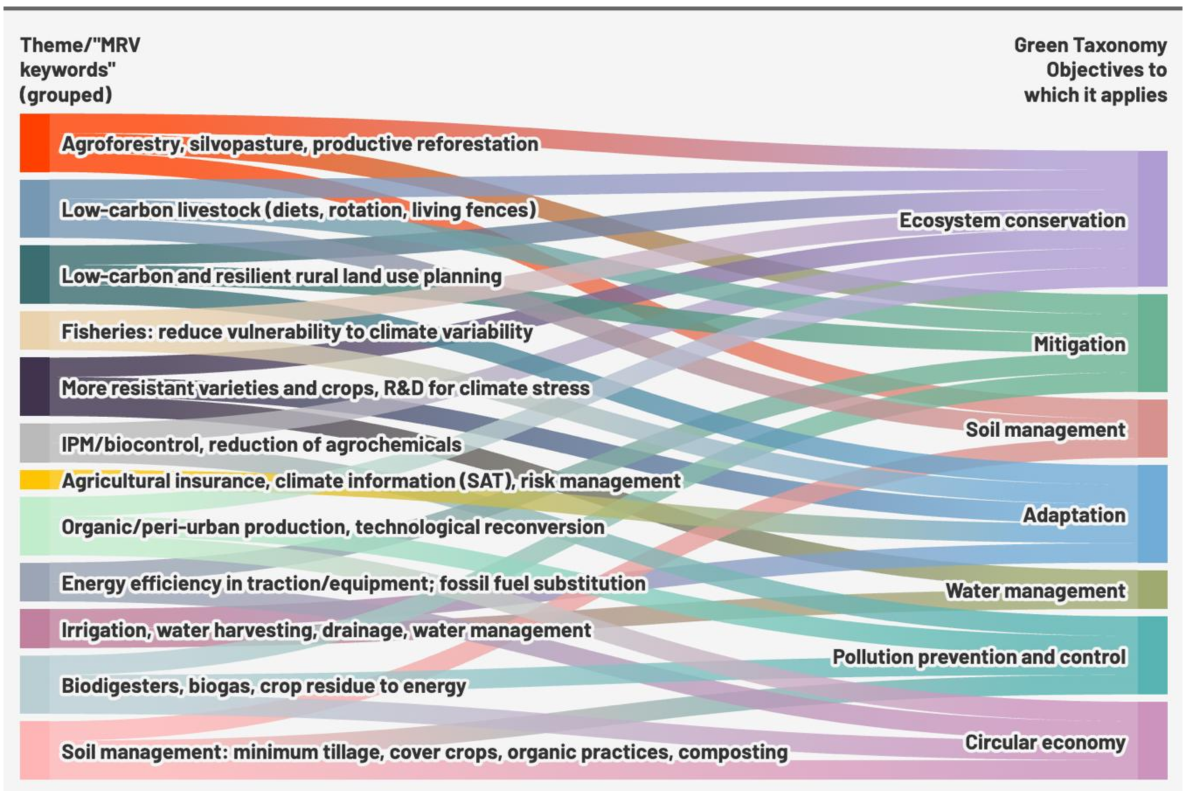


Figure 1.0. Correspondence between the MRV methodology (DNP) and the objectives of Colombia's Green Taxonomy (TVC).[3]

Moreover, in order to ensure that the MRV is not capturing financial flows that lack clear environmental co-benefits or are even harmful, we conducted a systematic screening of all projects classified under the MRV adaptation category, as shown in Appendix A3. Using a refined keyword filter, we retained only those whose titles explicitly signal alignment with nature-positive outcomes. Those without clear descriptors were flagged as being 'indeterminate.' The result is that a low share of 4% and 11% of total MRV investment volume falls into this subset, depending on the year.[4]

1.4. Green Investment in Agriculture

a. Holistic Analysis

i. Quantitative Trends

This section demonstrates the result of the descriptive analysis. As shown in Figure 1.1, total agricultural investments peaked during the 2014–2017 period. This peak coincides with the implementation of point 1 of the Peace Agreement on Comprehensive Rural Reform, which entailed renewed commitments to reactivate public investment in rural areas. In contrast, after increasing between 2011–2013 and 2014–2017, green investments in agriculture stagnate and even falls during the 2018–2021 period. This partly reflects the reorientation of spending toward emergency measures during the COVID-19 crisis, when part of the agricultural budget was

[3] The labels on the left group the keywords/actions used by the DNP's climate-finance MRV methodology (Methodological Guide for the Classification and Tracking of Climate Finance, 2023) to pre-classify projects in the agricultural and fisheries sectors. The right-hand categories correspond to the environmental objectives defined by Colombia's Green Taxonomy—mitigation, adaptation, ecosystem and biodiversity conservation, water management, soil management, circular economy, and pollution prevention and control. The flows depict correspondences between MRV activities and TVC objectives. This figure is illustrative and does not represent financial amounts; it shows semantic and thematic alignments only.

[4] Indeterminate share (4–11%). '*Indeterminate'* refers to MRV adaptation-labeled projects whose titles lack explicit nature-positive keywords (upper bound = 11% of total MRV volume). The lower bound (4%) is obtained when we reclassify as green those projects whose titles explicitly reference food security in ethnic communities, on the grounds that (i) local production–consumption models can reduce transport-related footprints, and (ii) these interventions typically support traditional agroecological practices in ethnic territories, which are associated with lower environmental pressures. This adjustment is title-based only (see Appendix 2 for screening rules). As these projects still meet MRV's algorithmic and expert inclusion criteria and none violate the exclusion rule, we retain them in the aggregate analysis while transparently reporting the associated uncertainty.

redirected to short-term food-security programmes without a clear green label. The trend is reversed in the 2022–2023 period, when green investment recovers and surpasses its previous levels. In absolute terms, this corresponds to an increase of 91 billion COP from 2011 to 2013 to 200 billion COP in the 2022–2023 period, expressed in constant 2015 prices. Thus, green investment in agriculture shows an upward, sustained path when compared to the total declining investment of the sector itself.[5]

However, in relative terms, the proportion of agricultural green investment within agricultural investment increased from 1.81% to 2.37% during the same interval, as shown in Figure 1.2. Thus, despite such improvements, the share of agricultural expenditures labeled as being sustainable is still very small. While this can be attributed to part of the interventions with direct effects on agri-food systems being registered under other sectors, this confirms that the relative weight of sustainable agriculture continues to be limited.

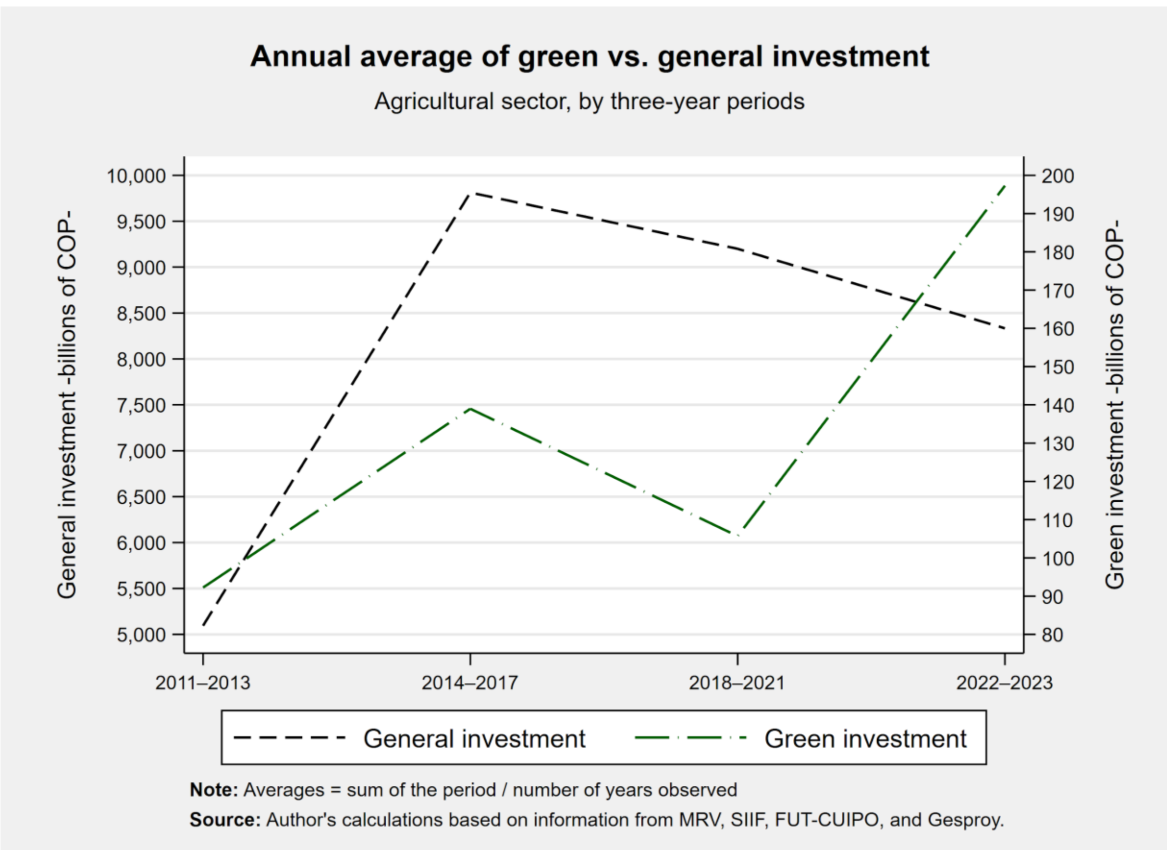


Figure 1.1 *Trajectory of green investment in the agricultural sector and relationship*

[5] We quantify total agricultural expenditure by aggregating all projects tagged to the agriculture sector in SIIF Nación (national budget), SISFUT/ CUIPO (territorial budgets), and GESPROY (royalties-financed projects) for 2011–2023. Operating expenditures were not included (investment spending only).

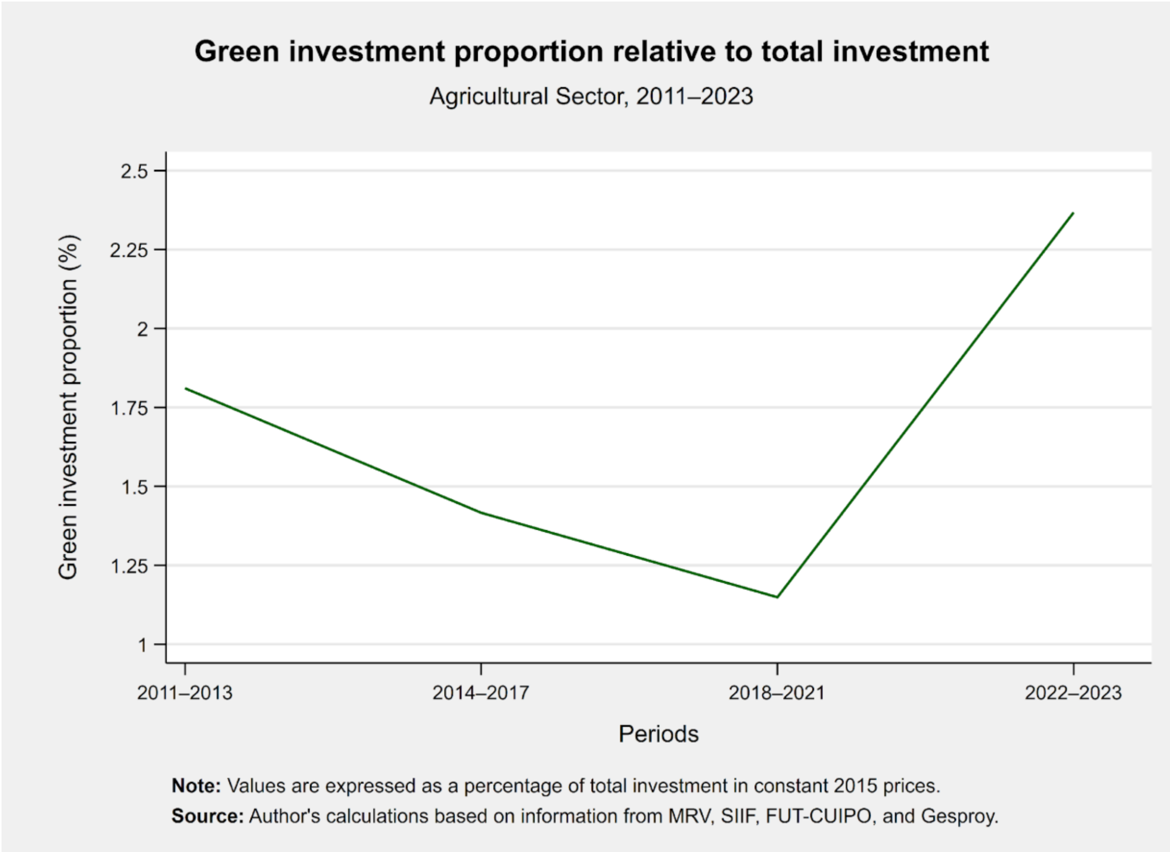


Figure 1.2 *Share of green investment in total investment in the sector*

ii. **Qualitative Trends**

From 2010 to 2014, Colombia established the related institutional basis needed to slowly incorporate sustainability considerations. The agenda was primarily framed as adaptation and food security, supported by early coordination and planning efforts such as the Inter-Institutional Network on Climate Change and Food Security (RICCLISA), CONPES 3700 (2011) on climate policy coordination, and the National Plan for Adaptation to Climate Change (PNACC, 2012). However, budget execution rates indicate that most spending tagged as 'green' or climate-related flowed through environment and risk-management institutions, particularly in response to the La Niña 2010–2011 emergency and related instruments such as the Adaptation Fund under the framework of Law 1523 of 2012. In agriculture, projects focused on irrigation and drainage districts, basic technical assistance, and small pilots on sustainable agriculture, consistent with an adaptation narrative centered on vulnerability reduction rather than explicit low-carbon or biodiversity-oriented productive transformation.

In this early period, project-based and territorially concentrated funding patterns emerge. Department-level projects financed through Colombia's General System of Royalties (SGR), notably in Caquetá, Casanare, and Risaralda, represented approximately 25% of agricultural green investment. Another significant component comprises technology-oriented interventions for the agricultural sector and investment from the MADR in forestry and reforestation. Consistent with the project-title corpus, the dominant framing is resilience through projects supportive of water management, risk reduction, and food security, while "de facto" ecosystem-based practices such as watershed conservation, agroforestry, and silvopastoral arrangements on degraded soils, more tolerant crops appear before they are explicitly named as NbS. The post-La Niña response also reinforces a social and territorial line, including vegetable gardens and self-consumption units for affected populations, linking climate response with poverty reduction and territorially targeted rural development, especially in Amazonia, Orinoquía, and post-conflict zones.

From 2014 to 2018, Colombia experienced the rise of the climate agenda and transition to 'green growth.' This could partially explain the peak in investment presented previously in Figure 1.1. After the Paris Agreement was ratified in Colombia through Law 1844 of 2017, Law 1931 of 2018 mandated climate mainstreaming to all sectors. As the first framework law on climate change, it did so by setting guidelines and obligations for all sectors, including agriculture. In parallel, the Green Growth Mission (2015–2018) and its incorporation into the 2014–2018 National Development Plan provided clearer policy space for sustainable production and adaptation objectives in the agricultural sector. During this period, early priorities centered on climate-smart agriculture and sustainable livestock, supported by technical and financial impetus from international cooperation. The projects with the highest investment were at the national level managed by MADR, where 50% are aimed at mitigation and adaptation in a comprehensive manner. The projects include, again, the development of the forestry sector, technological solutions, and mitigating risk in national agricultural production.

From 2018 to 2022, Colombia consolidated the climate institutional architecture while facing macro and fiscal restrictions due to the pandemic. In terms of regulations, the 2018–2022 National Development Plan (NDP) incorporates the Pact for Sustainability, which promotes *producing by conserving and conserving by producing*. In 2020, Colombia updated its NDC with greater ambition, and thus adopted the Comprehensive Plan for Climate Change Management of the Agricultural Sector (PIGCC-Agro) in 2021. In financing, the issuance of sovereign green bonds and the Green Taxonomy (2022) stand out as signaling instruments to direct public and private capital towards eligible activities in the AFOLU sector. This phase is also associated with a reorganization of the narrative toward climate-smart agriculture (CSA) and low-carbon rural development, where mitigation becomes a co-objective alongside adaptation.

In parallel, the institutional bases to increase conservation financing were initiated. For example, Law 870 of 2017 established Payments for Environmental Services, The Visión Amazonía initiative, which was launched in 2016 within Colombia's REDD+ strategy, mobilized around USD 100 million up to 2021, Launched in 2019, the BioCarbon Fund's Integrated Sustainable Landscapes Program in the Orinoquía (OSILP) mobilized a USD 20 million grant to promote low-carbon planning in cocoa and livestock chains. Consistent with the discourse signals in project titles, this period also makes extension and technical assistance to small producers more visible. In doing so, it reframed biodiversity as a basis for a new rural economy.

Territorially, a significant share of major projects was again organized through SGR at the department level, with concentration in specific productive chains such as cocoa, livestock, and fish farming, and agroforestry promotion, often at investment sizes in the 12–20 billion COP range. This reinforces a key analytical point. That is, the system can mobilize sizeable green spending, but often via project-based cycles and clustered portfolios rather than stable, territorially systematic scaling.

Finally, from 2022 to 2023, Colombia promoted a new ecological vision based on rebound expectations. The NDP 2022–2026 (*Colombia World Power of Life*) places environmental and social sustainability at the center of public policy and assigns agriculture a more prominent role through agroecological transition, regenerative livestock and farming, strengthened peasant economies, and 'conservation with production' including through deforestation prevention, restoration of degraded lands, and controls on frontier expansion. Consistent with the project-title corpus, this shift is accompanied by an agroecological reframing in which climate action in agriculture is conceived as promoting the transformation of the production model and socio-ecological repair. Formalized in the Public Policy on Agroecology, the agroecological transition places local knowledge, polycultures, organic soil management, and diversified agroforestry systems at the center. This can be affirmed as references to small and medium-sized producers, inclusion, marketing, and extension become more prominent in how projects define beneficiaries and territories. In portfolio terms, the emphasis shifts from works to landscape practices and arrangements such as good practices, crop diversity, and agroforestry, without completely abandoning the low-carbon label, which increasingly became associated with regenerative practices and clean energy in the rural environment.

In terms of institutional development, the National Climate Finance Strategy, or CONPES 4088, was updated. In doing so, it provides support in financing the fulfillment of Colombia's NDCs. Moreover, CONPES 4081 enabled a loan for the project of climate-smart initiatives for adaptation to climate change and sustainability in prioritized agricultural production systems.

For this period, average annual green investment in agriculture reaches around COP 200 billion, compared to about COP 90 billion in 2011, marking the highest level in the series. Part of this peak is associated with the arrival and preparation of large international cooperation operations for the sector, which, although not yet reflected as disbursed external resources in the MRV figures, have mobilized additional public investment and national budget co-financing commitments. An illustrative example is the sustainable agriculture programme structured with GCF/CAF, which mobilizes around USD 100 million in grants and credits, rendering it one of the largest adaptation-oriented operations approved for the sector. Finally, sectoral composition continues to evolve, with the coffee chain entering among the highest-investment project areas through the SGR portfolio.

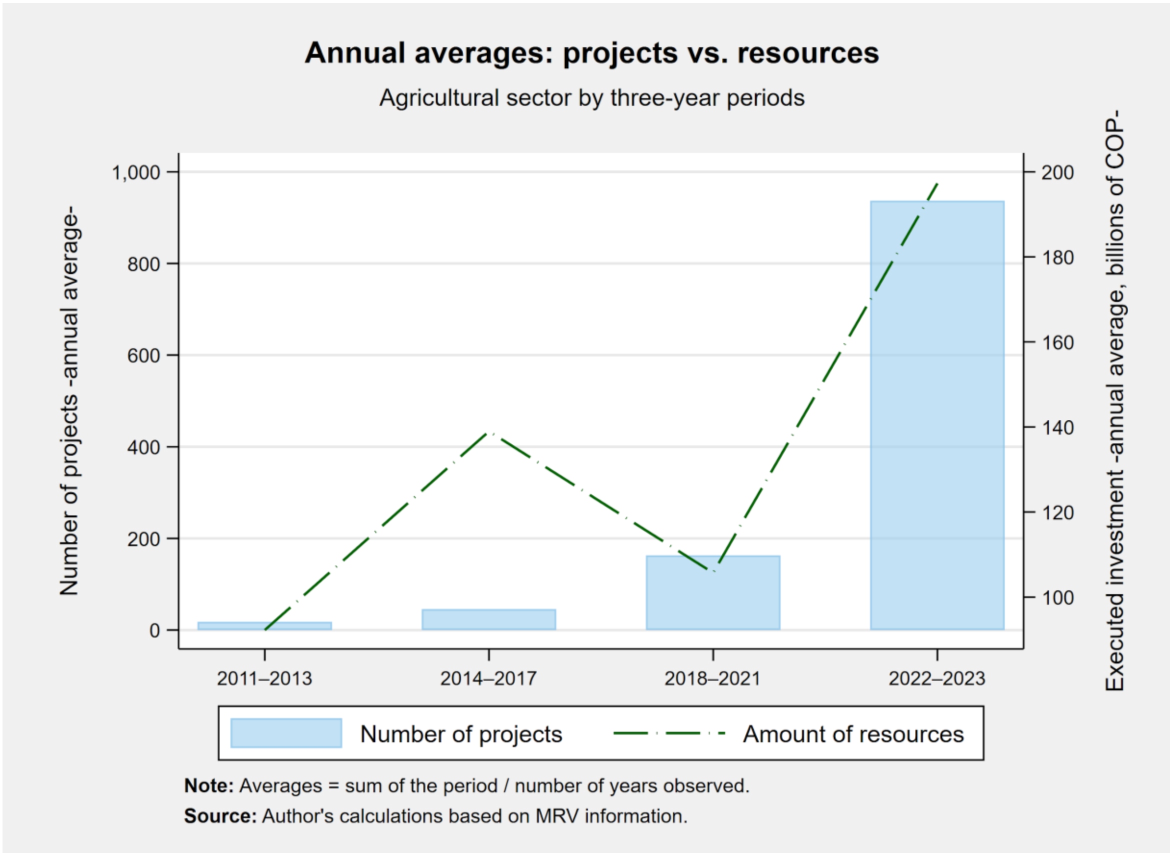


Figure 1.3: *Annual average of green projects and green resources in the agricultural sector, by government period*

b. Disaggregated Analysis

i. Regional Distribution

This section analyzes the territorial distribution of green investment in the agricultural sector. The central objective is to examine the extent to which green investments in agriculture have been geographically concentrated across regions, and how such coverage has expanded over time. It also assesses the degree to which the allocation of funds is related to the agricultural importance of the territories, and discusses the institutional implications of the observed patterns. This component focuses exclusively on territorialized investment, that is, those channeled through regional or local entities. Therefore, projects of national scope that do not present specific geographical detail are excluded.

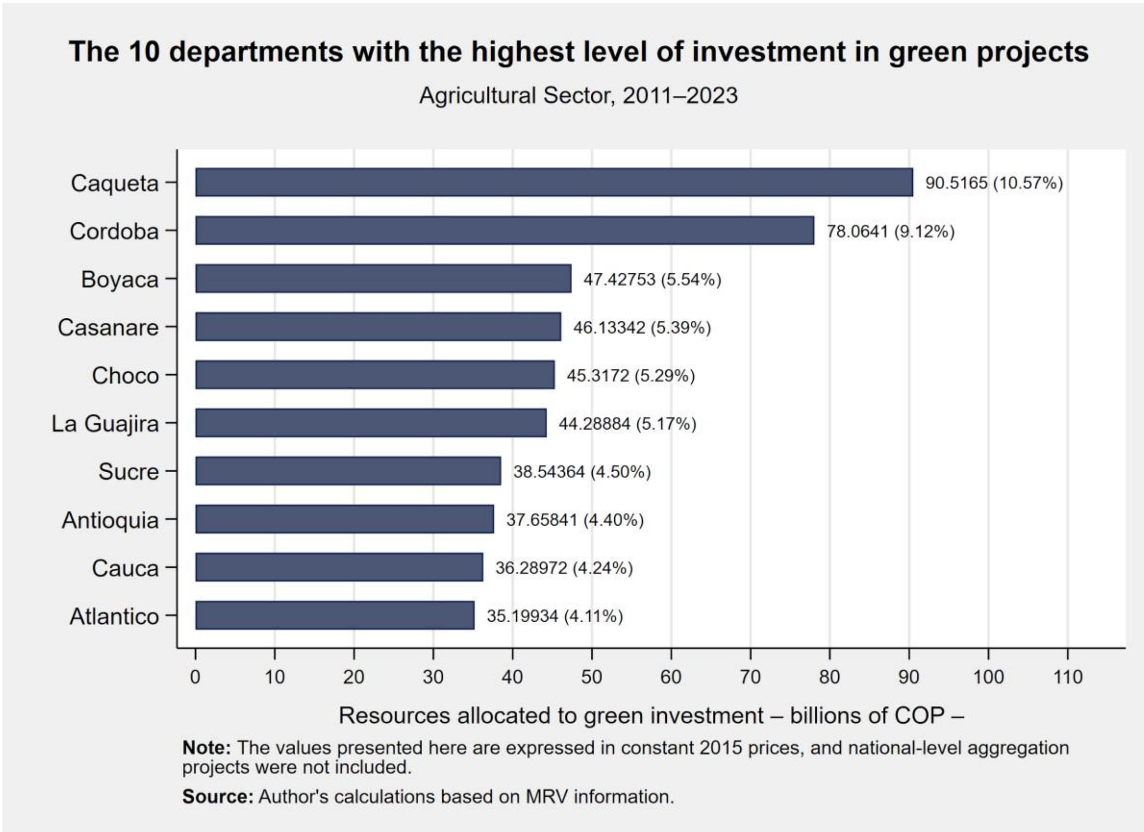
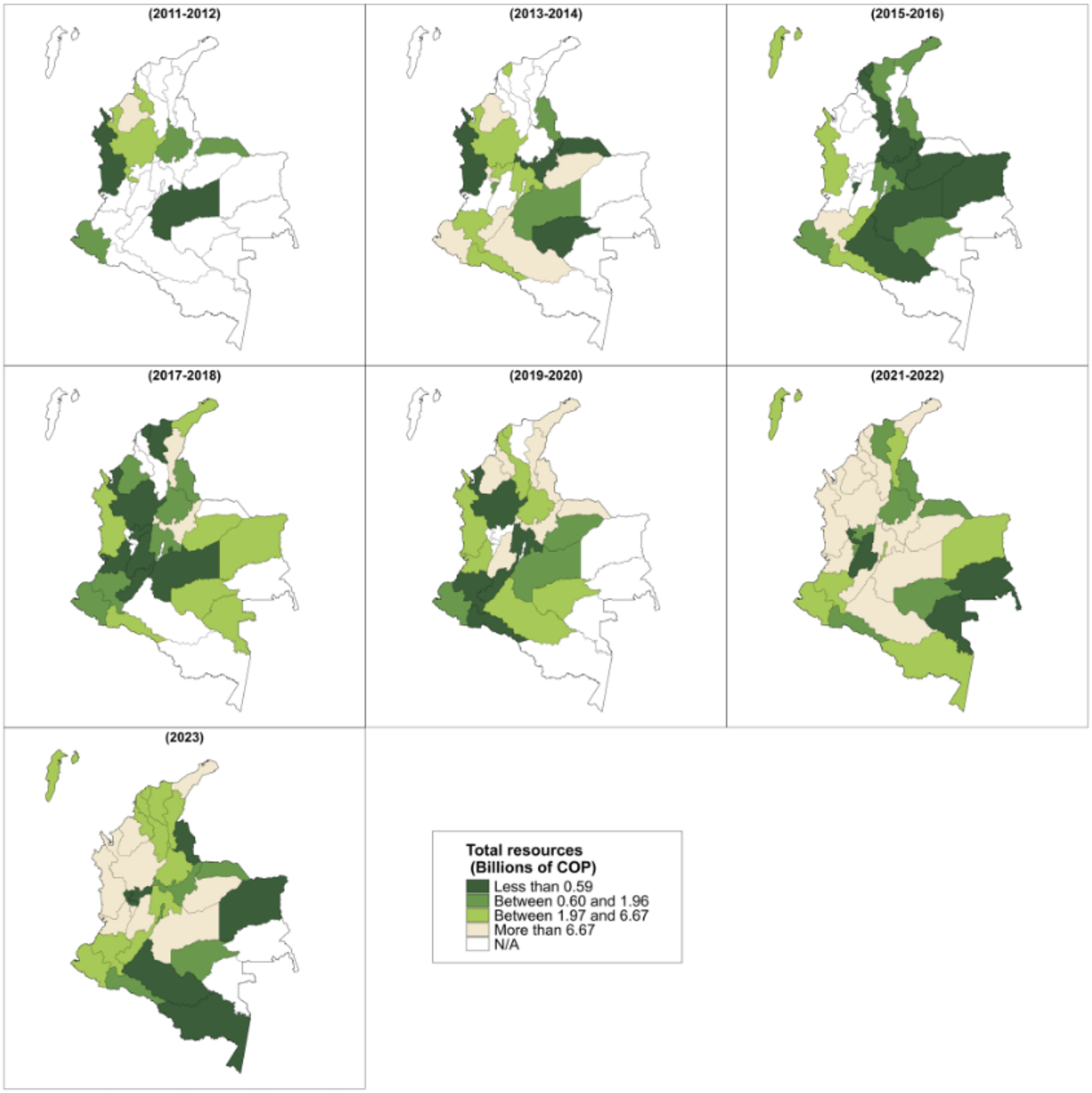


Figure 1.4: Descriptive Statistics of Total Resources Devoted to Environmentally Sustainable Projects by Department for the Agricultural Sector - Billions of COP-

The distribution of the total amounts indicates a concentration of green agricultural investment in a few departments. As Figure 1.4 shows, *Caquetá* tops the list with approximately 90 billion pesos invested in sustainable agricultural projects between 2011 and 2023, which represents about 10.5% of the national total. In second place is *Córdoba* with about 78 billion, or 9.1% of the total. They are closely followed by several peripheral departments: *Chocó* with about 62–64 billion or 7% of the estimated total, *La Guajira* with 44–55 billion or 5% of the total, and *Casanare* with 46–49 billion or 5.4% of the total. Other departments that stand out in absolute amounts are *Sucre* with 47 billion, *Antioquia* with 37–47 billion, and *Boyacá* with 43–47 billion, all concentrating between 4% and 6% of agricultural green financing each. Together, the top 10 departments account for about 58% of total investment in this sector. It is important to note that these values are absolute, without weighting by the extension or agricultural productivity of each region.



Note: The values are expressed in constant 2015 prices.
Source: MRV Climate Finance System, author's elaboration.

Figure 1.19 *Agricultural green investment in pesos by agricultural area, by department*

As Figure 1.5 illustrates, the territorial expansion of green agricultural investment has been progressive, moving from an initial focus on a few departments to a quasi-national coverage by the end of the period. In the first years, green agricultural projects were concentrated in peripheral areas of the country. In fact, Chocó was the only department with reported investment in 2011. In 2012, 7 other departments were added, including Arauca, Nariño, Sucre, and Antioquia. Other traditionally agricultural departments in the center of the country took longer to participate. For example, Cundinamarca only appeared with green resources in 2015, Tolima and Valle del Cauca in 2017, and departments in the Amazon, such as Vaupés, in 2018. By the 2021–2022 period, the entire national map shows departmental coverage with more than 30 departments with green investment in the agricultural sector, culminating in 2023 with the inclusion of Amazonas.

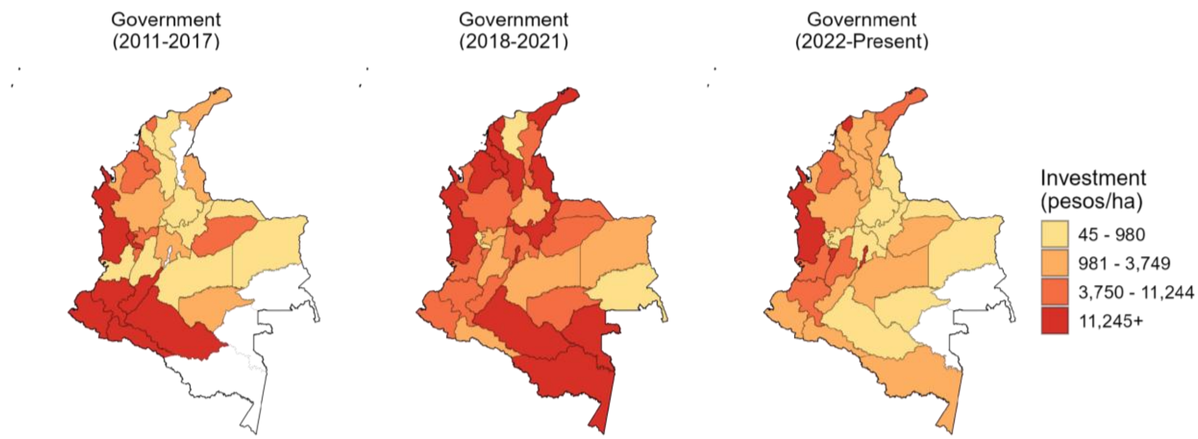


Figure 1.5: Green investment in the agricultural sector by department and period[6]

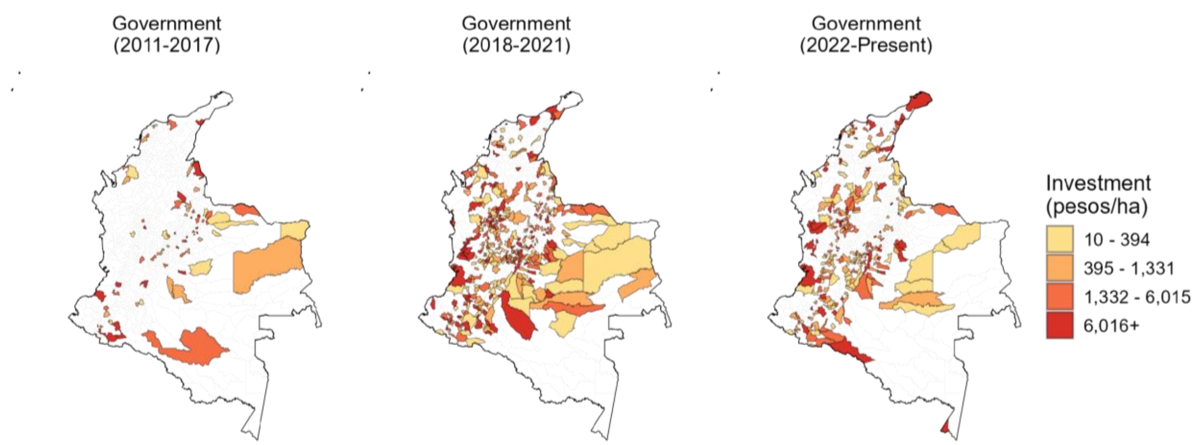


Figure 1.6. Green investment by municipality and by period

Going further, while no municipality was yet listed with green agricultural investment in 2011, municipal coverage has grown steadily since then. A notable jump occurred between 2021[7] and 2023, a period in which the number of municipalities with green

[6] These maps represent the average annual investment of pesos per hectare per period.

[7] The increase in the number of municipalities analysed here is only valid within the previously defined time interval. This is because the CUIPO (Single Category of Ordinary Budget Information) database, which is the official source of the records of transfers to the municipalities, was created,

investment projects increased from 140 to 450. As this figure is equivalent to just under 42% of the country's municipalities, there is still incomplete coverage at the local level, with many of these uncovered municipalities that are characterized by traditional agricultural sectors still not possessing sufficient investment in a green transition.

Nonetheless, the concentration is also high in certain municipalities. For example, the municipalities of Albania and Dibulla in La Guajira, account for more than *COP 40 billion* in green agricultural investment during this period. Likewise, Montelíbano in Córdoba exceeds *18 billion invested*. Several Amazonian municipalities in Caquetá, such as *San José del Fragua, Solano, Milán* and *San Vicente del Caguán*, each concentrate *12 billion* pesos in green projects oriented to agriculture, mainly those related to the sustainable rural development category. These cases illustrate how, within the leading departments, resources are often focused on a few municipalities.

In general, it can be observed that departments with high absolute amounts correspond to rural areas on the national periphery where large-scale agri-environmental projects have already been executed. This includes Caquetá, Córdoba, Chocó, and La Guajira. In contrast, while many regions in the interior have high levels of agricultural production, they often have more modest amounts.

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or, more precisely, reformulated, in 2021 from the old FUT (Single Territorial Form) database. Prior to this year, there was no standardized methodology that would allow for systematic recording of environmentally sustainable investments. Consequently, it is not appropriate to establish comparisons between the years 2021, 2022 and 2023 with periods prior to 2021.

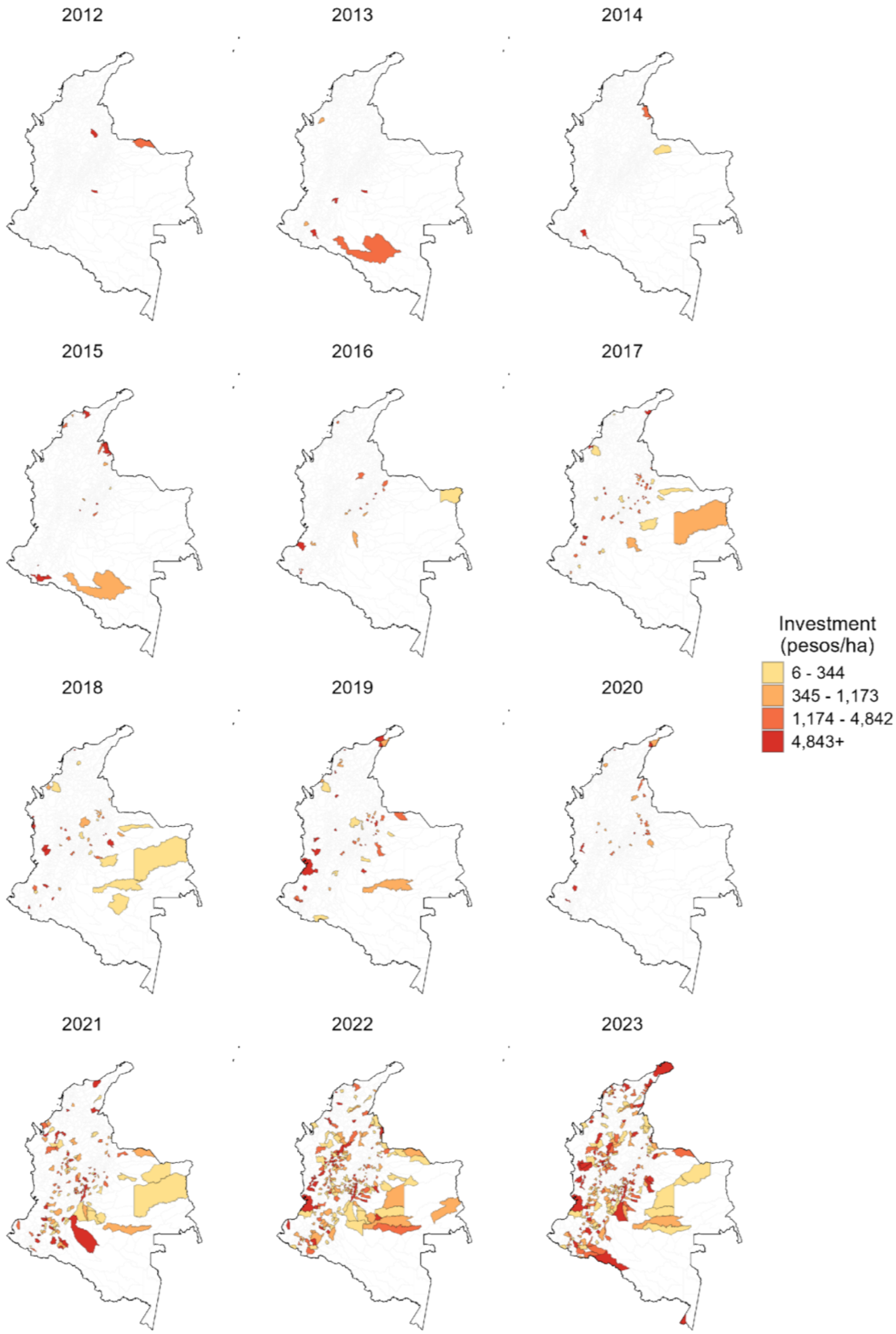

Figure 1.21 Agricultural green investment by municipalities by period[8]

[8] These maps represent the average annual investment of pesos per hectare per period.

The analysis of investment by territories suggests a basic coherence between the types of projects and the biophysical and productive constraints of each territory. For example, support is given to aquaponics and orchards in La Guajira, while water adaptation in Sucre responds to water stress. Moreover, agroforestry in Chocó is coupled with humid landscapes and the need for diversification, whereas silvopasture in Córdoba and Caquetá addresses degradation of grasslands and thermal stress, and rice R+D in Casanare addresses the climatic sensitivity of a central crop in this region.

1.5. Allocation Assessment

Building on the aforementioned analysis of the spatial concentration of public investment in agriculture, two complementary analyses are proposed to assess their territorial alignment with the areas that require priority attention. The first is a relevance coefficient that relates departmental and/or municipal participation in green agricultural investment with their participation in the area of national agricultural use. The second is a contrast with variables related to environmental conditions, such as but not limited to deforestation, water stress, and climate risk.

The relevance coefficient is defined as c = %investment/%agricultural and livestock area, the latter of which is measured as the department's share of the national total. Values $c<1$ indicate that, relative to their share of agricultural land, territories receive a smaller share of green agricultural investment. This is treated as a signal of potential under-allocation and thus serves as a starting point for territorial prioritization, which must be adjusted in light of production structure, intensity, and environmental criteria.

As can be seen in Figure 1.7 this indicator reveals persistent deficits at the departmental level. This holds true in production centers in the interior and the Caribbean, such as Tolima, Valle del Cauca, Caldas, Risaralda, Norte de Santander, Bolívar, and Magdalena. The same applies to border territories such as Vichada, Meta, and Caquetá.

Moreover, this trend persists at the municipal level. As demonstrated by Figure 1.8, the deficits are concentrated in municipalities of productive corridors in the interior and the Caribbean, and in agricultural frontiers. For example, some of the municipalities with the highest deficit are La Macarena in Meta, Tarqui in Huila, Puerto Carreño in Vichada, Rio Blanco in Tolima and Tena in Cundinamarca.

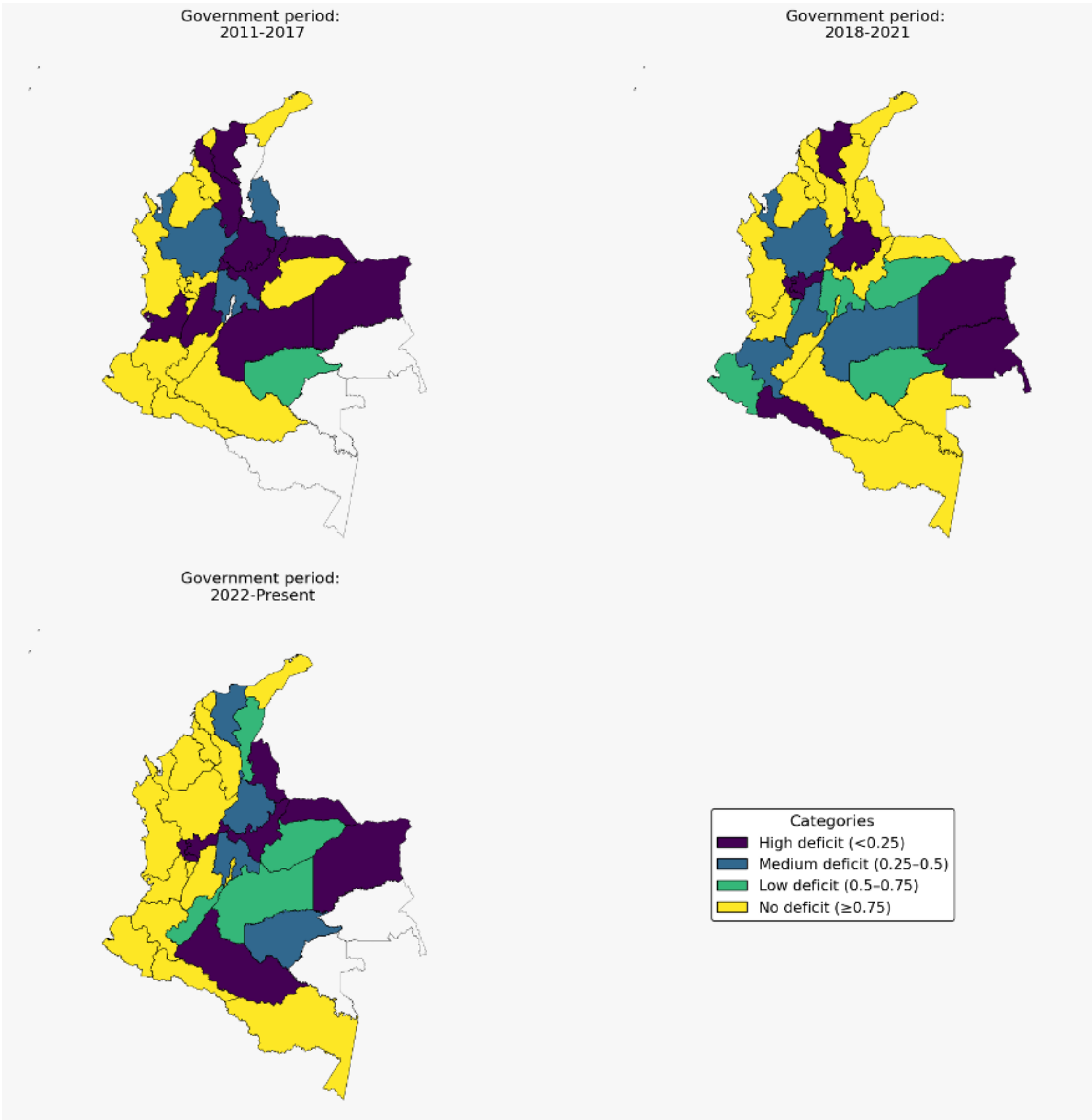

Figure 1.7 Relevance coefficient by department.[9]

[9] *The coefficient is constructed from the total investment accumulated to 2023*

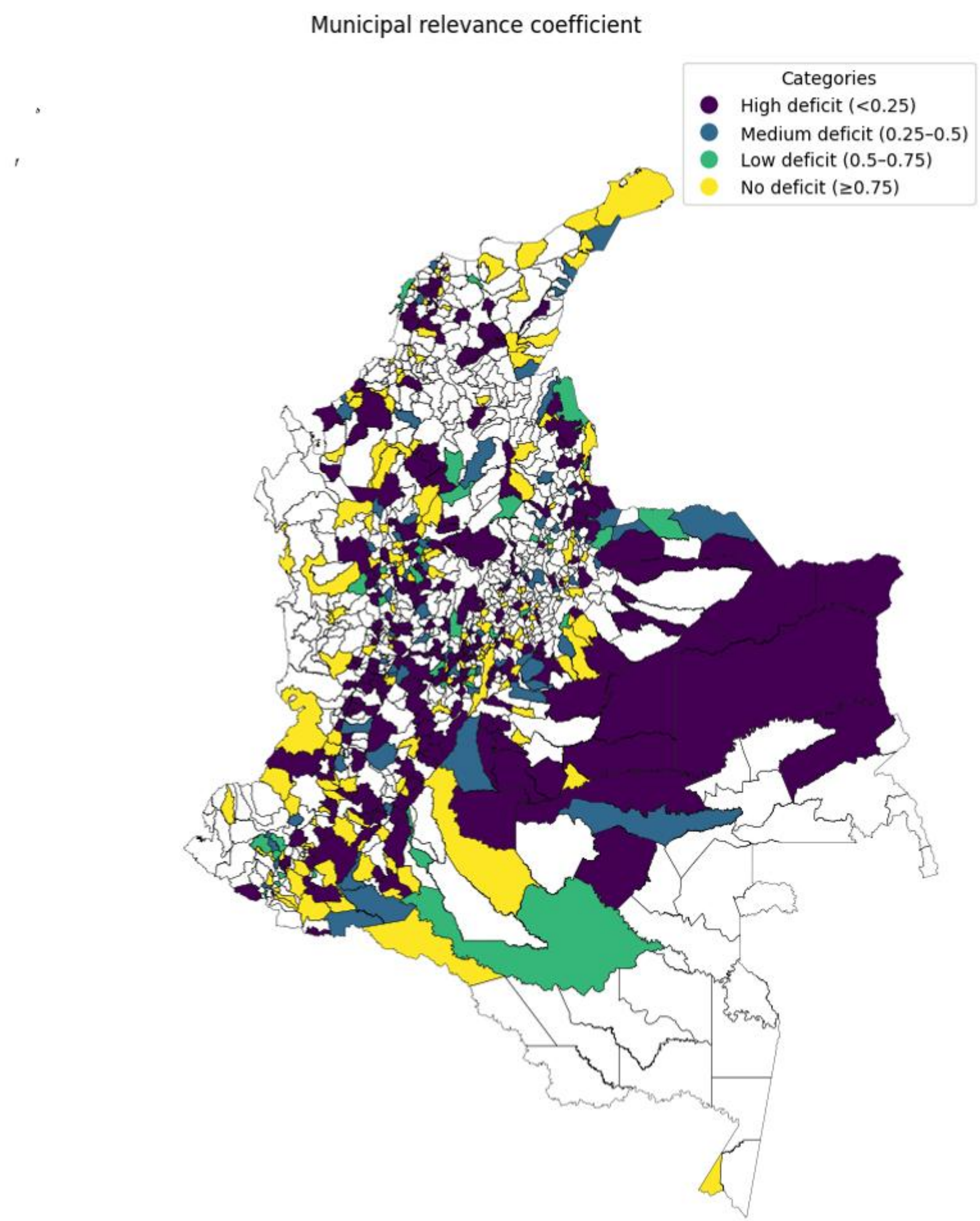

Figure 1.8 Relevance coefficient by municipality.

Going further, to contrast green investment with environmental conditions, we examine its relationship with municipal-level proxies of environmental pressure. In principle, indicators such as AFOLU emissions, deforestation associated with agricultural frontier expansion, soil erosion attributable to agricultural activities, and other direct-impact metrics can help identify where NbS are most warranted.

However, these direct-impact metrics are not consistently available at the municipal level. Thus, among the available proxies, we rely on deforestation as a signal of frontier pressure, soil erosion, water stress, and climate risk. While these variables are not measures of 'unsustainable agriculture' per se, they reflect multi-causal environmental pressures in which agriculture may be a contributor.
In addition, some indicators are snapshots, rather than panels, and are thus not up to date. For example, water stress still draws on the National Water Study (2014), and available soil-degradation metrics are dated.

With these caveats, the next subsection presents four 5×5 bivariate maps. Each map crosses green investment per hectare with one of the following environmental impact indicators: (i) Deforestation, (ii) soil erosion, (iii) water stress, and (iv) climate risk. Interpretation is consistent across maps. Red tones highlight municipalities with high environmental pressure and low investment per hectare, and thus represent potential need hotspots. Blue–green tones indicate low pressure and high investment, indicating potential over-allocation. Unshaded municipalities are those where MRV does not yet identify green investments. As this is an exploratory exercise that complements the indicator presented above, it should be viewed as indicative.

Figure 1.9 presents a 5×5 bivariate map crossing deforestation with green investment per hectare. The map shows a continuous red belt along the Andean–Amazon foothills, southern Meta, Guaviare, Caquetá, and Putumayo, with additional red municipalities toward the northeast border, such as those in the Catatumbo and Arauca area. Examples of municipalities in the high deforestation and low investment corner include La Macarena, Puerto Rico, Vista Hermosa, and Mapiripán in Meta, Valparaíso in Caquetá, Villagarzón and San Miguel in Putumayo, El Tarra, Sardinata, and Hacarí in N. de Santander.

This belt coincides with the north-western Amazon deforestation arc recognized by IDEAM monitoring, which consistently locates the bulk of national forest loss in the Amazon departments cited above. The main drivers identified by IDEAM include pasture clearing linked to land grabbing, unsustainable extensive cattle ranching, unplanned and illegal roads, illicit crops, and other illegal activities (IDEAM, 2018). In this context, these red clusters should be prioritized for NbS packages focused on frontier control and landscape restoration.

Deforestation × Investment/ha

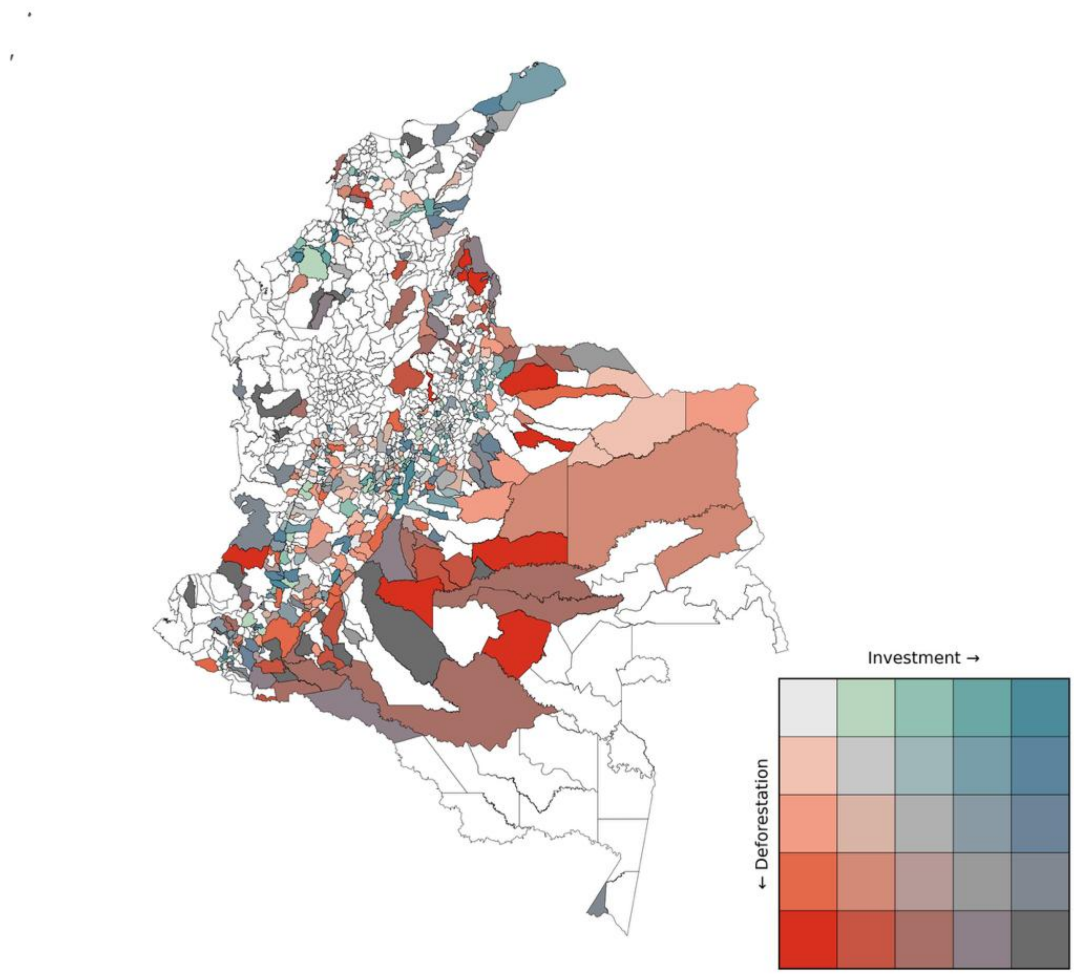

Figure 1.9 Correlation between green investment and deforestation[10]

Figure 1.10 presents a 5×5 bivariate map crossing soil erosion with green investment per hectare. The erosion layer comes from IDEAM's national soil erosion baseline,

[10] Municipal 5×5 bivariate choropleth crossing deforestation and green agricultural investment per agricultural hectare. The vertical axis is deforestation (low→high); the horizontal axis is investment (low→high). Both variables are ranked by quintiles. The bivariate palette marks red = high deforestation & low investment (top priority) and blue–green = low deforestation & high investment; blank polygons indicate municipalities with no MRV-identified green investment. Deforestation indicator. The base layer is the annual deforestation map at 30×30 m (IDEAM), 2012–2023. For each year, deforested pixels were summed within municipal polygons; we then computed the annual mean (2012–2023) and expressed it as the percentage of municipal area. The resulting continuous indicator was segmented into quintiles for mapping (ranking purpose only; no linearity implied). Sources: IDEAM (deforestation monitoring 2012–2023); MRV climate-finance data; authors' calculations.

which classifies the type, form, and severity of erosion. According to IDEAM and UDCA (2015), roughly 40% of Colombia's soils showed some degree of erosion. The bulk of mapped erosion is attributed to land use practices, deforestation for agricultural expansion, hillside cropping without conservation, extensive grazing, and poorly managed irrigation and drainage in districts. In aggregate, 92.9% of agricultural lands and 77.3% of grazing lands exhibited erosion (IDEAM & UDCA, 2015).

Red clusters align with steep Andean slopes, including numerous municipalities across the Upper Magdalena corridor in Tolima–Huila, the central Andes with municipalities across the coffee belt and adjacent valleys, and the eastern Andean piedmont transitioning into the Llanos. A southern belt is also visible along the Andean–Amazon foothills, which include southern Meta–Guaviare–Caquetá–Putumayo. Within these clusters, several municipalities such as including Cachipay, Mesitas del Colegio, La Vega, Guatavita in Cundinamarca, La Florida in Nariño, Natagaima in Tolima, Boyacá and Northern Antioquia, merit priority attention.

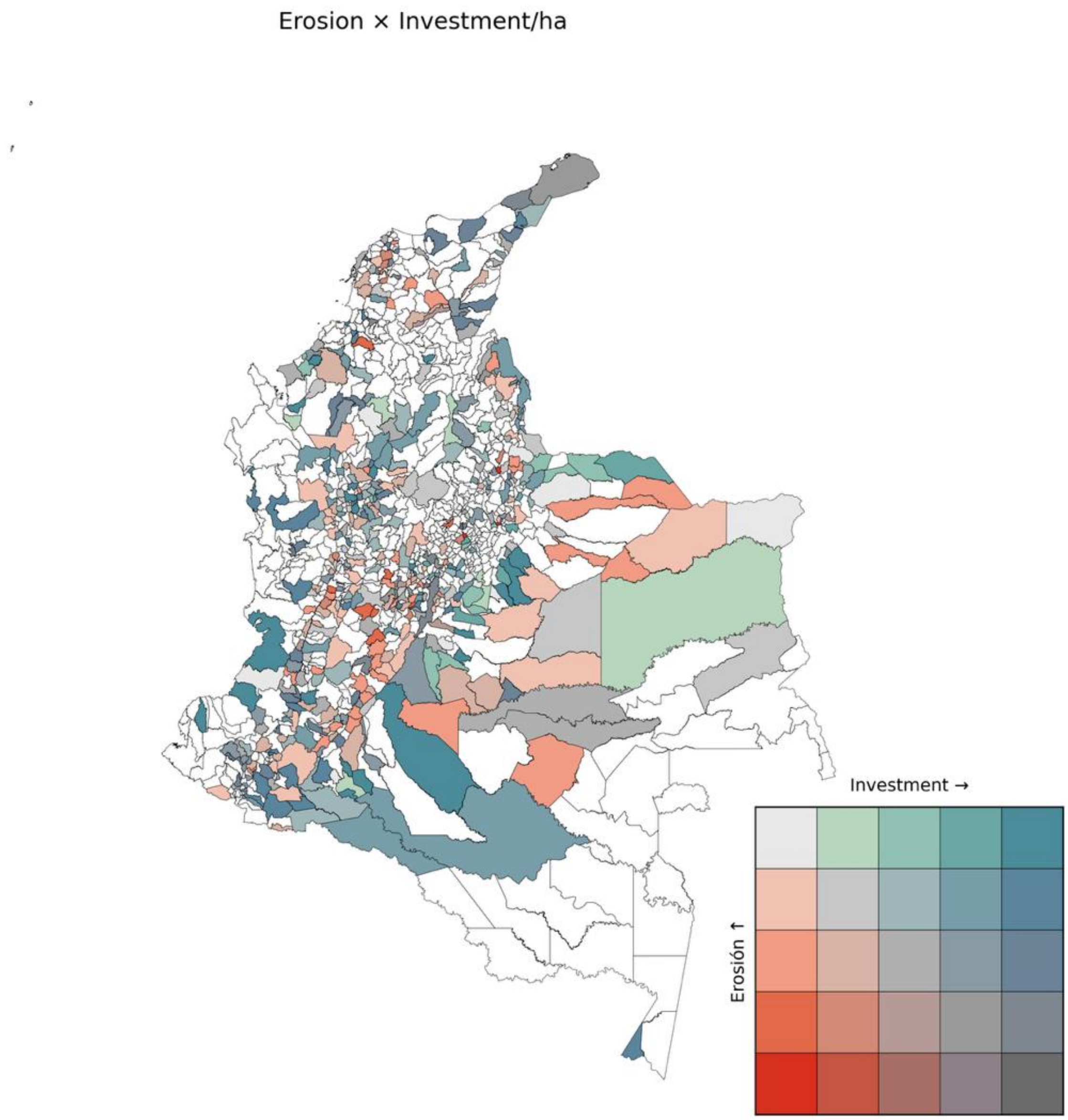

Figure 1.10 Correlation between green investment and erosion[11]

[11] Municipal 5×5 bivariate choropleth crossing soil-erosion severity and green agricultural investment per agricultural hectare. The vertical axis is erosion (low→high); the horizontal axis is investment (low→high). Both variables are ranked by quintiles. The bivariate palette marks red = high erosion & low investment (top priority) and blue–green = low erosion & high investment; blank polygons indicate municipalities with no MRV-identified green investment. The erosion layer is IDEAM's national baseline 2010–2011 (scale 1:100,000; ~42,000 polygons, ~777 ha average per polygon) and does not cover 100% of the territory. For the municipal indicator, each polygon was assigned to a municipality via centroid; we then took the mode (most frequent) erosion value per municipality to represent the predominant degree. Finally, the original five-level severity scale (1 = most severe … 5 = no evidence) was recoded to 1–5 with 5 = highest erosion for interpretability in the bivariate ranking (no linearity implied). Sources:

Figure 1.11 presents a 5×5 bivariate map crossing water stress on the vertical axis with green investment per hectare on the horizontal axis. We use the water stress Index (Índice de Presión Hídrica a los Ecosistemas - IPH) from the National Water Study (IDEAM, 2014). The IPH measures green water pressure as the ratio of the agricultural/grassland green water footprint to the available green water in each subbasin (year 2012). High values indicate intense competition for rainfall stored soil moisture between agriculture, livestock, and ecosystems. A key limitation is that the IPH does not capture farm-level practices. Instead, it infers demand from land cover and crop and pasture extent. In other words, high IPH reflects structural land use pressure, not whether good practices are already in place. We therefore treat it as a proxy to target territories.

The map reveals a dense red corridor along the central Andean spine, with numerous municipalities in the Upper Magdalena such as Tolima and Huila, as well as the coffee-belt region and adjacent Andean slopes showing high stress and low investment. Additional red clusters appear in the Northern Andean foothills. These patterns are consistent with ENA2014 results that concentrate high IPH in Andean and Caribbean basins with intense agricultural and livestock land use. Within these red clusters, several municipalities stand out for exhibiting high water stress and low investment per hectare, including La Victoria and Obando in Valle del Cauca, Salento and Génova, Santa Rosa de Cabal in Risaralda, and Bojacá in Cundinamarca.

IDEAM, Soil Erosion Baseline 2010–2011 (IDEAM–U.D.C.A., 2015); MRV climate-finance data; authors' calculations.

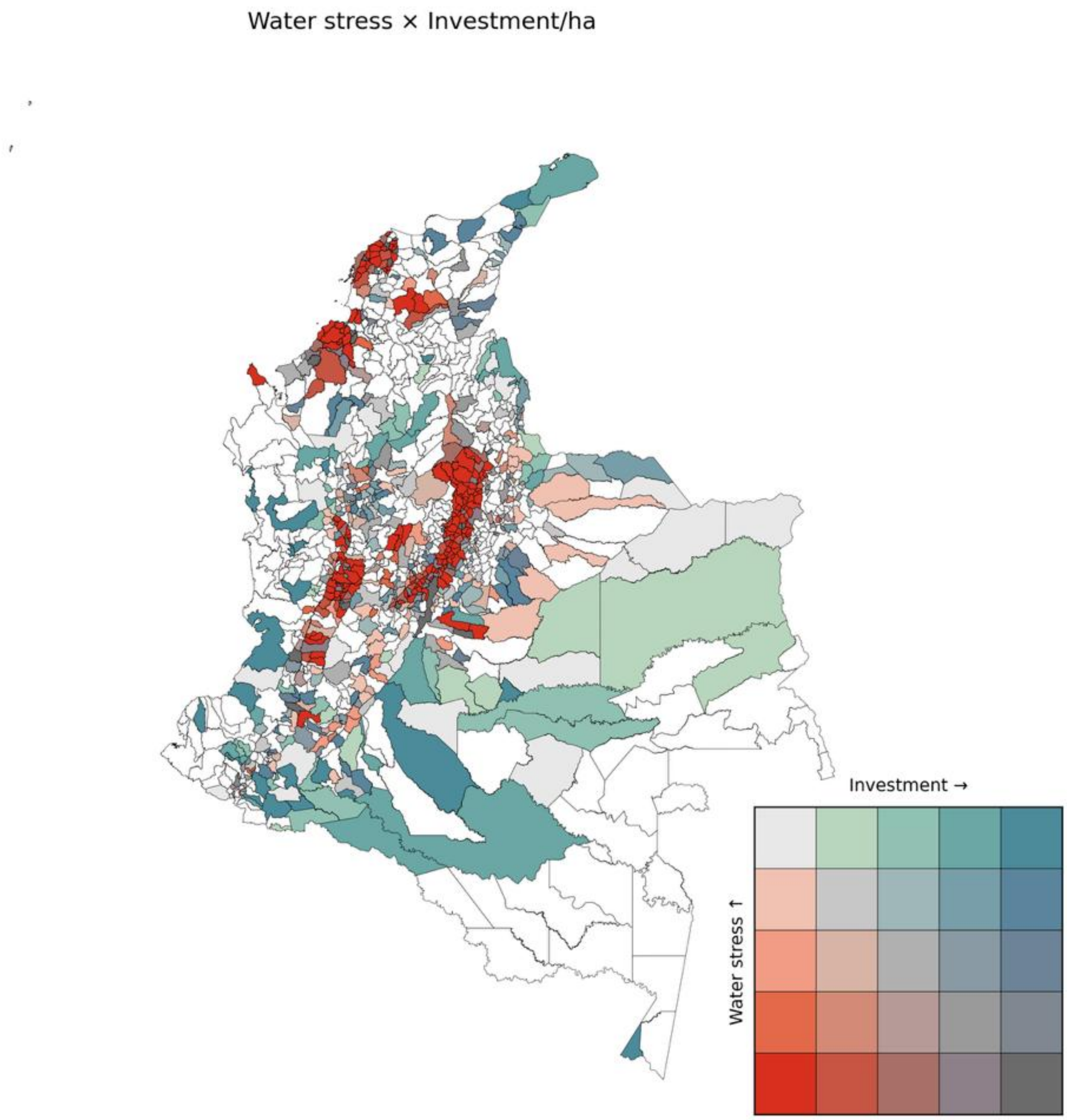

Figure 1.11 Correlation between green investment and water stress.[12]

[12] Municipal 5×5 bivariate choropleth crossing water stress (IPH) and green agricultural investment per agricultural hectare. The vertical axis is stress (low→high); the horizontal axis is investment (low→high). Both variables are ranked by quintiles. The bivariate palette marks red = high stress & low investment (top priority) and blue–green = low stress & high investment; blank polygons indicate municipalities with no MRV-identified green investment. The Índice de Presión Hídrica (IPH) is a continuous measure of pressure on water resources (higher = greater pressure), provided nationally as 316 polygons that cover all of Colombia (average polygon ≈ 360,000 ha). For the municipal indicator, each municipality was assigned the predominant IPH value (the value occupying the largest share of its area) and then segmented into quintiles for mapping; this reclassification serves ranking purposes only. Sources: IDEAM (ENA 2014) IPH; MRV climate-finance data; authors' calculations.

Figure 1.12 shows the bivariate map of 5×5 by quintiles that crosses climate risk with green investment per hectare. In line with the previous results, this spatial analysis shows red zones, with low investment and high need for adaptation, in the Andean corridor of the Caribbean, as well as in agricultural frontiers, which include Orinoquía and the Amazonian foothills. Some of the municipalities that require additional attention are Villagarzón and Puerto Asís in Putumayo, Malambo in Atlántico), and Rivera in Huila, among many others**.**

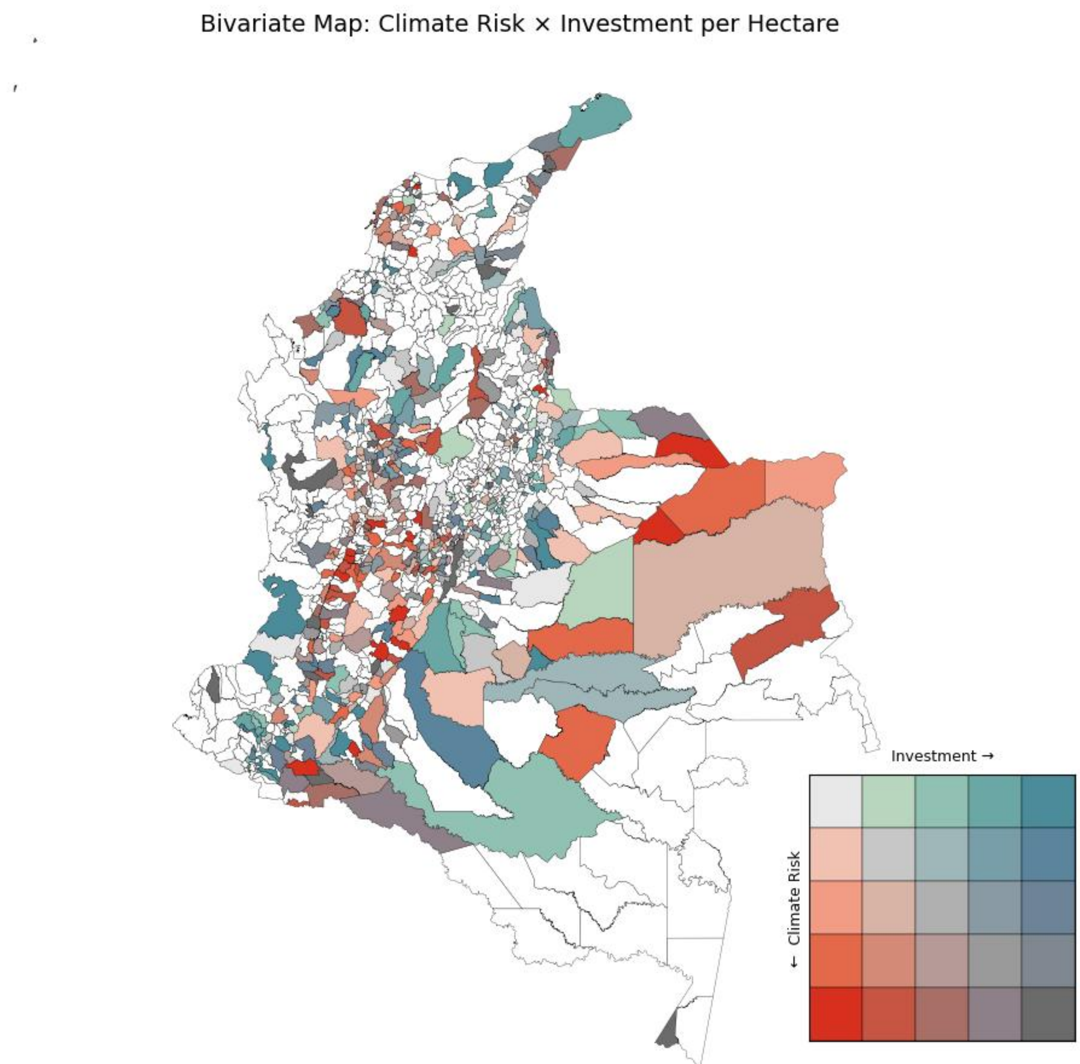

Figure 1.12. Correlation between green investment and climate risk.[13]

[13] Municipal 5×5 bivariate choropleth crossing the climate risk index and green agricultural investment per agricultural hectare. The vertical axis is risk (low→high); the horizontal axis is investment (low→high). Both variables are ranked by quintiles. The color palette is bivariate: red marks high risk & low investment

All in all, the spatial lens shows that green investments in agriculture are not yet systematically aligned with environmental pressures. The relevance coefficient and the bivariate contrasts with deforestation, soil erosion, water stress, and climate risk consistently identify municipal need hotspots where environmental degradation is high, while green investment per hectare is low. These hotspots coincide with strategic ecosystems, the Andean–Amazon foothills, the Upper Magdalena, and the inter-Andean valleys, where strengthening green investment would generate the greatest environmental returns. This calls for a shift from diffuse spending to pressure-based targeting, concentrating financing and technical assistance where NbS can deliver the highest environmental returns and risk reduction.

(top priority), while blue–green marks low risk & high investment; blank polygons indicate municipalities with no MRV-identified green investment. The climate-risk layer (IDEAM, 2017) is available at the municipal level nationwide and comprises five categories, 'Muy bajo,' 'Bajo,' 'Medio,' 'Alto,' 'Muy alto', recoded to 1–5 solely to enable ranking in the bivariate map (no linearity implied). Sources: IDEAM (2017) municipal climate-risk index; MRV climate-finance data; authors' calculations.

Section 2: Impact Evaluation of the Economic Consequences of the Transition from Traditional Support to a Green Support to Agriculture in Colombia

In this section, we develop in detail the impact evaluation of the economic consequences of a transition from traditional support to green support to agriculture, Nonetheless, we present environmental effects separately in Appendix A1, where we summarize the expected environmental impacts of scaling up nature-based practices. This appendix is based on a literature review that compiles per-hectare environmental benefits reported for key nature-based practices such as soil conservation, reduced emissions, biodiversity and water related gains and combines them with Colombia-specific land-use data to generate order-of-magnitude benchmarks.

2.1 Literature Review

The agronomic literature has explored the differences between sustainable and traditional agriculture. Research comparing conventional agriculture with sustainable agriculture highlights the differences between short-term yields and long-term profitability and resilience. In the short term, agronomic studies show that organic and agroecological systems tend to register yields on average around 80% of conventional systems (Seufert et al., 2012; Durham & Mizik, 2021). However, as sustainable agriculture is less dependent on external inputs such as synthetic fertilizers and pesticides, this results in significant gains in energy efficiency and nutrient use, reducing costs (Mäder et al., 2002; Rodale Institute, 2011). Moreover, certain sustainable practices contribute to improved soil quality, biodiversity, and long-term productivity with substantial but progressive yield benefits (Raveloaritiana & Wanger, 2024). Therefore, while sustainable agriculture may be less profitable in the short-term, the difference may not be as evident if a more comprehensive view is taken.

In the long term, agronomic and economic studies suggest that sustainable systems can match or even exceed the profitability of conventional agriculture. This can be attributed to lower input costs and, in some cases, higher selling prices (Riar et al., 2024). That is, Africa and Latin America achieved substantial increases in productivity by reducing dependence on external inputs (Agroecology in West Africa, 2025; Agroecology in Latin America, 2025; SRI, 2025). Similarly, organic farms earn on average 22–35% higher profits globally, with larger gains in contexts where certification and consumer demand translate into substantial price premiums (Crowder & Reganold, 2015; Durham & Mizik, 2021). Going beyond increases in yield, there are other benefits to consider. According to Moret-Bailly and Muro (2024), in contexts where inputs are expensive and certification markets are limited, the main economic advantage comes from the efficiency and stability of these systems.

All in all, while conventional systems retain an advantage in maximizing short-term returns, sustainable systems are more climate-resilient and profitable in the long term. Agronomy emphasizes the ecological underpinnings of these outcomes, while economics emphasizes market mechanisms and input cost savings as key drivers of profitability. This dual evidence highlights the importance of considering time horizons. Therefore, although sustainable systems may require planned transitions and supportive policy frameworks, they are ultimately capable of matching or surpassing conventional agriculture in terms of economic viability.

However, we argue that the current evidence does not allow us to compare the impacts of these two types of investment. This is because most studies assess the performance of inputs or practices after adoption, not the impact of the policies that induce their adoption. As traditional and sustainable programs face different constraints and thus generate different adoption rates, such evidence is insufficient to compare policy impacts.

Therefore, our analysis seeks to assess the impact of redirecting funds towards sustainable agriculture on yield. As such, it represents the first study to assess the impact on yields of state-led support to sustainable agriculture, relative to traditional agriculture. Such findings are important, as the uncertainty exacerbated by this literature gap has resulted in the lack of public support or even an increase of public resistance, which has hindered government prioritization of sustainable agriculture.

In this regard, Colombia offers a particularly representative case for this type of research because it combines many of the structural features and policy challenges common to a wide range of developing and middle-income countries. That is, the country has a highly diverse agricultural sector that spans from smallholder subsistence farming to large export-oriented agribusiness, reflecting the heterogeneity of production systems found across Latin America, Africa, and Asia. At the same time, Colombia faces acute pressures to balance food security, rural development, and global environmental commitments, a dilemma shared by many countries undergoing similar transitions. The lessons generated in this context are therefore not only relevant domestically but also transferable to other countries facing analogous trade-offs, allowing this case to inform global debates on how to design agricultural support that aligns with climate and development objectives.

2.2 Data

To carry out the analysis, we used comprehensive information on public procurement projects from the Electronic Public Procurement System (SECOP), agricultural production data from the Municipal Agricultural Assessment (EVA), and disaggregated data on climate variables obtained from the climate research unit of the University of East Anglia. As our analysis focuses on procurement due to data availability, we recognize that it represents only a fraction of overall public spending and does not capture the full spectrum of public finance impacts. Nonetheless, public procurement accounts for 13-20% of GDP in many countries, representing $9.5 trillion in annual global spending (UNEP, n.d.). Regardless, this focus should therefore be seen as a partial but policy-relevant lens, rather than a comprehensive assessment of state expenditure. While we give a brief description of the data sources below, we present full details of the data in the appendix.

i. SECOP

SECOP is the digital database of the national system of public procurement. All contracting entities are required to publish complete documentation in SECOP. We extracted the data from SECOP through a combination of web-scraping and from open government platforms. Using a set of inclusion and exclusion criteria, which is presented in Table A1 in the appendix A3, only agricultural contracts were captured.

All contracts were classified into two operational categories: Services and materials. Services include technical assistance, extension and specialized professional support such as that of agronomists and veterinarians. Materials refer to support for fertilizers, seeds, and agrochemicals.

Only public procurement contracts were considered. Interchangeably referred to as projects throughout the document, only those with a value of at least $2 per EPA in the municipality were captured. This serves the double purpose of ensuring that only projects with complete information are included in the database, and it excludes very small-scale or 'ghost' projects, which would hardly generate detectable effects at the municipal level. In total, we have 48,072 contracts, distributed in 1083 municipalities.

ii. EVA

The National Agricultural Survey (EVA) collects information biannually for the period 2007–2023, covering 239 crops in 1,122 municipalities and key variables such as cultivated area, production, and yield for both transitional and permanent crops throughout the country. In this context, we use panel data for 90 crops, which together represent 98.5% of total agricultural production. This is aggregated to obtain a total production at the municipal level, which is expressed in monetary terms using wholesale prices, harvested area, and yield.

iii. Climatic Variables

We use monthly temperature and precipitation data from the University of East Anglia's climate research unit (CRU TS v4.08). We then aggregate this information at the municipality level and construct climatic anomalies. Our methodology follows standard procedures in the literature, such as in see Barrios et al. (2010).

2.3. Methodology

Our approach allows us to estimate the causal effects of both green and non-green public procurement projects on key agricultural outcomes, including production, harvested area, and yields. Below, we describe how we classify projects into green and non-green categories and provide an overview of the empirical strategy used to estimate their causal impacts. Additional methodological details and a full description of the data construction process are provided in the Appendix.

i. Data Rendering

The classification of projects aimed at green agriculture is central to this study. As a first step, we identified all SECOP projects that are related to agriculture using inclusion and exclusion terms as explained in the appendix. To do this, we first used the Green Taxonomy developed by the Government of Colombia, which is a national classification system of economic activities and assets that contribute substantially to environmental objectives and thus provides explicit criteria for green agriculture. Moreover, we also drew on academic and grey literature, such as Damania et al. (2023), and we consulted with experts including those that part of the research team, which consists of specialists in environmental, resource, and agricultural economics with knowledge of Colombia's environmental and agricultural policies.

This process allowed us to generate a list of inclusion terms that indicate whether each of the agricultural public procurement projects from SECOP can be classified as targeting green agriculture. An exhaustive list of terms associated with green farming practices for each category is presented in Table A2 in the appendix. Following this, we classified all agriculture SECOP projects using the project description. The matching process was based solely on the inclusion of a term reduced to its root. For example, the root sustainib* captures both sustainability and sustainable, and any project description that included these variants was classified as green.

To visualize the type of projects classified as green, Figure 2.1 presents word clouds of the terms in the project descriptions of inputs and services. The 50 most frequent words in the dataset are displayed. As word size and color intensity are proportional to frequency, larger and darker elements correspond to terms that appear more frequently in project descriptions. It highlights that support to farmers, such as extension services, is dominant in this type of project.

Figure 2.1 Word cloud of the descriptions of SECOP projects classified as green agriculture

To visualize the investments classified as green, Figure 2.2 presents word clouds of the green terms in the descriptions of materials and services projects. This cloud, unlike the one presented above, is built only considering the list of terms that determine whether a project is considered green or not. Out of a total of 144 unique roots, the 50 most frequent roots in the dataset were visualized. In addition to general words related to nature-based solutions such as sustainable, environmental services, mitigation, and adaptation, we observed that text related to forestry and water resources were recurrent in the projects.

Figure 2.2 Word cloud classifying projects as green from the descriptions of SECOP projects classified as sustainable agriculture

ii. Estimation

The impact of these projects is measured against three indicators: The total value of agricultural production in constant dollars, the harvested area in hectares, and yield, expressed in terms of production per hectare cultivated. These indicators allow us to capture both the scale of production and an approximation of its efficiency. The first and second variables contribute to scale, while the third variable relates to efficiency.

This study applies a difference-in-differences (DiD) method, which estimates casual effects by comparing the pre- and post-treatment changes in outcomes for a treatment group against a control group (Angrist & Pischke, 2009; Card & Krueger, 1994; Athey & Imbens, 2022). This method allows us to identify the causal effect by systematically comparing municipalities from three groups: (i) Those that received green agricultural contracts, (ii) those that received traditional agricultural contracts, and (iii) those that did not receive any agricultural contracts. In doing so, this classification allows us to assess whether public procurements in green agriculture generate different results compared to the procurements that implement other forms of support or compared to the absence of intervention.

Thus, a central aspect of our strategy is that municipalities are not compared in isolation, but under conditions that are as equivalent as possible. We used climatic and temperature differences, as well as the initial characteristics of each municipality, to make these comparisons.[14] In addition, we incorporate time effects, which allows us to analyze each year within its own context. Moreover, we also consider the size of the rural population, given its impact on productive capacity and the adoption of new practices. With this approach, we ensure that comparisons are fairer, enabling results to more accurately reflect the effects of agricultural contracts, particularly those supportive of green agriculture.

Our empirical strategy focuses on distinguishing two complementary types of effects: The extensive and intensive margin. The extensive margin captures the impact of receiving at least one contract intended to support agricultural activities. In contrast, the intensive margin examines how outcomes vary with the amount of support received, measured as the cumulative value of contracts in constant dollars within each category. Together, these two margins allow us to assess both whether having a contract matters and whether receiving more support leads to stronger effects.

We present results using all available information for both margins. Going further, we demonstrate the results restricted to contracts received in the last three years to differentiate the cumulative effects from those that are manifested in the short term. A full description of the methodology and equations is provided in Appendix A3.

2.4 Results

i. Homogenous Findings

We present the results in a series of figures that analyze three central indicators of agricultural production: (i) Total production as measured in constant 2012 dollars, (ii) harvested area expressed in hectares, and (iii) yield described as production per hectare. The results combine service and material projects, and were estimated controlling for factors such as the rural population, climatic conditions, and characteristics of each municipality and year. The detailed tables from which these figures are derived, as well as the disaggregated results for service and material contracts, can be found in the appendix.

For each indicator, two estimators are presented, one that reflects the effect of green contracts and the other that reflects that of non-green contracts. Both are compared against a counterfactual of not having that type of contract. When the estimate is

[14] Climatic differences are calculated using aggregated high-resolution data from 1901 to 2023 in high-resolution grids of 0.5° × 0.5°, while anomalies constructed from national historical average deviations.

positive, it means that the start of that type of contract is associated with an increase in the indicator. In addition, confidence intervals are provided to assess whether the impacts are significantly different from zero and to approximate whether the differences between the two effects are statistically significant.

Figure 2.3 presents the results when treatment is defined in the long-term extensive margin, where municipalities are considered as treated from the first year in which they receive a contract. The results indicate a positive and statistically significant impact on all three indicators of the agricultural performance of municipalities that receive green contracts. In contrast, non-green contracts are associated with a process of spatial intensification of production practices, which involves yield increases accompanied by a reduction in cultivated area. As this results in a non-significant total effect on production, the results demonstrate that green contracts are more effective in enhancing long-term economic performance within the extensive margin.

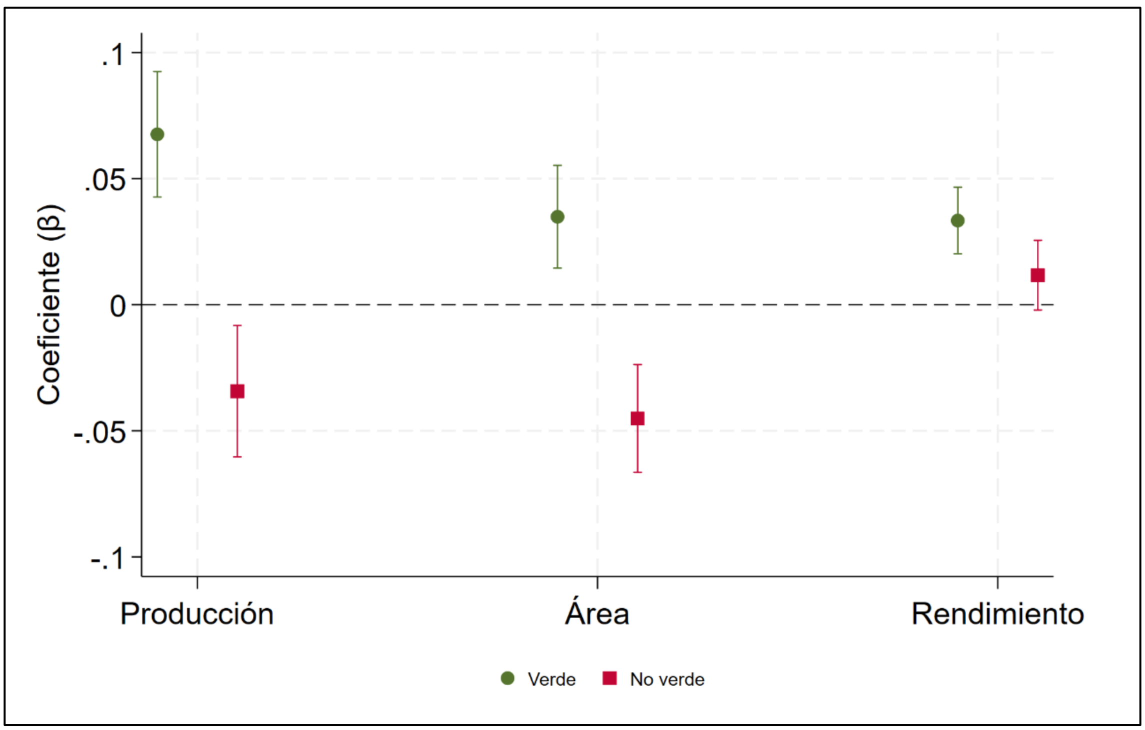

Figure 2.3 Effects of having at least one green or non-green project

Figure 2.4 shows the results corresponding to the long-term intensive margin, where the cumulative value of the contracts is considered according to their type. In general, a positive effect on the returns of both green and non-green contracts is observed, though there is no statistically significant differences between the two. However, the results suggest that the mechanisms through which performance improvements are generated differ. While green contracts tend to expand production significantly through a significant increase in yield and cultivated area, non-green contracts are again associated with a process of spatial intensification. Thus, even in the intensive margin, there is no evidence to claim that green contracts under perform conventional contracts in enhancing long-term economic performance.

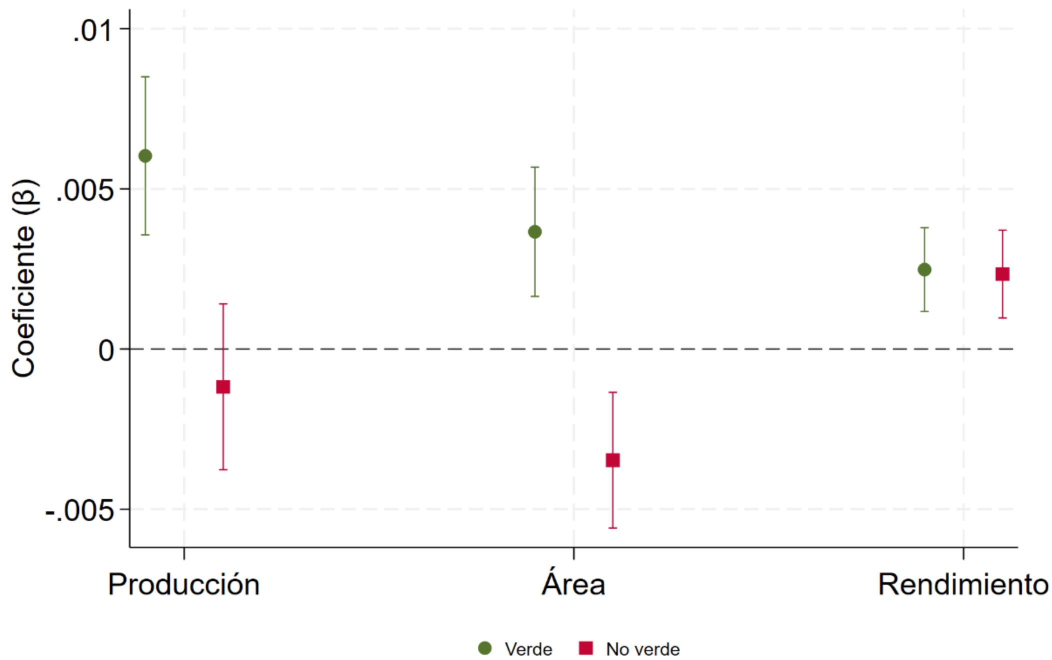

Figure 2.4 Effects of the cumulative value of contracts by type

The magnitude and interpretation of policy impacts depend on the time horizon over which they are evaluated. Shorter time frames are particularly relevant for policymakers, as they correspond more closely to political and budgetary cycles. Hence, we assess whether the results differ when focusing on outcomes shortly after project implementation. Specifically, we re-estimate the models using treatment indicators defined only by contracts received within the previous three years.

Figure 2.5 presents the results for the short-term extensive margin, where a municipality is considered treated if it received at least one green or non-green contract during this three-year window. The results closely mirror those obtained using longer time horizons. While green contracts are associated with positive effects on agricultural yields and non-green support is associated with a significant reduction in area and thus in total production, the estimated differences between the two types of contracts are not statistically significant. Thus, there is no evidence to claim that green contracts under perform in the short-term extensive margin.

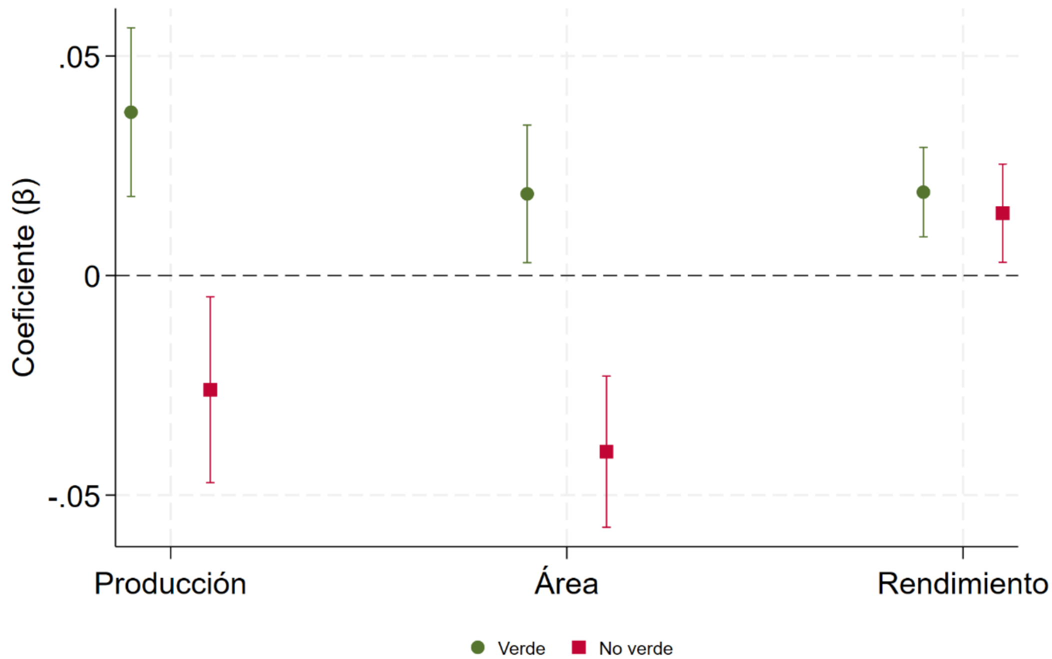

Figure 2.5 Effects of having at least one green or non-green project in the last 3 years

Figure 2.6 reports the corresponding results for the short-term intensive margin, which captures the intensity of project exposure through the total value received. Here, the point estimates are somewhat larger for non-green contracts than for green contracts. As this difference is not statistically significant, there is also no evidence to claim that green contracts are less effective in the short-term intensive margin.

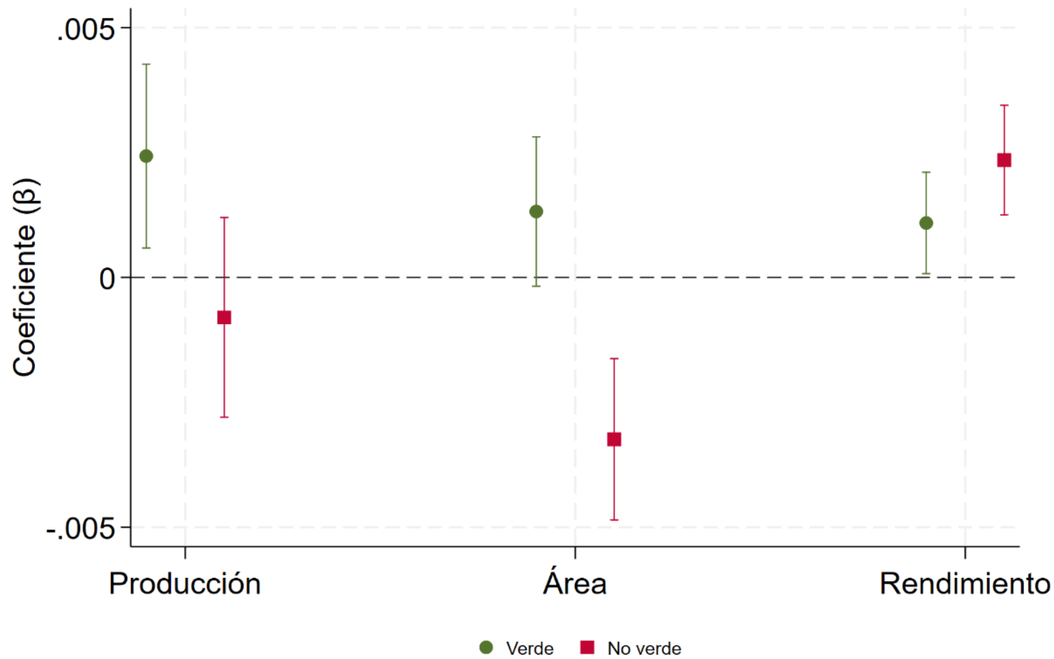

Figure 2.6 Cumulative value effects of green or non-green contracts over the past 3 years

Finally, we also present the dynamic year-by-year results for the extensive margin, as shown in Figures 2.7 and 2.8. These results illustrate the effect of receiving at least one green contract for the first time on yields. Each coefficient reflects the impact corresponding to the number of years that have elapsed since the initial assignment of the contract. Consistent with previous findings, green contracts generate immediate benefits on yields. These production gains are accrued faster than non-green contrasts, which also generate immediate benefits. Importantly, the coefficients for the pre-treatment years are not statistically significant, indicating that the parallel trends assumption holds and thus supports the validity of the difference-in-differences approach. When examining the effects year by year after treatment, the estimates are not statistically significant, meaning that there is no evidence to claim that green contracts underperform non-green ones in this front as well.[15]

[15] As dynamic event-study estimates typically have lower statistical power than the aggregated treatment effects presented in the previous figures, the results should therefore be interpreted within the specific time frame beginning with the first contract assignment.

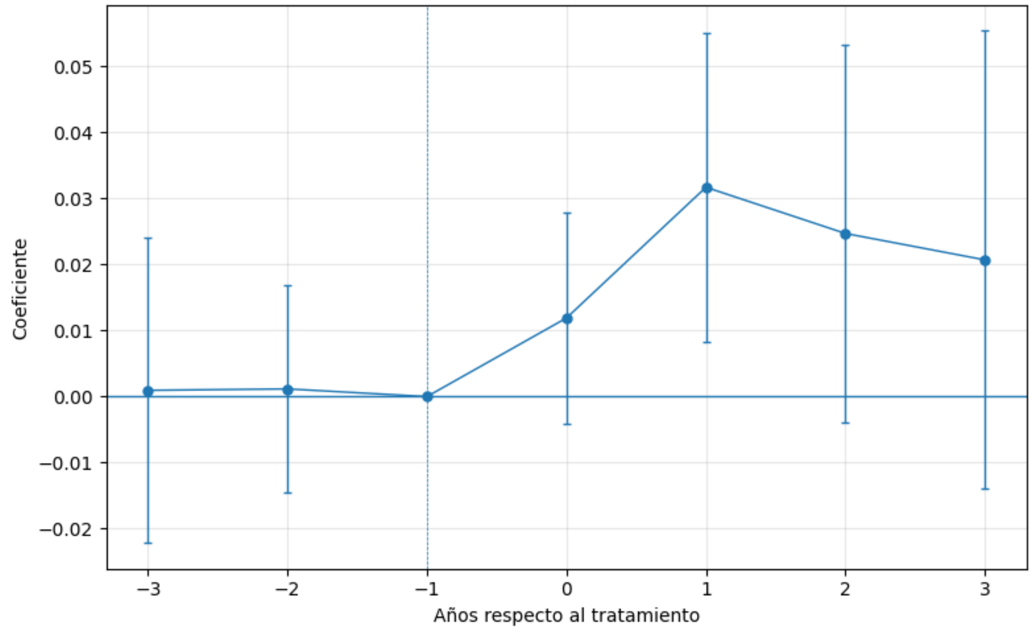

Figure 2.7 Dynamic Effects on yields – GREEN Contracts

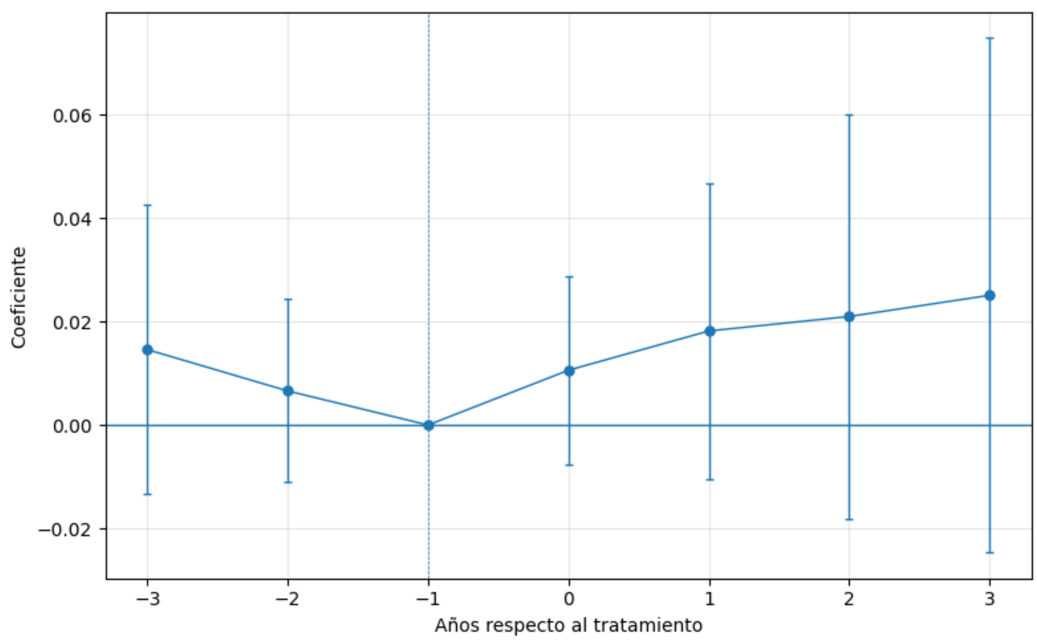

Figure 2.8. Dynamic Effects on yields – NON-GREEN Contracts

Taken together, these findings indicate that there is no economic rationale that supports the usage of non-green contracts over those of a sustainable nature, at least in the scope of this study. In the shor term, there is no evidence that supports the argument that green contracts are less effective than non-green contracts in producing produce larger yield effects. In the long-term, green contracts perform at least as well as non-green ones, with some specifications suggesting even larger yield gains.

As the literature review discusses, there are several reasons that could explain this pattern. Firstly, green contracts often involve changes in production practices or the incorporation of new techniques, which require a period of adaptation before reaching returns comparable to those of non-green contracts. Second, the text analysis of the contracts shows that terms such as forestry and trees are among the most frequent, reflecting investments in crops or species that require several years to generate productive results. Consequently, it is reasonable to expect that the benefits of these contracts will materialize cumulatively over time. Third, many green contracts are aimed at improving local environmental conditions, the productive effects of which only become evident after a prolonged process. For example, improving soil fertility through nature-based solutions can take several years to translate into substantial yield increases, unlike the use of synthetic fertilizers that generate immediate results.

ii. Heterogenous Findings

Using the same estimation techniques applied in the main results, we now present the long-term results in a manner that differentiates between service contracts and material contracts. Service contracts include, for example, rural extension services, while material contracts correspond to the provision of inputs. Figure 2.9 shows the results of the effect of having at least one green or non-green contract, distinguishing between services and materials. Figure 2.10 presents the results considering the cumulative value of the contracts. In both cases, the left pane reports the results for service projects, while the right pane describes the results for materials projects.

The findings show a consistent pattern in the long-term. Although they do generate positive and significant effects on the harvested area, green service projects do not have significant effects on yield, whereas non-green service projects do have a significant impact. In contrast, green material projects show clear increases in production, area, and yields when compared to non-green material projects, which increase yield while decreasing area, and thus result in a non-significant effect on production. This is observed both for the extensive effects of having at least one such contract, as shown in Figure 2.9, and for the intensive effects of the accumulated value of contracts, demonstrated by Figure 2.10.

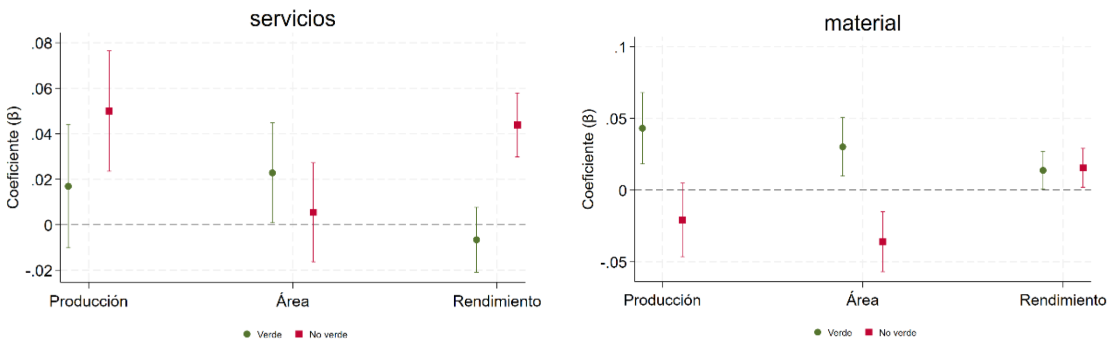

Figure 2.9 Effects of having at least one green or non-green project, by category

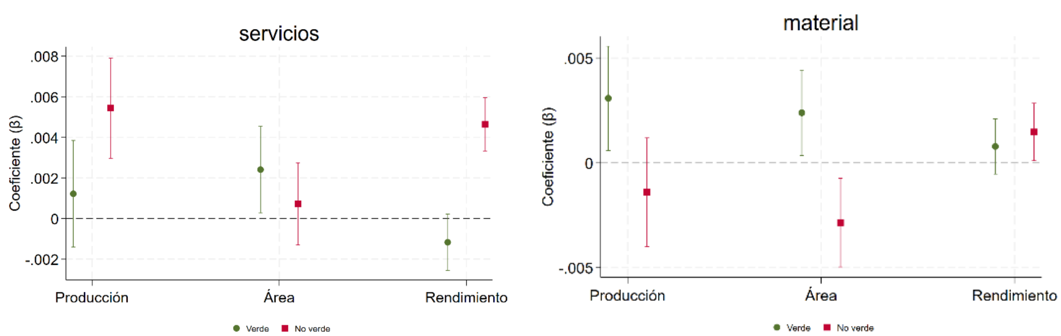

Figure 2.10 Cumulative value effects of green or non-green contracts, by category

As with the main results, the observed effects may be time-scale-conditioned. To examine this dimension, we replicate the estimates using the cumulative value of contracts received in the last three years, separated by service and material contracts. The results are shown in Figure 2.11. Non-green projects have a greater effect on performance than green projects in the short term, which only show a significant effect when the contract amounts are added over more time, but not when limited to the last three years as demonstrated in figure 2.3. As evidenced by the positive significance levels in Figure 2.4, the accumulation effect is important to display the full benefits.

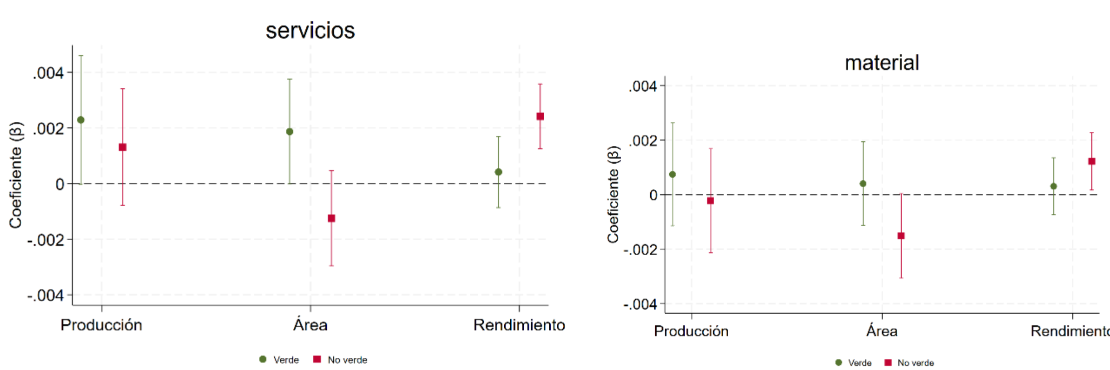

Figure 2.11 Cumulative value effects of green or non-green contracts over the past 3 years by category

All in all, the evidence indicates that material contracts are more effective than those related to services in promoting production. This is because green agriculture projects that provide material inputs are effective in increasing yields, with an effect that is not different from that of non-green projects in most specifications. By contrast, green service projects do not show significant impacts on yields, whereas non-green service projects do.

There are several possible explanations for this result. First, some of the benefits from NbS come from cost reduction through the reduction of chemical inputs and associated costs, rather than yield increase. Extension services could offer cost-reducing alternatives that can generate benefits for the producers and that are not reflected in yield measures. Second, it is always possible that there are frictions and tensions in the dissemination and adoption of new practices and knowledge. In this sense, as the direct provision of inputs can be used immediately and efficiently, it can offer faster positive results. More research is required to unravel these different possible explanations.

In this regard, the results differentiated by type of project highlight a paradox. Although extension services were expected to have a greater impact on sustainable agriculture, given that it requires more knowledge and traditional agriculture requires more inputs, we find the opposite. This suggests shortcomings in the current service-centered orientation of rural extension, historically focused on conventional agriculture in Colombia.

With that said, a potentially concerning result is the impact of green contracts on the total area devoted to agriculture. Future research should determine whether this transition is replacing traditional crops on land already used for agricultural production or if it is generating expansion into previously non-agricultural areas. While the former would improve sustainability by replacing more unsustainable practices, the latter may lead to unsustainable repercussions, given that changes in land use have a more direct impact on CO_2 emissions than agricultural practices themselves (IPCC, 2023).

3. Conclusion

Despite Colombia's ambitious upstream policy framework for sustainable agriculture, implementation gaps remain at the downstream level. This can be affirmed as green instruments account for only 2.37% of total agricultural spending. Despite the framing of green spending having broadened from project-level actions to more programmatic approaches integrating mitigation, adaptation, and social objectives, such fiscal policies are often financed through episodic, administration-specific initiatives that hinder a stable, long-term transition, Spatially, the footprint of green projects has expanded but remains concentrated in a small set of departments and municipalities, and thus unaligned with need.

Moreover, in the Colombian context, empirical evidence does not support concerns related to a loss of yield and agricultural production if the government replaces traditional agricultural supports with those of a sustainable nature. This means that redirecting resources towards green projects, even if they come from traditional agricultural programs, does not imply a loss of productivity. In fact, according to some specifications, green agricultural projects can generate greater profits, especially in the medium and long term. This indicates that Colombia can scale green agricultural support to the regions that most need it without sacrificing long-term productivity.

At a more disaggregated level, we paradoxically find that providing inputs outperform the provision of services in terms of effects on yield. As prior research indicates that a transition to sustainable agriculture tends to be more knowledge intensive and requires strong technical support (Laajaj & Macours, 2026), we conclude that some benefits occur through cost reduction and might not be perceived when focusing on yield outcomes. More importantly, the limited effects of services might be connected to the inadequacy of extension services and lack of training in agroecology, together with its sparse ability to reach remote regions of Colombia.

Based on these findings, this report would like to conclude by offering the following policy options:

1. Build on a long-term strategy that goes beyond specific administrations, setting explicit, time-bound scaling targets to move well beyond the current ~2% share of green agricultural spending.

2. Adopt transparent targeting criteria such as deforestation pressure, erosion risk, water stress, climate risk, and green investment per agricultural hectare as a part of the standard approval criteria for projects to allocate financial flows and to track their impact.

3. Design new and refine existing fiscal policies, such as input subsidies and rural credits, to support producers in the short term, where the economic benefits of sustainable agriculture may not be able to cover transition costs.

4. Implement large-scale public awareness campaigns to ensure producers are aware of the long-term benefits of sustainable agriculture.

5. Provide top-down guidance, as well as capacity building, to ensure that public procurement is supportive of agroecology-informed extension services.

6. Implement safeguards and monitoring tools to ensure a sustainable transition in existing agricultural territories, and to prioritize low-frontier-expansion risk projects when needed.

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Appendix for Section 1

A1. Alignment between the MRV and TVC

Table 1 presents the cross-analysis of the words included in the TVC and MRV developed by MinHacienda (MinHacienda, 2022).

Table 1. MRV activities in TVC

Colombia Taxonomy			MRV	
Sector Taxonomy	**Activities Taxonomy**	**Commen**	**Sub-sector**	**MRV Activities**
N/A	There is no equivalence	The adaptation is not yet developed in the taxonomy	**Rural development**	Provide guidelines for incorporating adaptation measures into sectoral instruments of agricultural policy
Agriculture	Investments and practices for the transition to organic farming (advanced or transformative practices: Transition from transitional crops or pastures to agroforestry systems (e.g. to cocoa, fruit trees or forestry) and agrosilvopastoral systems)			Promoting agroforestry systems
Agriculture	Investments and practices for the transition to organic farming (complementary technological			Develop technological packages for agroforestry

	adoption practices: biodigesters and energy saving and clean energy)			
Agriculture Water supply and treatment	Investments and practices for the transition to organic farming (core practice: Water resources management) Investments for water efficiency	Two activities of the Taxonomy can be applied		Use smarter, precision irrigation systems and agricultural practices with ecosystem approaches to conserve water
Agriculture	Investments and practices for the transition to organic farming (advanced or transformative practices: Improvement of genetic material in seeds and reproductive material. Biotechnology in agricultural production chains)			Use, conserve and exchange genetically improved crop varieties that are more resistant to extreme weather conditions
Agriculture	Investments and practices for the transition to organic farming (advanced or transformative practices: Improvement of genetic material in seeds and reproductive material. Biotechnology in agricultural production chains)			Promote research and development of genetically improved crops that are more resilient to extreme weather conditions
N/A	There is no equivalence	The adaptation is not yet developed in the taxonomy		Incentivizing climate-resilient farming methods in a sustainable way

Agriculture	Investments and practices for the transition to organic farming: (practice of complementary technological adoptions)	Energy saving and clean energy - improve equipment maintenance and routines for fuel saving and procure clean energy for power generation		Reduce fossil fuel consumption for power generation in traction (e.g., efficient tillage), irrigation, and other agricultural processes
Agriculture	Investments and practices for the transition to organic farming (basic practice: fertilizer management)			Use organic and biological fertilizers instead of chemical ones
Agriculture	Investments and practices for the transition to organic farming (Basic practice: Pest and disease control)			Comprehensively manage pests and diseases in the face of extreme weather events
N/A	There is no equivalence			Develop urban and peri-urban agriculture programs in vulnerable areas
Agriculture	Investments and practices for the transition to organic farming (all practices)			Encourage organic and ecological production
N/A	There is no equivalence			Promote agricultural production based on community, associative and cooperative figures

N/A	There is no equivalence	Training and technical assistance practices are only addressed by the forestry sector		Develop and strengthen technical assistance models with self-management approaches for community development
N/A	There is no equivalence	Training and technical assistance practices are only addressed by the forestry sector		Strengthening local, regional and national institutional capacities for the promotion of strategies and policies for community, associative and cooperative agriculture
N/A	There is no equivalence	The adaptation is not yet developed in the taxonomy		Develop and strengthen social food and food security programs to respond to extreme weather events
N/A	There is no equivalence	The adaptation is not yet developed in the taxonomy		Identify and evaluate adaptation measures to reduce the vulnerability of priority agricultural production systems through best agricultural practices

	Data-driven GHG reduction solutions			Collecting, processing, and disseminating agroclimatic information through the SAT to promote adaptation
Livestock Agriculture	Investments and practices for the transition to sustainable livestock farming (all practices) Investments and practices for the transition to sustainable agriculture (all practices)	Applies to both sectors		Develop and implement strategies for GHG mitigation in agricultural and livestock production
Livestock Agriculture	Investments and practices for the transition to organic farming and sustainable livestock farming: (practice of complementary technological adoptions - biodigesters and clean energies-)	Applies to both sectors		Promote productive and technological reconversion in the agricultural sector
	Composting of organic waste			Producing composts from organic waste
N/A	There is no equivalence	The adaptation is not yet developed in the taxonomy		Support the formulation of land use plans with a low-carbon and climate-resilient rural development approach

N/A	There is no equivalence	The taxonomy does not address insurance issues or tax incentives		Develop and strengthen agricultural insurance and economic incentives
Agriculture	Investments and practices for the transition to sustainable agriculture: (intermediate practices: Waste management and treatment of water contaminated with organic waste, and complementary technological adoptions including biodigesters		**Agriculture**	Using Crop Residues for Power Generation
Agriculture	Investments and practices for the transition to sustainable agriculture: (basic practice: soil conservation; eligibility criteria: good tillage practices)			Employ farming practices such as minimum tillage and ground cover
Agriculture	Investments and practices for the transition to sustainable agriculture: (basic practices: soil conservation and water resource management)			Efficiently use water and soil in agricultural activities
Forestry	Reforestation for commercial purposes (all practices)			Reforestation through commercial plantations
Livestock	Investments and practices for the transition to sustainable livestock			Implement agro-silvopastoral systems

	farming: (advanced practice: Intensive silvopastoral systems (SSPI))			
Livestock	Investments and practices for the transition to sustainable livestock farming: (all practices)	A GHG measurement practice is not specified, however, the practices of the livestock sector are influenced by the achievement of GHG mitigation (e.g., clean energy)	**Cattle farming**	Evaluate GHG emissions in livestock production by determining emission factors specific to Colombia
Livestock	Investments and practices for the transition to sustainable livestock farming: (all practices)	Livestock sector practices are conducive to the achievement of GHG mitigation (e.g., clean energy)		Promote mitigation projects in cattle farming
Livestock	Investments and practices for the transition to sustainable livestock farming: (complementary technological adoption practice: biodigesters for integrated manure management)			Take advantage of manure and other solid waste through biodigesters for electricity generation, household biogas and biofertilizers
Waste	Anaerobic digestion of organic waste with methane capture or use			
Livestock	Investments and practices for the transition to sustainable livestock farming: (intermediate practice:			Supplementing the Cattle Diet

	Animal welfare (excludes health aspects)			
Livestock	Investments and practices for the transition to sustainable livestock farming: (all practices)	Livestock sector practices are conducive to the achievement of climate change mitigation and adaptation objectives in a cross-cutting way		Evaluate options for joint implementation of adaptation and mitigation measures on livestock farms
Livestock	Investments and practices for the transition to sustainable livestock farming: (all practices)	The practices of the livestock sector are conducive to the achievement of the objectives of mitigation and adaptation to climate change and other environmental objectives in a transversal way, including animal welfare issues.		Stabilizing the cattle herd
N/A	There is no equivalence	Taxonomy does not address issues of economic incentives		Implement economic incentives for GHG mitigation in livestock production
Livestock	Investments and practices for the transition to sustainable livestock farming: (basic practice: Division and rotation of pastures)			Promote rational grazing

N/A	There is no equivalence	Activity not yet developed in the Green Taxonomy	**Other primary productive activities**	Reducing the vulnerability of fisheries due to climate variability

Table 2. TVC activities in MRV

Sector Eligibility Criteria - Investments and practices for the transition to sustainable livestock farming	Are in MRV? (Yes/No)
BASIC PRACTICES	
Division and rotation of paddocks	yes
Efficient management and protection of water sources	yes
Physical protection of the soil	**yes**
INTERMEDIATE INTERNSHIPS	
Pasture and forage management	yes
Organic and green fertilizers, use of manure and effluents	Yes
Animal welfare (excludes health aspects)	yes
ADVANCED OR TRANSFORMATIVE PRACTICES	
Silvopastoral systems (in several possible arrangements that can integrate those listed below, being the most common in Colombia)	
Living fences	yes
Scattered paddock trees	yes
Forage hedges	Yes
Mixed forage banks	yes
Intensive silvopastoral systems (SSPI)	yes
COMPLEMENTARY TECHNOLOGICAL ADOPTIONS	
Biodigesters, aquatic plant channels and aquaculture systems, oxidation lagoons, composting and vegetative systems	yes
Clean energy (solar, wind, gravity) and energy efficiency[FA2]	yes

Sectoral eligibility criteria - investments and practices for the transition to organic farming	Are in MRV? (Yes/No)
BASIC PRACTICES	
Crop rotation (in transitional or short-cycle crops2)	yes
Fertilizer Management	yes
Pest and disease control	yes
Soil conservation	yes
Water resources management	yes
INTERMEDIATE INTERNSHIPS	

Waste management and treatment of water contaminated with organic waste	yes
Organic or green fertilizers (use of plant covers)	yes
Transition from transitional crops or pastures to agroforestry (e.g., cocoa, fruit trees, or forestry) and agrosilvopastoral systems	yes
Introduction of polycultures or companion crops in permanent crops3	yes
Improvement of genetic material in seeds and reproductive material. Biotechnology in agricultural production chains	yes
COMPLEMENTARY TECHNOLOGICAL ADOPTIONS	
Biodigesters	yes
Energy saving and clean energy	yes

Eligibility criteria for the conversion of coffee crops	Are in MRV? (Yes/No)
BASIC PRACTICES	
Soil conservation	yes
Fertilizer Management	yes
Pest and disease control	yes
INTERMEDIATE INTERNSHIPS	
Waste management and treatment of water contaminated with organic waste	yes
Organic or green fertilizers (use of plant covers)	yes
ADVANCED or TRANSFORMATIVE PRACTICES	
Introduction of polycultures or companion cultures in permanent crops	yes
Improvement of genetic material in seeds and reproductive material. Biotechnology in agricultural production chains	yes
Biodigesters	yes
Energy saving and clean energy	yes

Eligibility criteria for rice crop conversion	Are you on MRV? (Yes/No)

BASIC PRACTICES	
Soil conservation	yes
Water resource management	yes
INTERMEDIATE INTERNSHIPS	
Pest and disease control	yes
Improvement of genetic material in seeds and reproductive material.	yes
Protection of water bodies, reduction of water stress	yes
ADVANCED or TRANSFORMATIVE PRACTICES	
Organic or green fertilizers	yes
Biological control	yes
Biodigesters	yes
Energy saving and clean energy	yes

Eligibility criteria for the conversion of fruit crops	Are you on MRV? (Yes/No)
BASIC PRACTICES	
Soil conservation	yes
Water resource management	yes
Pest and disease control	yes
INTERMEDIATE INTERNSHIPS	
Improvement of genetic material in seeds and reproductive material. Biotechnology in agricultural production chains	yes
Introduction of polycultures or companion cultures in permanent crops	yes
ADVANCED or TRANSFORMATIVE PRACTICES	
Organic or green fertilizers	yes
Protection of water bodies, reduction of water stress	
Biodigesters	yes
Energy saving and clean energy	yes

Eligibility criteria for cocoa crop conversion	Are you on MRV? (Yes/No)

BASIC PRACTICES	
Soil conservation	yes
Fertilizer Management	yes
Pest and disease control	yes
INTERMEDIATE INTERNSHIPS	
Waste management and treatment of water contaminated with organic waste	yes
Introduction of polycultures or companion cultures in permanent crops	yes
ADVANCED or TRANSFORMATIVE PRACTICES	
Organic Fertilizers	yes
Protection of water bodies, reduction of water stress	
Biodigesters	yes
Energy saving and clean energy	yes

We recognize that the adaptation category may contain a limited number of investments that are not strictly green or that combine adaptive objectives with environmentally ambiguous components. To address this concern, we carried out an additional review of all adaptation-tagged projects, combining text-based screening, manual inspection, and the use of project-level dimensional classifications to identify and exclude likely false positives. The purpose of this exercise was not to claim that the category is conceptually pure, but to assess whether the potential contamination is quantitatively important for the analysis. Our review suggests that, after applying these filters, the amount of investment that plausibly remains misclassified is small, and does not materially alter the interpretation of the adaptation category as a useful approximation of green investment.

A2. Methodological note on the screening of MRV adaptation projects

This verification aimed to determine whether all projects classified by MRV as adaptation were indeed environmentally sustainable. The exercise focused only on the adaptation dimension, as mitigation and joint projects are, by definition, environmentally positive. This consisted of three stages.

First, all 1,330 adaptation-labeled projects in the agricultural portfolio were reviewed manually. From their titles, 52 recurring keywords associated with nature-positive or climate-smart practices were extracted. Each project containing one or more of these terms received the binary value 1 = green, and 0 = non-green otherwise.

Second, an additional reading was performed to identify titles whose use of sustainable or related terms referred to economic or social sustainability rather than environmental outcomes. Of such cases, 33 were flagged as indeterminate. For instance, projects mentioning sustainable productivity or sustainable marketing without ecological content. These were reassigned a value of 0 = green = false, and 1 = indeterminate.

Third, all projects recorded under the MRV category Biodiversity and Ecosystem Services were automatically validated as green = 1. This is because this classification explicitly implies environmental benefit.

After these filters, the indeterminate subset represented 11 % of total MRV investment volume in the agricultural sector. The share fluctuates slightly by year but remains modest. Given that all projects comply with MRV's algorithmic and expert validation and none violate exclusion criteria, these indeterminate cases were retained in aggregate estimates, while their uncertainty is transparently reported. Together, these steps ensure that the quantitative results used throughout the report accurately represent the share of agricultural investments with explicit, verifiable environmental co-benefits.

A3. Narratives of Green Investment. Graph representations

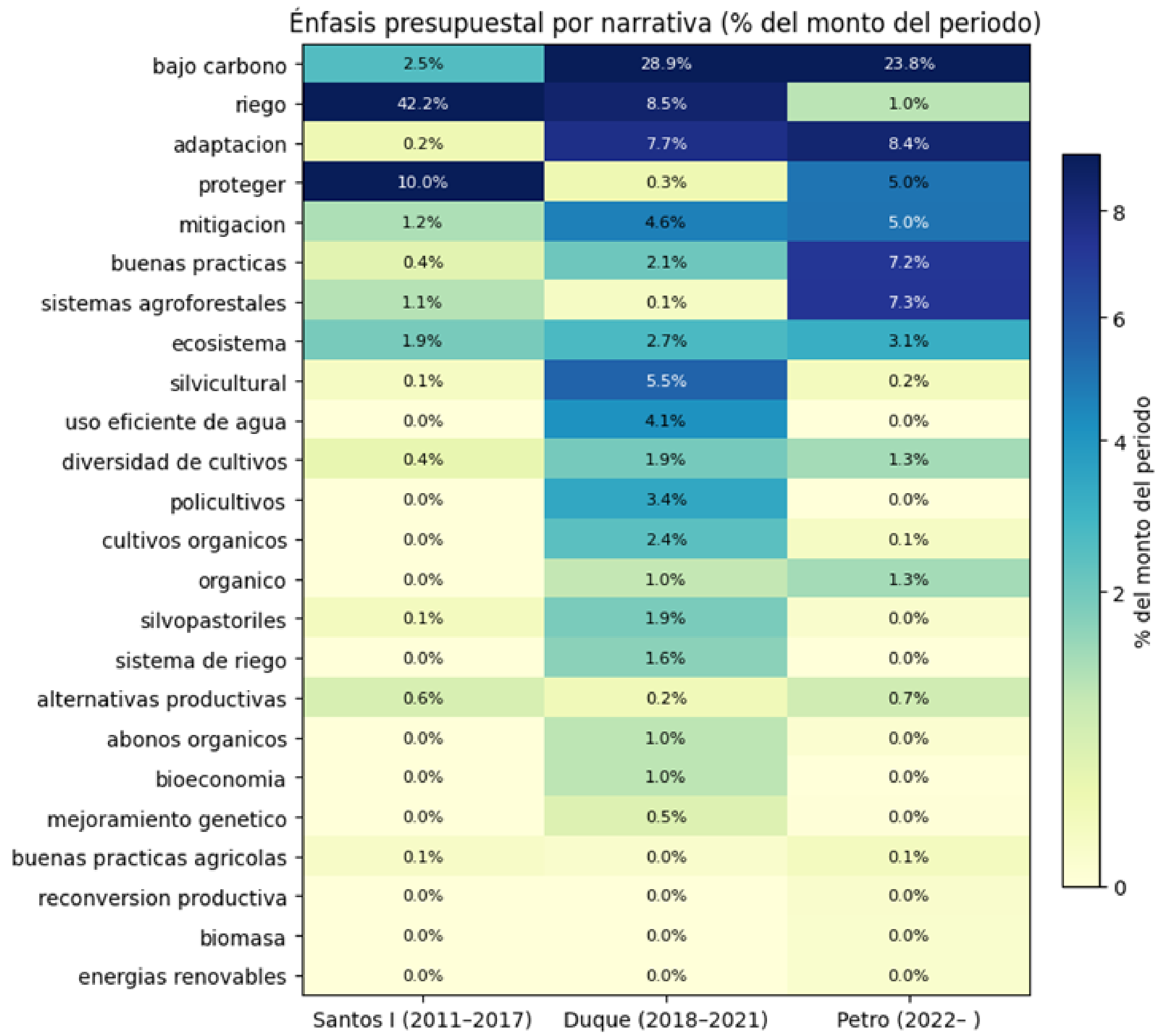

Figure 1.5 Recurring words in investment projects from a predefined dictionary[16]

[16] *Budget emphasis matrix by narrative (controlled component).* ' The heat map uses a dictionary of keywords associated with adaptation, mitigation/low carbon, and NBS/ICA (e.g., *agroforestry, silvopastoral systems, good practices, organic, crop diversity, water efficiency, irrigation, ecosystem*). For each period, the amounts of the projects that contain each keyword are summed and expressed as a % of the amount of the period. A single project can contain multiple keys; therefore, the percentages do not add up to 100% and should be interpreted as relative intensity of expenditure in each narrative, not as an exclusive composition of the budget.'

Figure 1.6 Recurring words in investment projects. Clouds of words that illustrate programmatic emphases[17]

[17] *Word clouds (uncontrolled component).* ' The clouds are constructed with the count of terms in MRV project titles and descriptions for each period (a) 2011-2017, b) 2018-2021, c) 2022-2023). Empty words are excluded and orthographic variants are unified; It is not controlled by text size or length. The size reflects only the frequency of occurrence of each term in the corpus of the period.'

Appendix of Section Two

A1. Environmental Expected Impacts

a. Method and Assumptions

This subsection integrates secondary literature on per-hectare environmental benefits of Nature-based practices with Colombia-specific land-use data to estimate the potential benefits of their adoption at scale. We selected four production systems or inputs that are already among the dominant forms of sustainable support to agriculture, but with the potential to be adopted much more widely in the country. These include silvopastoral systems, agroforestry systems, conservation agriculture, and biofertilizers.

We first drew from a literature review comparable figures on the potential benefits per hectare associated with the adoption of the four production systems or inputs. Appendix 1 carefully describes the literature review from which the numbers were extracted. We then use data from the *Encuesta Nacional Agropecuaria (ENA*) on land use corresponding to adoptable areas for each of these four sustainable production systems or inputs, with a large benefit intensity per practice/production system. Subsequently, we report a policy-relevant scenario in which adoption increases by 20 percentage points (pp) within the area suitable for each practice. Moreover, using the 2019 ENA survey and the 2014 national census depending on data availability, we report adoption levels of the different production systems and inputs to provide an idea of the current degree of progress in sustainable agriculture in the country and room for improvement.

For each practice, we multiply the per-hectare benefit (i.e., tCO_2e/ha·yr) by the area that could adopt the practice to obtain a 'full-potential' figure. Afterwards, we scale the figure linearly to a 20pp adoption scenario (i.e., 0.20 × adoptable area). For greenhouse gases, we interpret the result as annual mitigation potential in tCO_2e/yr. For soil, the metric provided is 'hectares with strong erosion-control co-benefits (ha preserved)'. To estimate the latter, following FAO’s regional assessment, we assume that half of agricultural lands are negatively affected by surface soil erosion. Water-quality effects are reported as typical % reductions observed in field studies and are interpreted qualitatively at the national scale, given their local, basin-specific nature. We benchmark magnitudes against Colombia’s total GHG emissions in 2018, which were

220.257 $MtCO_2e$ as per the UNFCCC's BUR3, to aid interpretation of the potential reduction of GHG emissions.

b. Potential benefits associated to adoption of key sustainable production systems

Practice / Production systems / Inputs	GHG mitigation (tCO2e/ha·yr)	Water quality improvement (% reduction in pollutants)	Soil erosion reduction (%)	Land use area in Colombia (ha)	Current adoption rates in Colombia	Full potential benefits (if adoption changed from 0 to 100%) (tCO2e/ha·yr)	Full potential benefits in soil erosion (ha of area preserved)	Benefits assumin 20 percentage points adoption (tCO2e/h a·yr)
Silvopastoral systems	14.8	Turbidity −94%, SST −80%, DBO5 −67%, PO4 −67%, Coliforms −96%	80%	Livestock: 38,511,643 (ENA, 2023)	2,8% of area (ENA, 2019)	569,972,316	15,404,657	113,994,463
Agroforestry systems	8.4–15.8	Improved infiltration, ↓ sediment & P losses	80–99%	Permanent crops: 2,948,920. Cocoa,	1,1% of area (ENA, 2019)	35,681,932	1,474,460	7,136,38

				avocado and coffee: 1,145,996 (ENA, 2023)				
Conservation agriculture	1.1–5.7	NO_3^- leaching −56–69%	20–68%	Temporary crops: 1,493,667 (ENA, 2023)	Share of farms adopting: Minimum tillage — 29%; No-till/direct seeding — 33%; Cover cropping — 4% (CNA, 2014)	5,078,468	328,607	1,015,69
Biofertilizers	0.11–0.13	NO_3^- leaching −32%, N_2O −10%	Indirect (via soil aggregation)	Permanent & temporary crops: 4,442,587 ha	Chemical fertilizers: 50.8% of sown area (ENA 2019). Non-chemical (bio/organic)	533,110	Indirect (via soil aggregation)	106,622

					fertilizers: 8.8% of sown area (ENA 2019).)			

Table A: quantification of the yearly benefits associated to widespread adoption of key sustainable production systems

Table B. GHG benefits under a 20pp adoption scenario (benchmarked to national emissions, 2018)

Practice / Production systems / Inputs	20pp GHG (MtCO2e/yr)	Share of national GHG 2018 (%)
Silvopastoral systems	113.99	51.76
Agroforestry systems	7.14	3.24
Conservation agricultural	1.02	0.46
Biofertilizers	0.11	0.05

c. Literature review and sources for per-hectare environmental benefit estimates

This subsection documents the literature and Colombia-specific sources used to quantify per-hectare benefits for each practice. Where rates were reported in Mg C/ha·yr, we converted to tCO_2e/ha·yr using 3.667. For avoided N_2O from biofertilizer substitution, we applied IPCC (2019) Tier-1 defaults, where EF_1=1% of N applied emitted as N_2O-N; $GWP_{100}(N_2O)$=273.

i. Silvopastoral systems (SPS) – Colombia & LATAM

Intensive silvopastoral systems (SPS) in Colombia have been reported to achieve carbon assimilation of approximately 14.8 tCO_2e/ha per year, based on field implementations supported by CIPAV and associated programs. These systems also provide important water-related benefits. Monitoring conducted under the Mainstreaming Sustainable Cattle Ranching (GCS) program across multiple micro-watersheds recorded notable improvements in turbidity and reductions in suspended sediments following the establishment of riparian buffers and the adoption of silvopastoral practices. Reduced sediment export is consistent with the ecological functioning of SPS, as continuous vegetation cover and improved soil structure enhance infiltration and reduce surface runoff, thereby limiting erosion and sediment transport. These findings are documented in CIPAV/GCS environmental evaluation materials and World Bank project documentation for the GCS program (2013–2019).

ii. Agroforestry systems (AFS) – Colombia (coffee, cacao) & Mexico (coffee)

Coffee agroforestry systems (AFS) in Colombia sequester approximately 8.4 tCO_2e/ha per year, with a range from around 3.3 to 19.4 tCO_2e/ha per year depending on shade management and system design (Andrade & Zapata, 2019). In cacao systems, evidence from Caldas shows even higher sequestration rates, averaging approximately 15.8 tCO_2e/ha per year. Agroforestry also provides important hydrological benefits: shade trees improve water infiltration and saturated hydraulic conductivity, which helps reduce surface runoff and the transport of particulate phosphorus (Lozano-Baez et al., 2021). In terms of erosion control, agroforestry systems can significantly reduce soil loss. For example, Cenicafé reported up to a 99% reduction in erosion when ground covers are used, while coffee agroforestry trials in Mexico have documented erosion reductions of 80–98% (Geissert et al., 2017).

iii. Conservation agriculture (CA) – global & LATAM evidence

Meta-analyses show that conservation agriculture practices such as no-till can enhance soil carbon sequestration by approximately 1.1 tCO_2e/ha per year on average, with values reaching up to 5.7 tCO_2e/ha per year in tropical systems (Powlson et al., 2016). In addition, CO_2 fluxes from tilled soils are about 21% higher than those observed under no-till systems (Abdalla et al., 2016), indicating the mitigation potential of reduced soil disturbance. Conservation practices also contribute to improved water quality: cover crops reduce nitrate leaching by an average of 56% (Thapa et al., 2018), with global analyses reporting reductions of up to 69% (Nouri et al., 2022). Furthermore, cover cropping significantly reduces soil loss, with evidence showing 68% reductions in soil-carbon erosion (Huang et al., 2025). At a broader scale, country-level analyses in Argentina, Paraguay, and Brazil indicate that widespread adoption of conservation agriculture can lead to 20–33% declines in soil erosion (Borrelli et al., 2017).

iv. Biofertilizers – AMF and Azospirillum

Azospirillum can enable partial nitrogen substitution of approximately 25–30 kg N/ha per year without yield loss in Latin American maize trials (Condori et al., 2024). Using the IPCC (2019) emission factor EF_1 = 1%, this reduction in synthetic nitrogen application translates into avoided emissions of roughly 0.11–0.13 tCO_2e per hectare per year. Evidence from a meta-analysis on arbuscular mycorrhizal fungi (AMF) further indicates environmental benefits, including an average 10% reduction in N_2O emissions and 32% lower nitrate leaching (Qiu et al., 2022). In addition, microbial inoculants may contribute indirectly to erosion control by improving root development and soil aggregation, although measurable reductions in soil erosion are typically achieved when these practices are combined with complementary measures such as residue retention or cover cropping.

d. Discussion

Therefore, the 20pp adoption scenario highlights very large non-monetary public benefits, especially from SPS when considering livestock's dominant land footprint and high per-hectare gains. Even the conservative benchmarking to 2018 national emissions suggests that SPS alone could offset on the order of half of Colombia's annual GHG emissions if scaled by 20pp across adoptable pastures, with substantial co-benefits for water and soils.

Regarding the former, water improvements materialize locally, within the micro-watersheds and riparian reaches where practices are implemented. SPS and AFS increase perennial cover and roughness, lowering turbidity and suspended sediments. CA and biofertilizers reduce nutrient losses, especially nitrate. The empirical literature for Colombia consistently shows large decreases in particulate transport and meaningful reductions in nitrate leaching under cover crops and AMF. At basin scales, targeting priority sub-watersheds such as municipal intakes, reservoirs, and erosion hotspots can translate these site-level effects into lower water-treatment costs, extended reservoir life, and reduced flood-sediment risks.

Concerning the latter, the loss of topsoil erodes yield potential, degrades water quality, and shortens reservoir life. The scenario indicates 3.08 million hectares with strong erosion-control benefits under SPS alone at 20pp adoption, plus 0.36 million hectares across AFS and CA. This implies millions of hectares with improved infiltration, aggregate stability, and vegetative cover, which provides conditions linked to drought resilience and reduced disaster risk. In addition, agroforestry adds robust, landscape-friendly mitigation and hydrologic gains in perennial crops. CA and biofertilizers contribute to new and additional, as well as cost-effective reductions in CO_2e and nutrient losses. These findings argue for coordinated policy to accelerate the transition.

A2. Research Design of the Impact Evaluation

1. Methodology

This section gives specific details of the methodology, including the equations and econometric details of the models used. Our empirical strategy focuses on estimating the effects of receiving at least one green agricultural contract compared to: (i) not receiving any green agricultural contract, and (ii) receiving at least one non-green agricultural contract. We consider both the extensive margin—that is, whether or not a municipality receives a contract—and the intensive margin—the size of the investment, measured by the total value of the contracts or by the number of contracts.
Formally, we use the difference-in-differences method and estimate a double-ended fixed-effect (TWFE) model for municipality i in period t as follows:

$$ln\, ln\, (Y_{it}) \;=\; \beta_0 + \beta_1 Verde_{it} + \beta_2 No\, Verde_{it} + \delta X_{it} + \gamma_i + \alpha_t + \varepsilon_{it}$$

Where it represents the indicator of interest, which can correspond to production, harvested area or yield. The y variables $Y_{it}Verde_{it} \;\; No\, Verde_{it}$ are the treatment variables, which can be defined in two ways. As indicators, when working with the extensive margin, taking the value of one from the first year in which the municipality receives at least one green contract (or non-green, respectively). Or as continuous variables, when the added value of the green or non-green contracts received by the municipality is measured, expressed in logarithms. The vector X_{it} is collected by covariates such as rural population and climatic conditions. Finally, the fixed effects of municipality are represented by γ_i, and the fixed effects of year by α_t.

To analyze the dynamics of the estimated effects, we supplemented the reference TWFE specification with an event study design. In particular, we estimate the following model:

$$ln\, ln\, (Y_{it}) \;=\; \vartheta_0 + \sum_{j\epsilon(-m,n)} (\beta_j D_{ij}) \; + \vartheta_1 n\_Other\_Ag_{it} + \delta X_{it} + \gamma_i + \alpha_t + \varepsilon_{it}$$

where j indexes the years relative to the first year in which a municipality receives the contract. Consequently, it D_{ij} indicates either the first green agricultural contract or the first non-green agricultural contract. In each case, we also control for the number of contracts assigned in that year that belong to the opposite category ().$n\_Other\_Ag_{it} + \delta X_{it}$

There are, however, several aspects that must be considered in this empirical strategy. First, estimates in the extensive margin are based only on the year of the first contract received, which does not necessarily correspond to the best contract (either in terms of targeting or size), so the results should be interpreted with caution. Second, measures of intensive margin depend on the cumulative values of contracts, but do not capture the heterogeneity between different types of projects (e.g., those targeting specific crops) or the possible temporal structure of their effects. Thus, contracts that provide inputs for perennial crops or forest plantations can impact yields only several years after their execution. Still, as long as the distribution of contract types remains relatively stable between municipalities, comparisons between green and non-green agricultural projects are informative. To reinforce the validity of the results, we also estimate specifications in which the treatment variables are constructed considering only the contracts received in the last three years. Under this approach, if a municipality receives at least one contract in 2014, it is considered treated only until 2016, and the value of that contract is incorporated into the intensive margin variables only until that same year.

2. Data

To carry out the analysis, we used comprehensive information on public procurement projects from the Electronic Public Procurement System (SECOP), agricultural production data from the Municipal Agricultural Assessment (EVA), and disaggregated data on climate variables obtained from the climate research unit of the University of East Anglia. While our analysis focuses on procurement, we recognize that it represents only a fraction of overall public spending and does not capture the full spectrum of fiscal policy or public finance impacts. This focus, adapted to data availability, should therefore be seen as a partial but policy-relevant lens, rather than a comprehensive assessment of state expenditure.

a. SECOP

SECOP data comes from Colombia's official platform for trading data management. All contracting entities are required to publish complete documentation in SECOP. The system has two versions. The first is SECOP I, which was created in 2007 and records as well as publishes processed information, albeit in a manner that is operated offline. The second is SECOP II, which was implemented in 2015 and digitally manages the entire contractual cycle.

The SECOP I data were extracted through web scraping, while the SECOP II data were obtained from the open data platform maintained by Colombia Compra Eficiente. Subsequently, all contracts were classified into two operational categories: Services and materials. Services include technical assistance, extension, and specialized professional support such as that of agronomists and veterinarians, while materials refer to support for fertilizers, seeds and agrochemicals.

For this work, we only consider agricultural projects. To identify them, we developed a set of inclusion and exclusion criteria. A project was considered agricultural if it contained at least one agricultural inclusion term and did not contain exclusion terms. Inclusion terms consider products, practices, working groups, and places that are irrevocably associated with the agricultural sector, such as rancher or farmer'On the other hand, exclusionary terms consider work groups, places, or practices that are irrevocably incompatible with the agricultural sector as urban. A complete list of agricultural classification terms is presented in Table A1 in the appendix.

In addition, only public procurement contracts that have a value of at least $2 per EPA in the municipality are considered. This is because those with a smaller magnitude have a very low probability of impacting the agricultural yield of the municipality. We measured this at constant 2012 dollars and using the 2014 national agricultural census to have the number of UPAs per municipality. In total, we have 48,072 contracts, distributed in 1083 municipalities.

b. EVA

Developed by the National Administrative Department of Statistics (DANE), the National Agricultural Survey (EVA) is one of the main official sources of information on agricultural production in Colombia. The survey collects information biannually for the period 2007–2023, covering 239 crops in 1,122 municipalities and including key variables such as cultivated area, production, and yield for both transitional and permanent crops throughout the country.

The collection of information involves different local entities, including the departmental Secretariats of Agriculture, the Municipal Agricultural Technical Assistance Units (UMATA), and other actors in the sector (MADR, 2016). This increases the representativeness of information. However, because they depend on informed consensus rather than statistical sampling methods, measurements may lack accuracy.

Since our analysis involves the entire agricultural sector, production is expressed in monetary terms. To this end, prices of the main agricultural products are compiled from various sources, including the Colombian Mercantile Exchange, the DANE Annual Manufacturing Survey, the Ministry of Agriculture and Rural Development (MADR), and different associations in the sector. These prices are integrated on a consolidated basis and are reported through AGRONET, the official information and communication network of the agricultural sector in Colombia. However, as this database only covers 29 crops, it was necessary to complement the information with the Price Information System of the Agricultural Sector (SIPSA), which records the wholesale prices of agricultural products marketed in the country.

With SIPSA data, annual prices were calculated for each crop as the average of monthly prices in the country's main wholesale markets. Subsequently, a discount factor, used in a standard manner by the authorities, was applied to convert wholesale prices into producer prices. Finally, the municipal panel for the period 2007–2023 includes information on 90 crops, which together represent 98.5% of total agricultural production and are aggregated to obtain a total production at the municipal level.

c. Climatic Variables

The monthly temperature and precipitation data come from the University of East Anglia's climate research unit (CRU TS v4.08), which provides information on monthly climate variations from 1901 to 2023 in high-resolution grids of 0.5° × 0.5°. These spatial data were aggregated at the municipal level using area-weighted averages, using the geographic boundaries of each municipality. From the monthly information, annual averages of temperature and precipitation were calculated. In addition, climatic anomalies of temperature and precipitation were constructed, defined as deviations from the national historical average, divided by the long-term standard deviation, following the methodology of Barrios et al. (2010). The reference period used for these calculations is 1950–2000.

3. Data Rendering

The classification of projects aimed at green agriculture is central to this study. To do this, we resort to multiple sources, with the Green Taxonomy developed by the Government of Colombia being a key input. This taxonomy constitutes a national classification system of economic activities and assets that contribute substantially to environmental objectives and thus provides explicit criteria for green agriculture. It includes, for example, practices that conserve ecosystems, enhance ecosystem services and promote sustainability. This includes silvopastoral systems in livestock or sustainable forest management.

We revised this taxonomy to extract relevant terms and categories from regenerative and sustainable agriculture. In addition, we drew on academic and grey literature such as Damania et al. (2023), consulted with experts, and incorporated the field experience of the research team, which consists of specialists in environmental, resource, and agricultural economics with knowledge of Colombia's environmental and agricultural policies.

From this process, we generated a list of inclusion terms, which were reduced to their minimum roots following standard practice in text analysis. To facilitate analysis, we group the terms into categories, namely: General, agriculture, negative qualifiers, landscapes, ecosystem services, efficient use and management, and water. An exhaustive list of terms associated with green farming practices for each category is presented in Table A2.

These terms were used to classify projects based on a description of the objective of each SECOP project. The descriptions were pre-processed by removing adverbs, prepositions, and punctuation marks. Accordingly, only the words relevant to the classification remained. The matching process was based solely on the inclusion of a term reduced to its root. For example, the root sustainib* captures both sustainability and sustainable, and any project description that included these variants was classified as green.

Appendix A3. Additional Results and Supporting Documents

Table A1: Agricultural Project Exclusion and Inclusion Terms

	A. Terms of Inclusion
General	agri*; agro*; livestock*; livestock*; bovin*; vaccinate*; porcine*; avicol*; porcical*; fish*; aquacult*; bird*; ovin*; Capri*; milk*; stable*; corral*; pastore*; forage*; silo*; pork*; rural extension*; equine*; Aphthous; umata; UPRA; pig*; hen*; chickens; fry*; farm; young bull*; seedlings; urea; vegetable; breeding foot; suckling pig*; insecticide*; herbicide*; pesticide*; concentrated; pasture; heifer*
Crops	coffee plantation*; cultiv*; sowing*; sow*; harvest*; greenhouse*; nursery*; orchard*; irrigation*; Irrigates*; Fertilizes*; fertilizer*; seed*; cultiv*; canaduzal*; cocoa; banana; banana; bean*; Cafe; white hair; rice; wheat; corn; manioc; horticulture
Machinery	tractor*; sower*; harvester*; plough*; mill*; thresher; a rototiller; Scythe; drag; fumigator; Trapiche; Sheller; rotavitor; rake
People	shepherd*; livestock*; cowherd*; rancher*; agricult*; peasant*; landowner*; fisherman*; Pesquer*; forest*; forester*; agroforest*; forester*; silvopast*; caficult*; zootecni*
Rural	rural; corregimiento; sidewalk
Other	plant material; Inputs; property; orchard; moving; cart; producer*; owner* land*; collection center*; Fruit*
	B. Exclusion Terms
Pets	mascot*; canin*; felin*; *; Gat*
Water	aqueduct*; sewer system*; hydraulic*
Fire	fire*; emergency; calamity*
Kitchen	Food; kitchen*
Events	fair*; party*; festival*; theatre*; cultural*; deport*; garden*; tourist*; stadium*; logistic*
Training	Apprentices; Gastronomy*; Training
Transport	Aeronautical*; Navigation*; aircraft*
Goods	Mattress*; coffin*; lighter*; Tires*; Pneumatic*
Defense	Air*; aviation*; Battalion*; Army*; Infantry*; Police*; hospital*; INPEC*; Prison*; jail*; naval force; Navy; command; military*; subnet; cenac*; Plane*

Education	student*; dining room; lunch*; snack*; school*; university*; educational institution*; institute* educativ*; school institution*; high school* school*; school*; bookshop*
Urban	urban*; lift*; cemetery*; restaurant*; Capital District; Greenery
Other	Stationery; older adults; traffic light*; customs*; furniture*; residue; residual; Seine; toilet; school institutes; educational institutions; Ornamental; school institute; educational institution; ornamental; school institute; educational institution; covid; property; pupil

Table A2: Classification Terms of Green Agriculture Projects

General	sostenib*; Regenerates*; self-sustaining*; Restores*; Adapts*; Mitigates*; resilien*; climate change*; biodivers*; bioeconom*; circular economy* ; biotechnology*; bpg*
Agriculture	agrialimenta*; forestry*; agroforest*; ecology*; ecosistem*; Corridor* Hydro*; close* alive*; tree* scattered* pasture*; insulation* water source*; biological controller*; multi-crop* ; multispecies*; diversity* crop*; polycultiv*; agroecology*; organic*; management* integrates* pest* disease*; improvement* material* genetic* seed*; asociation* cultivation* ; crop* cover*; product* non*timber* forest* ; use* resource* forest*; sustainable* forest management*; agriculture* precision* ; climate-smart*; Runner* Biologic*; Product* Non-timber*
Landscapes	connectivity*; species*; area* protect*; Nature* Reserve*; reserve* ambien*; Ecology Reserve*; national park*; natural park*; Habitat*
Negative	Deforest*; overpast*; Issue*; contamination*
Ecosystems	Ecosistemic* service*; ambient* service*; ecological* service*; regula* climatic*; regulates* flooding*; regulates* temperature*; water quality*; cycle* water*; purifies* water*; flow* water*; air quality*; purifies* from the air*; pest control*; regulates* pest*; supre* pest*; nutrient cycle*; formation* soil*; reserve land*; carbon capture*; carbon sequestration*; reserve* carbon*; benefici* ambient*; benefici* ecologic*; Benefici* ECOSISTEMI*
Livestock	tree* scattered* pasture*; biomass*; silvopastor*; genetic improvement*; close* alive*; pastore* rotativ*; pastore* rational*; pastore* rotacio*; agriculture* regenerativ*; barrier* wind*; improvement* matter* genetic*
Use and handling	water*; irrigation*; soil*; resource*; forest*; tree*; biodivers*; fertilizer*; fertilize*; biofertilize*; biofertilizer*; Energy*; biochar*; biogas*; biofuel*; biomass*; residue*; Habitat*; ecosiste*; hydric*; aquifer*

Energy	biochar*; biogas*; biofuel*; energy* renewable*; thermal energy*; biomass*; biodigester*; clean energy* ; energy saving*
Soils	organic carbon capture*; organic matter* soil*; composting*; microorganism* soil* ; native microorganism*; salutation* soil*; bioremedia*; solid waste* management*; organic fertilizer*; green fertilizer*; biofertilizer*; bioinput* ; biofertilize*; sanid* soil*; waste management*; organic matter*
Water	Recycle*; irrigation system* ; irrigation* drip* ; collect water*; wetland*; management* integra* cuenca*; bioremedia*; lagoon* oxidation* ; treatment* wastewater*; management* water resources*; water saving*; reserve water*; harvest* water*
Composed	auto* sostenib*; agro alimenta*; bio econom*; sobre* pastore*; silvo* pastor*; bio fertilize*; bio fertilizer*; biofuel*; Biofuel*

Table A3: Main results – Extensive margin

	(1) Production	(2) Area	(3) Yield
A. Materials and Services			
Green	0.0676***	0.0349***	0.0334***
	(0.0127)	(0.0104)	(0.00674)
Not Green	-0.0343*	-0.0451***	0.0117
	(0.0133)	(0.0109)	(0.00706)
Remarks	18643	18643	18638
B. Services			
Green	0.0169	0.0228*	-0.00662
	(0.0138)	(0.0112)	(0.00729)
Not Green	0.0500***	0.00545	0.0439***
	(0.0135)	(0.0111)	(0.00717)
Remarks	18643	18643	18638
C. Materials			
Green	0.0432***	0.0302**	0.0138*
	(0.0127)	(0.0104)	(0.00672)

Not Green	-0.0208	-0.0359***	0.0155*
	(0.0131)	(0.0107)	(0.00696)
Remarks	18643	18643	18638

Note: This table reports the results of several bidirectional fixed effects (TWFE) models. Column 1 uses Production as the dependent variable, column 2 uses Area, and column 3 uses Performance. In all cases, the specifications use extensive margin treatment based on the first year in which at least one contract is received. The p-value refers to the proof of the null hypothesis that the two reported coefficients are equal

Table A4: Main Results – Intensive Margin

	(1) Production	(2) Area	(3) Yield
A. Materials and Services			
Green	0.00603***	0.00366***	0.00248***
	(0.00126)	(0.00103)	(0.000667)
Not Green	-0.00118	-0.00347**	0.00234***
	(0.00132)	(0.00108)	(0.000699)
Remarks	18643	18643	18638
B. Services			
Green	0.00122	0.00241*	-0.00117
	(0.00134)	(0.00109)	(0.000710)
Not Green	0.00544***	0.000715	0.00464***
	(0.00126)	(0.00103)	(0.000669)
Remarks	18643	18643	18638
C. Materials			
Green	0.00308*	0.00239*	0.000786

	(0.00127)	(0.00104)	(0.000672)
Not Green	-0.00140	-0.00285**	0.00147*
	(0.00132)	(0.00108)	(0.000699)
Remarks	18643	18643	18638

Note: This table reports the results of several bidirectional fixed effects (TWFE) models. Column 1 uses Production as the dependent variable, column 2 uses Area, and column 3 uses Performance. In all cases, the specifications use an intensive margin treatment based on the accumulation of the value of the assigned contracts. The p-value refers to the proof of the null hypothesis that the two reported coefficients are equal.

Table A5: Main Results – Extensive Margin – last 3 years

	(1) Production	(2) Area	(3) Yield
A. Materials and Services			
Green	0.0372***	0.0186*	0.0190***
	(0.00979)	(0.00799)	(0.00519)
Not Green	-0.0260*	-0.0401***	0.0142*
	(0.0108)	(0.00878)	(0.00570)
Remarks	18643	18643	18638
B. Services			
Green	0.0255*	0.0195	0.00605
	(0.0126)	(0.0103)	(0.00668)
Not Green	0.0150	-0.0109	0.0253***
	(0.0119)	(0.00969)	(0.00629)
Remarks	18643	18643	18638
C. Materials			
Green	0.0212*	0.0126	0.00884

	(0.00978)	(0.00799)	(0.00518)
Not Green	-0.0139	-0.0205*	0.00683
	(0.0100)	(0.00817)	(0.00530)
Remarks	18643	18643	18638

Note: This table reports the results of several bidirectional fixed effects (TWFE) models. Column 1 uses Production as the dependent variable, column 2 uses Area, and column 3 uses Performance. In all cases, the specifications use extensive margin treatment based on whether or not you receive at least one contract in the last 3 years. The p-value refers to the proof of the null hypothesis that the two reported coefficients are equal

Table A6: Main Results – Intensive Margin – last 3 years

	(1) Production	(2) Area	(3) Yield
A. Materials and Services			
Green	0.00243**	0.00132	0.00109*
	(0.000939)	(0.000763)	(0.000518)
Not Green	-0.000800	-0.00324***	0.00235***
	(0.00102)	(0.000824)	(0.000560)
Remarks	16455	16455	16451
B. Services			
Green	0.00229	0.00187	0.000415
	(0.00118)	(0.000962)	(0.000653)
Not Green	0.00131	-0.00125	0.00242***
	(0.00107)	(0.000873)	(0.000593)
Remarks	16455	16455	16451
C. Materials			

Green	0.000744	0.000405	0.000308
	(0.000963)	(0.000783)	(0.000532)
Not Green	-0.000220	-0.00151	0.00122*
	(0.000973)	(0.000791)	(0.000537)
Remarks	16455	16455	16451

Note: This table reports the results of several bidirectional fixed effects (TWFE) models. Column 1 uses Production as the dependent variable, column 2 uses Area, and column 3 uses Performance. In all cases, the specifications use an intensive margin treatment based on the accumulation of the value of the contracts assigned in the last 3 years. The p-value refers to the proof of the null hypothesis that the two reported coefficients are equal.